BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:

CONCENTRATED ANIMAL FEEDING	)	
OPERATIONS (CAFOS): PROPOSED	)	R 2012-023
AMENDMENTS TO 35 ILL. ADM. CODE	)	
501, 502 AND 504	)	

NOTICE OF ELECTRONIC FILING

To: **Attached Service List**

PLEASE TAKE NOTICE that on January 30, 2014, I electronically filed with the Clerk of the Pollution Control Board of the State of Illinois: **ENVIRONMENTAL GROUPS' FIRST NOTICE COMMENTS** on behalf of Prairie Rivers Network, Illinois Citizens for Clean Air and Water, Environmental Integrity Project and Environmental Law & Policy Center (collectively, "Environmental Groups") copies of which are attached hereto and herewith served upon you.

Respectfully Submitted,

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ENVIRONMENTAL GROUPS' FIRST NOTICE COMMENTS

The Environmental Groups (Prairie Rivers Network, Illinois Citizens for Clean Air and Water, Environmental Integrity Project and Environmental Law & Policy Center) appreciate the Board's consideration of the concerns we raised in our testimony and post-hearing comments. In many ways, the First Notice Rule is improved from the original rule proposal. Specifically, we thank the Board for making the following edits to the proposed rules, and strongly recommend that they be retained in the final rule:

- Declining to weaken the definition of "frozen ground" (Section 501.252). While Environmental Groups maintain that a definition that includes ground frozen to a depth of zero inches is more protective of water quality, the alternative selected by the Board is preferable to weakening the Agency's proposal to allow application of manure to frozen ground in even more circumstances.
- Clarifying the definition of livestock waste to include "soils and sludge removed from livestock waste storage structures" (Section 501.295).
- Clarifying the circumstances in which a cover and pad are required for a temporary manure stack (Section 501.404 (b)).
- Adding a reporting requirement for certain CAFOs (Section 501.505). (See our additional comments below).
- Striking the superfluous language that "no permit shall be required" for a CAFO unless it is required by the Clean Water Act (CWA) (Section 502.101(b)).
- Requiring permittees to state the total number of acres of land application area and an estimate of the amount of waste that will be applied each year (Section 502.201 (a) (9)).
- Requiring a demonstration of adequate land application area (both onsite and offsite) in Nutrient Management Plans (Section 502.510 (b) (2)).
- Requiring visual inspection of subsurface drainage during land application of manure (as well as before and after application) (Section 502.510(b) (13)).
- Including subsurface drainage tile among factors that must be considered during a field assessment of nutrient transport potential (Section 502.615 (a) (10)).

- Limiting the amount of manure that can be applied in geologically sensitive areas (Section 502.620 (h) and (j)).
- Including examples of practical alternatives to winter manure application (Section 502.630(a) (1) (A)).
- Including examples of steps that operators can take to provide manure storage capacity (Section 502.630 (a) (1) (C)).

These changes will help protect water quality and aid in the efficient administration of the new rule. We will not re-state here the arguments we made for these changes in our testimony and post-hearing comments, but we urge the Board to retain these edits in the Second Notice, and ultimately the final rule.

Nonetheless, there are a few issues that we hope the Board will reconsider as it develops its Second Notice rule.

- First, the Environmental Groups maintain that the same technical requirements for nutrient management should be established for all Large CAFOs;
- Second, we believe that offering the opportunity to appeal case-by-case designations under 502.106 is contrary to Illinois law and will unnecessarily disrupt the NPDES permitting process;
- Third, we suggest improvements that could be made to the proposed reporting program;
- Fourth, we renew our request to require production areas to be set back from surface waters and provide a supporting economic analysis for this requirement; and
- Finally, we respond to the questions posed by the Board in its First Notice Opinion and Order.

Below, we discuss each of these issues in detail.

I. The technical standards of Subpart F for land application should apply to all large CAFOs

Environmental Groups renew our request that the technical standards for land application for permitted CAFOs be applied to all Large CAFOs. The proposed technical standards establish methods based on the best available science that should be used when land applying livestock waste.

As discussed in the Environmental Groups' comments and acknowledged by IEPA, Large CAFOs pose similar threats to water quality whether they are permitted, subject to the agricultural stormwater exemption, or neither. Allowing hundreds of facilities to avoid proven safeguards for agronomic waste application could not only further degrade Illinois' water quality, but will increase IEPA's CAFO enforcement and permitting workload as preventable discharges continue to take place. The proposed two-tiered scheme for Large CAFOs creates an incentive for unpermitted large CAFOs to decline to implement the best practices and to hope that their precipitation-related discharges qualify as agricultural stormwater discharges.

In the time since Environmental Groups filed our post-hearing comments, USEPA has released a thorough literature review of the pollutants and water quality risks associated with CAFO waste and its management and disposal.[1] USEPA's review details the health and environmental threats posed by CAFO pollutants and concludes that "[w]idespread implementation of appropriate pathways and systems will help to reduce agricultural runoff and minimize the potential environmental problems associated with emerging contaminants from livestock and poultry manure."[2] The review goes on to discuss the importance of nutrient management plans given regional variability in appropriate practices.[3] USEPA has asked states to develop statewide technical standards as a means to account for such regional variability. Unfortunately, the rule as proposed does not ensure "widespread" adoption of Illinois best practices by the largest Illinois CAFOs.

The Board's final CAFO rule should at a minimum extend the technical standards in 502.615, 502.620, 502.625, 502.635, 502.640, and 502.645 to Large CAFOs intending to use the agricultural stormwater exemption. Under the first notice rule, unpermitted Large CAFOS seeking the agricultural stormwater exemption must comply only with 502.510(b). Applying the requirements of 502.510(b) to facilities seeking protection under the agricultural stormwater exemption without also requiring them to meet the technical standards in the sections listed above allows Large CAFO operators wide discretion in deciding how to determine realistic crop yield goals, manure and soil testing methods, and other factors critical to agronomic nutrient application and water quality protection. This approach creates additional burdens for all, requiring operators to demonstrate the chosen methods ensure appropriate agricultural utilization of the nutrients in the waste and IEPA to verify that agronomic utilization was in fact achieved.

The technical standards in Subpart F provide the context and information necessary to implement 502.510(b). Without this context, the requirements of 502.510(b) become nebulous. For example, 502.510(b) requires "protocols" for testing waste and soil, but does not require the science-based testing methods described in 502.635. It also requires agronomic application on adequate land, based on realistic crop yield goals, but without the critical definitions and methods required by 502.625 to determine application rates that will best protect water quality.

The lack of standards in the current approach does not build in flexibility, but rather creates loopholes that could lead to inappropriate application of the agricultural stormwater exemption following preventable wet weather discharges. The final rule should either make the technical standards for land application (502.510(b), 502.615, 502.620, 502.625, 502.635, 502.640, and 502.645) applicable to all Large CAFOS or to all Large CAFOS seeking the agricultural stormwater exemption.

[1] U.S. EPA, Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality (July 2013), attached as Attachment 1.
2 *Id*. at 71.
3 *Id*.

The need for flexibility by unpermitted but not permitted CAFOs in determining agronomic rates of application is difficult to comprehend. A system that holds one set of operators to scientifically-sound methods but allows another set of operators to fall short of those methods is not defensible.

II. Appeals of case-by-case determinations

The Board has proposed at first notice to amend the Agency's proposed rule to provide a facility designated as a CAFO under Section 502.106 with the right to appeal such designation to the Board. We believe allowing an appeal under 502.106 is contrary to Illinois law and would further disrupt the Agency's ability to implement its NPDES program for CAFOs in accordance with the CWA and with Agency agreements with the USEPA. As such, we recommend removal of the Board's amendment to Section 502.106 allowing a right of appeal.

The Board seeks to grant itself the right to review a designation by the Agency under Section 502.106 that an animal feeding operation is a CAFO. As a quasi-judicial body, the Board maintains the authority to review certain agency decisions, but those decisions must be ripe for review.[4] An agency decision is generally ripe for review when it is final. The basic rationale "is to prevent the courts, through avoidance of premature adjudication, from entangling themselves in abstract disagreements over administrative policies, and also to protect the agencies from judicial interference until an administrative decision has been formalized and its effects felt in a concrete way by the challenging parties."[5]

Similarly, Section 5(d) of the Illinois Environmental Protection Act restricts Board review to final agency determinations.[6] A final action is one that "terminates the matter before the Agency or affects the Petitioner's legal rights, duties or privileges."[7] "An administrative agency's action is final for appeal purposes when review will not disrupt the orderly adjudication process and legal consequences will result from the agency's action."[8]

In its First Notice Opinion and Order, the Board has found that an Agency CAFO designation under Section 502.106 is a final determination by the Agency. Yet Illinois law strongly suggests that a CAFO designation under 502.106 is far from final. CAFO designation does not terminate the matter before the Agency. To the contrary, the determination precedes the permit application and issuance, and as acknowledged by the IEPA and the Agricultural Coalition, the permit application process itself may lead to a conclusion that a permit is not necessary.[9]

Nor will legal consequences result from an agency designation. Section 502.106 simply allows the agency to make a determination that an Animal Feeding Operation (AFO) is a CAFO upon determining that the AFO discharges and is a significant contributor of pollutants to waters of the

[4] *Alternate Fuels, Inc. v. Illinois Environmental Protection Agency*, 215 Ill. 2d 219 (2005).
[5] *Abbott Laboratories v. Gardner,* 387 U.S. 136, 148-49 (1967).
[6] 415 ILCS 5/5(d) (2012).
[7] *Transtechnology Corp. vs. Illinois Environmental Protection Agency*, PCB 91-39 (April 25, 1991).
[8] *Ash v. Iroquois County Board*, PCB 87-173 (May 5, 1988) (citing *Port of Boston Marine Terminal Association v. Rederiaktiebolaget Transatlantic*, 400 U.S. 62, 71 (1970)).
[9] Tr. 10/23/2012 at 158-161.

United States.[10] While the designation may ultimately lead to IEPA issuing a permit and/or taking an enforcement action, the designation itself does not secure the legal fate of the operation. The agency has the usual discretion regarding how it will proceed, at which time the CAFO has the right to seek judicial review.

In *National Marine v. IEPA*, the Supreme Court of Illinois upheld the lower court's dismissal of a complaint for judicial review of IEPA's issuance of a notice of potential environmental liability under Section 4(q) the Illinois Environmental Protection Act as improper pre-enforcement judicial review.[11] The 4(q) notice informed the plaintiff that it may be liable for a release of a hazardous substance and requested the plaintiff take identified response actions to clean up the threat. The court found the agency action insufficiently final, because

> The 4(q) notice neither determines nor adjudicates the liability, rights, duties or obligations of the party subject to it. It merely puts the party 'on notice' . . . and requests that the party take certain response or remedial actions. [citation omitted). The party may then undertake the response action requested, may meet and attempt to settle with the Agency, or may choose to ignore the notice entirely. Issuance of the 4(q) notice is preliminary to any final determination of liability by an adjudicative body and neither disposes of the proceedings nor adjudicates legal duties or rights.[12]

CAFO designation under 502.106 is analogous to the 4(q) notice. CAFO designation is preliminary to a final agency determination in two ways. First, designation will not dispose of the administrative proceeding. As the Agency has noted in both testimony and comments, it anticipates that CAFO designation will involve an ongoing process between the Agency and the designated facility. That process may itself reveal information that obviates the need for a permit.[13]

Second, 502.106 designation, like the 4(q) notice, neither determines nor adjudicates legal duties or rights. Upon designation, the agency will undertake review of a permit application that may or may not result in a permit being issued. Similarly, while the agency may initiate an enforcement proceeding, designation under 502.106 is clearly not an enforcement proceeding. Once an enforcement action is instituted, a designated CAFO would have the opportunity and right to contest the action before the Board (or in the Circuit Court).

As noted by the dissent in *Alternate Fuels v. IEPA*, "the ripeness doctrine does not deprive a litigant of access to the courts. Rather, it controls the timing of that access. . . ."[14] In *Alternate Fuels*, the Illinois Supreme Court found the agency determination ripe for review where the agency had initiated an enforcement proceeding against the plaintiff.

[10] IEPA's Post Hearing Comments 1/6/13, p. 7
[11] *National Marine, Inc. v. Illinois Environmental Protection Agency*, 159 Ill. 2d 381 (1994).
[12] *National Marine*, 159 Ill. 2d at 389.
[13] Tr. 10/23/2012 at 158-161.
[14] *Alternate Fuels*, 215 Ill. 2d at 253.

There is a real danger in granting review at this preliminary stage. Allowing appeal to the Board before IEPA has issued a permit or pursued an enforcement case "could potentially open the door and enable parties 'to litigate separately every alleged error committed by an agency in the course of the administrative proceedings.'"[15]

The extra burden of premature Board review could seriously interfere with the state's ability to bring discharging CAFOs under permits. The Illinois NPDES program for CAFOs is already failing to meet "minimum thresholds for an adequate program" under the CWA.[16] The program's shortcomings are partially attributable to a lack of resources available to accomplish tasks the Agency is already required to undertake. CAFO NPDES permitting in Illinois is already a highly litigious and drawn out process. Litigating preliminary determinations could cripple the Agency's ability to protect Illinois waters from CAFO pollution.

Several factors further illustrate the problems the Agency already faces with NPDES permitting:

- The Agency has less than seven full-time employees responsible for reviewing permit applications, performing inspections, responding to complaints, and performing non-CAFO inspection duties.[17]
- USEPA found that very few facilities were applying for permits of their own volition.[18]
- When facilities finally submit permit applications, they are frequently incomplete, requiring the Agency to issue multiple notices of incomplete applications.[19]
- The Agency was unable to meet its commitment with USEPA to complete NDPES permit coverage for ten CAFOs by June 30, 2009.[20]
- At the time of USEPA's review, CAFO NPDES permit applications had been sitting with the Agency for 4 to 10 years without final action.[21]
- The Agency is faced with a staggering scope of enforcement: between the years 2004 and 2008, between 36% and 59% of CAFOs inspected had at least one violation, and many of these violations were related to discharges.[22]

Allowing Board review at the preliminary stage of CAFO designation is contrary to state law and would only encourage more litigation and further strain an over-taxed program. We respectfully request the Board exclude the right of appeal from the final rule.

[15] *National Marine*, 159 Ill. 2d at 392 (quoting *Dubin v. Personnel Board*, 128 Ill. 2d 490, 497 (1989).
[16] Initial Results of an Informal Investigation of the National Pollutant Discharge Elimination System Program for Concentrated Animal Feeding Operations in the State of Illinois, Region 5 United States Environmental Protection Agency (September 2010) (Region 5 Investigation Report), p. 3. (Ex. 14 at Springfield Hearing, 8/23/12).
[17] Region 5 Investigation Report, pp. 33-34.
[18] Region 5 Investigation Report, pp. 13, 35.
[19] *Id.*
[20] Region 5 Investigation Report, p. 31.
[21] *Id.* p. 13.
[22] *Id.*

III. Reporting requirement

The Environmental Groups strongly support the Board's decision to adopt a reporting program for unpermitted CAFOs under Section 501.505. Such a program is necessary in order for the Agency to be able to fulfill its CWA responsibilities. Under 40 C.F.R. § 123.26(b)(1), states are required to "maintain a program capable of making comprehensive surveys of all facilities and activities subject to regulation and to identify persons who have failed to comply with permit application or other program requirements."

While the IEPA has stated that its efforts to develop a comprehensive inventory utilizing existing sources of information renders a registration or reporting program unnecessary,[23] the Environmental Groups agree with the Board's assessment that the sources of existing information on CAFO operations in Illinois are incomplete and incapable of providing information adequate to develop such an inventory. The existing datasets the Agency proposes to use from the Illinois Department of Agriculture and Illinois Department of Public Health have been shown to be incomplete for the purposes of compiling a comprehensive inventory.[24] There is no way IEPA can ensure these existing datasets capture all existing CAFOs in Illinois.[25] Further, none of the sources of information from which the Agency proposes to draw information have the information necessary to be able to determine which facilities should be inspected.

While the IEPA may claim it has compiled and submitted an inventory list of CAFOs to USEPA making the reporting program unnecessary,[26] according to a December 2013 communication with USEPA, any such list has not been determined to be accurate or adequate by USEPA.[27]

The Environmental Groups also agree with the Board's proposed reporting requirements, which include the items listed in the IEPA's May 2011 draft rule, with the addition of information to be collected on waste containment and storage units. The Environmental Groups support the Board's determination that adding waste containment and storage information to the list of items will be helpful to the Agency in prioritizing inspections. And we believe, as a whole, the Board's list of items to be reported by CAFOs is necessary and appropriate for Illinois to implement the NPDES program and aid the Agency in fulfilling its responsibilities under 40 C.F.R. § 123.26(b)(1).

We appreciate the Board's desire for a simplified reporting process. We do, however, continue to urge the Board to require just two more items of information: 1) the number of acres available for land application of waste, and 2) for facilities that have them, CAFO waste management

[23] IEPA Post Hearing Comments, 1/15/13 at 3, citing Tr. 8/21/2012 at 110-113.
[24] *See* Prefiled Testimony of Kendall Thu 10/16/2012, at 5-6; Bruce Yurdin Tr. 8/21/2012 TR at 105-106, and Environmental Groups' Post Hearing Comments, 1/16/13 at 12-13.
[25] For example, the Illinois Department of Agriculture does not have documentation of livestock facilities built prior to the enactment of the Livestock Management Facilities Act, 510 ILCS 77/1 (1996).
[26] IEPA Post Hearing Comments, 1/15/13 at 14.
[27] In-person meeting between ICCAW, EIP and USEPA Region 5, December 2013. Additionally, we note that in 2010 USEPA mandated IEPA to fulfill its longstanding commitment (made under previous Performance Partnership Agreements) to compile a comprehensive inventory of CAFOs. (See Region 5 Investigation Report p. 31-33, Ex. 14 at Springfield Hearing, 8/23/12). It has been nearly four years since that time and to date no such inventory by IEPA has been deemed complete by USEPA.

plans. This information is equally important to the Agency in setting priorities for inspecting CAFOs and ensuring compliance with NPDES and Environmental Protection Act requirements.

A. Acres available for land application of waste

USEPA sought basic land application information in its proposed CAFO Reporting Rule. Proposed 40 CFR § 122.23(k)(2)(v) imposed the requirement to report the total number of acres available for land application as follows:

> (v) Where the owner or operator land applies manure, litter, and process wastewater, the total number of acres under the control of the owner or operator available for land application.[28]

USEPA reasoned that this was important information to collect from CAFOs because

> A CAFO's available land application area is likely to affect the amount of manure that can be land applied for agronomic purposes and the potential amount of nutrients that could flow into surrounding waters of the United States. Combining information about manure quantity and characteristics with land available for application would indicate where issues might exist regarding excess manure.[29]

USEPA also notes that land application areas are "integral parts of many or most CAFO operations" and that land application "is typically the end point in the cycle of manure management at CAFOs."[30] Gathering information on CAFO land application areas is therefore just as important as collecting information on production area waste containment and storage. Without land acreage information, it will be impossible for the Agency to determine whether unpermitted large CAFOs have enough acreage to qualify for the agricultural stormwater exemption through application at agronomic rates.

When USEPA decided to withdraw its proposed reporting rule, it did so based on the expectation that it would be able to obtain information from the states.[31] There is no other realistic way for the IEPA to obtain this information from CAFOs aside from including it as an item to be reported under Section 501.505. We therefore request the Board to add language from USEPA's proposed 40 CFR § 122.23(k)(2)(v) to the list of Illinois' Section 501.505 reporting requirements.

B. Waste Management Plans

We also continue to urge the Board to require submittal of waste management plans, where they already exist. These plans provide information on how manure will be managed to prevent

[28] *See* USEPA CAFO NPDES Reporting Rule, 76 Fed. Reg. 65431-01, at 65437.
[29] *Id.* at 65438.
[30] *See* 2001 Proposed CAFO Rule, 66 Fed. Reg. 2960-3145, at 3010 (Jan. 12, 2001) (hereinafter 2001 Proposed CAFO Rule), attached as Attachment 2.
[31] *See* 2012 CAFO Reporting Rule, 77 Fed. Reg. 42679 (July 20, 2012).

pollution and fulfill regulatory requirements. Requiring these plans to be submitted provides another tool for the Agency to fulfill its regulatory duties.

Having waste management plans in-hand will not only help the Agency in prioritizing inspections for NPDES program implementation, but will also allow the Agency to identify facilities operating in violation of 415 ILCS 5/12 (a) and (b) for regulatory and enforcement purposes and to fulfill the intent of the Environmental Protection Act.

Very few CAFOs in Illinois ever have to submit their waste management plans to regulatory authorities.[32] Only CAFOs required to have NPDES permits by the IEPA are required to submit their nutrient management plans for approval. (Currently that is only about 41 facilities.)[33] Only new or expanding livestock management facilities housing over 5,000 animal units even have to submit their waste management plans to the Department of Agriculture for approval.[34]

There is no assurance that the hundreds of CAFOs under the 5,000 animal unit size threshold have and are following waste management plans because they are not required to submit the plan to the Department of Agriculture, and the Department does not conduct compliance checks unless it receives a complaint. Although CAFOs are required to prepare and maintain these plans under the Livestock Management Facilities Act (LMFA), evidence suggests that many do not.[35] Therefore a requirement to submit the plan to IEPA may provide an incentive for CAFOs to comply with existing requirements under the LMFA.

Requiring CAFOs to submit waste management plans with their reporting information will not create an undue burden on CAFOs because we are only asking that such plans be submitted where they already exist.

Neither should the submittal place undue administrative costs or a burden on the IEPA. We are not asking that the Agency be required to review and approve the plans. Simply having the plan would give the Agency a more complete comprehensive inventory, and would help to expedite inspection and enforcement actions, ultimately reducing regulatory burdens and administrative costs on the Agency. Further, because this is a one-time reporting requirement, it will be a less burdensome program for the Agency to implement than other reporting programs (for example, the program for Registration of Smaller Sources (ROSS) under the State's air pollution regulations, which requires annual registration).[36]

For the foregoing reasons, we support the Board's proposed reporting program for CAFOs under Section 501.505 and urge the Board to add the following provisions to the requirements:

> (7) total number of acres under the control of the owner or operator available for land application if the facility land applies manure, litter, or process wastewater;

[32] *See* Pre-filed Testimony of Stacy James, 11/7/12 at 3; Leder, Tr. 10/30/12 at 170; Env. Groups Final Comments, 1/16/13 at 13.
[33] *See* http://www.epa.state.il.us/water/permits/cafo/ (last visited 1/29/14).
[34] *See* 510 ILCS 77/20(d) and 8 IAC 900.802(d).
[35] *Id*., *see also* Leder, Tr. 10/30/12 at 170.
[36] *See* 35 IAC § 201.175.

(8) a complete copy of the facility's waste management plan or nutrient management plan if the facility has such a plan.[37]

IV. Production Area Setbacks

There are three ways that discharges from production areas can reach surface waters: 1) dry discharges from poorly managed facilities, 2) precipitation-related discharges from unprotected facilities, 3) facility inundation during flooding. The effectiveness of Illinois' production area regulations is overly-dependent on livestock managers following best management practices on a daily basis. Mistakes, unusual weather, and unpredictable events happen, so we need additional regulatory safeguards that minimize the chance that unintended discharges from production areas will reach surface waters.

By requiring good siting from day one of operation, Illinois could create a system that reduces the likelihood that discharges from unpermitted facilities will turn out to be regulatory violations requiring an NPDES permit. Therefore, Environmental Groups proposed to add to Section 501.402 a new requirement that "No livestock management facility or livestock waste handling facility that commences construction of such facility after the effective date of this Section shall locate within 750 feet of surface waters or within a quarter mile of designated surface drinking water supplies." In its first-notice publication, the Board declined to accept this proposal. We ask the Board to reconsider based on the following arguments. We then respond to the Board's comments regarding whether and how vegetative buffers should be incorporated into the production area setbacks proposed by Environmental Groups. Finally, in response to the Board's concern, we present new information regarding the economic impact of the setback rule we have proposed.

In its First Notice Opinion and Order, the Board commented that the Environmental Groups' two experts (Mr. Leder and Dr. James) did not support setbacks of the specific distances suggested. The distances proposed by Environmental Groups were an attempt by Dr. James to suggest a compromise among the following data points found in her October 16, 2012 prefiled testimony, which we expand upon here:

1) Illinois Attorney General's Office complaints claiming, among other things, that livestock waste discharges from production areas can a) travel 200 yards (600 feet) overland into surface waters, and b) enter nearby ditches and be detectable 5 miles downstream.
2) Scientific studies documenting that vegetative filter strips and buffers can remove significant amounts of pollutants in livestock waste. Dr. James cited Koelsch et al. 2006, a literature review of vegetative management of livestock lot runoff. Tables in the article demonstrate that in some cases, pollutant reduction can be very effective in vegetative treatment areas of less than 100 feet long, but in other cases over 1000 feet may be necessary. Another study (Dickey and Vanderholm 1981) cited by Dr. James was conducted in Illinois and found that a 299-foot vegetative filter area reduced the concentration of the chemical constituents in effluent from a dairy settling basin by

[37] For drafting purposes, we believe it makes the most sense to insert these provisions prior to the existing "(7) date the information in subsection (c) is submitted to the Agency."

approximately 80%; on a weight basis, the filter retained about 96% of the chemical constituents. The study included figures (Figs. 2 and 3) showing decreases in chemical concentrations as the effluent traversed the length of the filter.

3) Siting setback distances already codified in other states. For example, Minnesota prohibits the construction of new feedlots within 1000 feet of lakes and ponds and 300 feet of rivers and streams; Ohio prohibits manure ponds or lagoons within 1,500 feet of surface water intakes.

The Environmental Groups considered the above information and concluded that a 750 setback from surface waters and a quarter mile setback from surface drinking water supplies represent a fair balance between protecting both the unsuspecting public downstream and the environment while not being overly burdensome on livestock operators. We proposed a larger setback from drinking water supplies because data suggest 750 feet may not always be adequate to ensure no discharge from a production area.

In its First Notice Opinion and Order, the Board noted that existing regulatory siting requirements relative to floodplains provide production areas some protection from flooding. In particular, the Board cited the following requirements:

1) "No new non-lagoon livestock management facility or livestock waste handling facility may be constructed within the floodway of a 100-year floodplain."[38]
2) "New livestock management facilities and new livestock waste-handling facilities located within a 10-year flood height as recorded by the United States Geological Survey or as officially estimated by the Illinois State Water Survey shall be protected against such flood."[39]

As this question did not arise in the hearings, the Environmental Groups have not previously explained what little protection these two requirements offer. Federal Emergency Management Agency (FEMA) maps are used to determine whether proposed livestock facilities fall within the 100-year floodplain. Unfortunately, FEMA maps are not necessarily accurate or complete and should not be interpreted to mean that out-of-channel flooding will not happen in areas where no flood hazard area is drawn. The mapping effort has focused on urban areas and rivers and large streams. In rural areas, FEMA maps generally only illustrate flood hazard areas where the contributing drainage area is at least ten square miles. Hence, many rural headwater and small order streams do not have mapped floodplains. Even if the 100-year floodplain is mapped, the boundaries are not necessarily accurate because sometimes they are based not on engineering studies, but rather other available information such as historic observations.

The 10-year flood elevation in many cases has not been determined, because a technical study has not been conducted previously to compute it. As with 100-year floodplain mapping, this is particularly true of rural areas and small streams. Some FEMA Flood Insurance Studies include 10-year flood elevation profiles of selected stream reaches; the FEMA flood insurance maps do not, however, include any delineation specifically of the 10-year floodplain area. Whether the

[38] LMFA ILCS 77/13 (b) (1)) Sec 13(b)(1).
[39] 35 Ill. Adm. Code 501.402(b).

IEPA actually implements the 10-year flood protection requirements in Section 501.402(b) is unclear. When someone wants to construct a livestock facility, he or she submits a Notice of Intent to Construct Form to the Illinois Department of Agriculture. The Department does not ask applicants for information regarding the 10-year flood height, but they do ask applicants to certify whether they are proposing to construct in a 100-year floodplain.[40]

Environmental Groups maintain that a minimum siting setback from surface waters is important not only to prevent flooding of livestock facilities, but also to prevent discharges from production areas during non-flood events. In its First Notice Opinion and Order, the Board stated that the proposed rule contains a number of required management practices that "would reduce the risk of discharges from productions [sic] areas into surface waters."[41] The Board cited as examples proposed sections 502.610, 502.510(b), and 501.404(b)(3). While 501.404(b)(3) (Temporary Manure Stacks) applies to all animal feeding operations regardless of size or permit status, 502.610 only applies to operations with NPDES permits (as does the other production area section, 502.605) and 502.510(b) only applies to permittees and unpermitted large CAFOs claiming an agricultural stormwater exemption. Currently there are only 41 CAFOs with NPDES permits[42] out of the over 39,000 livestock farms in Illinois.[43] Small and medium unpermitted operations are not subject to the production area requirements in Section 502. Many animal feeding operations have waste storage structures other than manure stacks (e.g., lagoons, holding ponds, concrete pits, tanks).Therefore, the required management practices cited by the Board apply to only a small universe of facilities.

Illinois' surface waters should be protected from new livestock facilities not subject to the production area management practices proposed in the First Notice Opinion and Order. The record clearly shows that environmental violations at production areas are not uncommon under Illinois' current regulations, and that manure stacks are not the only sources of these violations.[44] With the exception of improving the regulation of manure stacks, the First Notice Opinion and Order does nothing to require better management of production areas without NPDES permits. Given this, the Environmental Groups ask the Board to reconsider our proposed setback. The setback, if added to Section 501.402, would apply to all livestock management facilities and livestock waste handling facilities that commence construction after the effective date of the Section. Such facilities do not include pasture operations, according to regulatory definition.

Vegetative Buffers

In its First Notice Opinion and Order, the Board commented that the Environmental Groups' setback proposal contains no requirement that the setback include vegetative filter strips or buffers. Environmental Groups would strongly support a requirement for vegetative buffers within siting setbacks from surface waters. A buffer immediately adjacent to the production area would improve the effectiveness of the setback. Suggesting a minimum buffer size is challenging given that a number of site-specific factors influence buffer effectiveness (e.g., vegetation type and density, slope, soil infiltration rate, waste volume and characteristics). The

[40] *See* http://www.agr.state.il.us/pdf/01nonlagnsiteinvestcert.pdf (last visited 1/29/14).
[41] *See*, Opinion and Order of the Board, 11/7/13 p. 201.
[42] *See*, http://www.epa.state.il.us/water/permits/cafo/ (last visited 1/29/14).
[43] Pre-filed Testimony of Peter Goldsmith, 11/7/12, Attachment A (Goldsmith and Wang 2011).
[44] *See* p. 1 of Attachment 5 to Pre-filed Answers of the IEPA, filed 8/13/2012.

Illinois Natural Resources Conservation Service has developed a conservation practice standard for agricultural wastewater treatment.[45] The purpose of the Vegetated Treatment Area standard is: "[t]o improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations"[46] The practice is intended to treat contaminated runoff from livestock holding areas or process wastewater, but only from small animal feeding operations. The minimum size of the vegetated treatment area is 100 feet.[47] Given this practice standard and the data in studies we previously cited, we believe the minimum vegetative buffer size within siting setbacks should be 100 feet. We believe the best approach would be to require a 100-foot vegetative buffer within the 750-foot (or quarter-mile) setback. If the Board deems this proposal too restrictive, then a stand-alone vegetative buffer requirement would be better than nothing at all.

Economic Impact

Finally, the Board commented that the record does not address the economic impact of the setbacks proposed by the Environmental Groups. Subsequently, we asked an economist at University of Illinois Urbana-Champaign to evaluate the economic impact of our proposal. In summary, the economist reasoned that because such a small percentage of Illinois' agricultural acreage falls within 750 feet of surface waters, that any economic impact of a siting setback on new livestock facilities would be negligible. He also concluded that setbacks are expected to have a positive economic impact on downstream water users because of the expected improvement in water quality. Therefore, it is clear that a setback rule should have a positive net economic impact.[48]

V. Board Questions

<u>Question 2: Erosion Factor "T" and Question 3: Revised Universal Soil Loss Equation</u>

The Environmental Groups defer to the expertise of the USDA Natural Resources Conservation Service (NRCS) on the matter of how the rule should define "Erosion Factor T" and "Revised Universal Soil Loss Equation" and which websites operators should consult. The Illinois NRCS State Office responded to questions 2 and 3 in Public Comment #30. We support the inclusion of those recommendations in the final rule.

However, to clarify, there are several suggestions in Public Comment #30 that the Environmental Groups do not support, and which we hope the Board declines to accept:

Section 502.615(c)(6) Nutrient Transport Potential – we disagree with the language suggested by NRCS, and indeed such language would be in violation of existing law[49] and the proposed Board regulations[50] prohibiting the application of waste within 200 feet of surface waters.

[45] Natural Resources Conservation Service Conservation Practice Standard Code 635, attached as Attachment 3.
[46] *Id.* at 635-1.
[47] *Id.* at 635-2.
[48] Nicholas Brozovic, "What are the economic impacts of proposed setbacks for livestock management or livestock waste handling facility siting?" (Jan. 16, 2014), attached as Attachment 4.
[49] 510 ILCS 77/20(f)(6).
[50] 35 IAC 502.645(b)(1).

Section 502.615(d)(3) Nutrient Transport Potential – while we do not disagree with NRCS that describing what is meant by "neutral" could improve the clarity of the rule, we disagree with their proposed language. Section 502.615(d)(2) already makes reference to agronomic nitrogen demand, and our concern is that the language NRCS suggests would allow for excess phosphorus buildup in the soil. A better interpretation of "neutral" is that soil test phosphorus will be the same at the end of the NPDES permit cycle as it was at the beginning. The NRCS suggestion would allow for phosphorus buildup over the permit cycle. As explained on pages 144-145 of the August 21, 2012 hearing transcripts, IEPA believes phosphorus-based application should be neutral because there are fewer environmental protections required than is the case for nitrogen-based application. Allowing soil phosphorus buildup would be environmentally risky.

Section 502.620(h) Protocols to Land Apply Livestock Waste – we disagree with NRCS's suggestion to delete this section, but agree the provision will protect the environment. We also agree that it would be helpful to provide examples of resources and protocols that should be used to classify the fields. In addition to the NRCS soil survey, soil probes could be used.

Section 502.620(j) Protocols to Land Apply Livestock Waste – we disagree with NRCS's suggestion to delete this section, and remind the Board that scientific evidence to support this provision was previously submitted. We agree with NRCS that it would be a helpful clarification if examples of resources and protocols could be provided (e.g., NRCS soil survey, soil probes, drill log data from water wells).

Section 502.620(k) Protocols to Land Apply Livestock Waste – we agree with NRCS that it would add clarity if examples of acceptable protocols for seasonal high water table determination were added to this provision. Methods exist for determining the seasonal high water table. We do not support removal of this provision. Precedent (albeit insufficiently prescriptive) exists at 35 IAC 560.203.

Question 4: Integrators/Contract Operations

The Environmental Groups appreciate the Board's request for additional explanation regarding the need for permit applicants to identify the integrator when a CAFO is a contract operation. We also appreciate the opportunity to suggest revised language for this requirement.

The Environmental Groups have suggested that the Board add a requirement under Section 502.201(a)(2) for CAFOs to provide the following information in their permit applications: "If a contract operation, the name and address of the integrator."[51] The Environmental Groups also suggested adding this language to Section 501.505 (c)(2), requiring submittal of the same information from unpermitted Large CAFOs.[52] As explained below, this information is important to ensure proper waste management practices by CAFOs.

Generally speaking, commercial business integration is typified by one firm being engaged in different aspects of the production cycle of goods, including growing raw materials,

[51] *See* Environmental Groups' Proposed Amendments to 35 Ill. Adm. Code Parts 501 and 502 at 29.
[52] *See Id.* at 19.

manufacturing, transporting, marketing, and/or retailing. Vertical integration of the livestock industry has been increasing in the past decade, with large companies known as “integrators” being involved in all or many of the different stages of production. These stages of production include “growing and processing feed grain, raising animals, slaughtering them, and packaging and marketing their meat.”[53] Integration is often done through production contracts under which growers raise animals that are owned by integrators. The terms of these contracts often detail conditions on how to raise the animals; how to construct housing facilities; how to feed and medicate the animals, and how to handle manure and dispose of carcasses.[54] Integration of the industry through contracting has become the dominant model of production. As of 2008, 90% of poultry, 69% of hogs, and 29% of cattle were contractually produced through vertical integration.[55]

The USEPA provides an in depth discussion on livestock contractor/integrator relationships in the Preamble to the its 2001 Proposed CAFO Rule.[56] USEPA identifies the growing linkages between CAFOs and processing companies and mentions evidence that CAFOs become concentrated in areas in close proximity to integrated meat packers and processing companies in order to gain efficiency and reduce the cost of travel, etc. This increases the probability of excess manure nutrients being concentrated in particular geographic regions exceeding crop needs for fertilizer in those areas and raising the potential for water pollution.[57]

The IEPA should collect information about integrators in permit applications so it can evaluate if there is a common integrator in the applicant’s particular geographic region, such that there is a potential for those CAFOs contracting with the common integrator to collectively exceed crop nutrient needs in the area based on the waste they produce. The Agency would maintain discretion to decide if it requires more information to make a determination as to whether the integrator exercises substantial operational control over the contract operation such that it should consider co-permitting.

With regards to USEPA’s assessment that CAFOs can become concentrated in areas in close proximity to integrators, thus increasing the potential for water pollution,[58] neighboring residents to Illinois CAFOs have similarly expressed such concerns.[59] Densely numbered livestock facilities located in central Illinois associated with a common integrator are believed to not have adequate land to dispose of the waste they are producing. Citizens have reported observing the sharing of land application areas for waste disposal between individual contract operations being managed by the same integrator.[60] Because there is virtually no Agency regulatory oversight over the development and implementation of waste management plans for CAFOs in Illinois, there is no way to ensure individual contract facilities have adequate land available for manure

[53] Paul Stokstad, *Enforcing Environmental Law in an Unequal Market: The Case of Concentrated Animal Feeding Operations*, 15 Mo. Envtl. L. & Pol'y Rev. 229, 234-35 (2008).
[54] *Id.*
[55] *Id.* at 236-237.
[56] *See* Attach. 2
[57] *Id.* at 3024.
[58] *See* 2001 Proposed CAFO Rule at 3024.
[59] Personal communications between the Illinois Citizens for Clean Air & Water and neighboring residents to CAFOs in McDonough, Schuyler, and Hancock Counties, Illinois from 2011-2014.
[60] Personal communications between the Illinois Citizens for Clean Air & Water and residents of Hancock County, Illinois, November 2013.

disposal. By requiring integrator information to be submitted by contract operations under Section 501.505 (c)(2), the Agency will be better able to determine if densely concentrated livestock operations are affiliated with each other through common integrator management and, in the event an unpermitted discharge occurs, who the potentially responsible parties are for enforcement and permitting purposes.

USEPA requires CAFO owners/operators to submit integrator information with general permit application materials in Notice of Intent (NOI) Appendix Form 2B (hereinafter "2B Form").[61] IEPA also currently requires submittal of the USEPA 2B Form for CAFOs seeking general permit coverage.[62] IEPA's 2B Form requires applicants to indicate if they are contract operations and, if so, who the integrator is.[63]

However, while integrator information is required in CAFO NPDES permit application materials under both state and federal programs, applicants are not providing this information. Out of a total of 41 CAFO NPDES permit applications submitted to the IEPA from 2009 – 2013, only one of the applicants that submitted a 2B Form provided integrator information.[64] Given the statistics cited above, it is unlikely that 98% of Illinois' permitted CAFOs are unaffiliated with an integrator. Therefore, there is a need to specifically require submittal of this information under Section 502.201(a)(2) of Illinois' CAFO CWA regulations.

Integrator information is not likely to be provided by CAFO owners or operators under the IEPA's or the Board's currently proposed regulations. The proposed definition of "owner/operator" under Section 501.345 does not provide sufficient detail to be interpreted as being inclusive of integrators, such that a contract operation would assume the need to provide integrator information in addition to other owner/operator information with its application. Furthermore, while the IEPA's proposed definition of owner/operator includes any person who "controls or supervises" a livestock operation, which may be characteristic of integrators subject to potential co-permitting, the definition does not fully define other circumstances in which an integrator may qualify as an owner/operator for CWA permitting purposes. These problems would be remedied by: 1) requiring contract operators to provide integrator information in addition to general owner/operator information with permit applications as proposed by the Environmental Groups[65] by the inclusion of definitions for the terms "contract operation" and "integrator" in the regulations so that CAFOs are better able to recognize when such information should be included in their applications.

[61] *See Id*. at 7260; *See* 73 Fed. Reg. 70418 at 70475 (Nov. 20, 2008). According to 40 CFR § 122.23 (d)(3), permit applications must include the information specified in § 122.21 and a notice of intent for a general permit must include the information specified in §§ 122.21 and 122.28. These requirements must also be met under state program requirements pursuant to § 123.25. (40 CFR § 123.25 cross-references § 122.21 (a)(1)(C), which provides that "applicants for concentrated animal feeding operations or aquatic animal production facilities must submit Form 2B.")
[62] *See* General NPDES Permit for Concentrated Animal Feeding Operations, NPDES Permit No. ILA01, Special Condition 1, available at: http://www.epa.state.il.us/water/permits/cafo/general-npdes-permit.pdf (accessed 1/14/14).
[63] *See* Facility Information to be provided in Section 1A of NPDES Form 2B, available at: http://www.epa.state.il.us/water/cafo/forms/3510-2b.pdf (accessed 1/14/14).
[64] *See* Illinois EPA, Facilities Covered Under General NPDES Permit for CAFOs, available at: http://www.epa.state.il.us/water/permits/cafo/facilities/index/page:1.
[65] *See* Env. Prop. at 29, and 2.

To clarify the meaning of the terms “contract operation” and “integrator,” the Environmental Groups propose two new definitions to be included under Section 501.201 as follows:

> Section 501.239 Contract operation
>
> A contract operation shall have its common meaning within the industry and shall include a livestock management facility as defined in Section 501.285 where livestock are maintained, cared for or raised in accordance with a production contract, marketing agreement, or other arrangement with an integrator. Production contract shall have its common meaning within the livestock industry and as the term is defined under the Agricultural Production Contract Code, 505 ILCS 17/5.[66]
>
> Section 501.264 Integrator
>
> A person or entity who provides animals to a contract operation or has an ownership interest in the animals or the livestock facility and 1) directs activities at the facility either through a contract or through the direct supervision of, or on-site participation in, activities at the facility; 2) establishes management and production standards for the maintenance, care, or raising of the animals at the facility, including, but not limited to, how they are grown, fed, or medicated, or 3) otherwise exercises substantial operational control over the operation of the facility. An ownership interest includes a right or option to purchase the animals.

The Environmental Groups believe integrator information should be also required to be submitted by unpermitted CAFOs under Section 501.505 (c)(2). This information would help reveal clusters of unpermitted CAFOs concentrated in a geographic region that might otherwise be overlooked.

For the forgoing reasons, the Environmental Groups urge the Board to adopt the proposed language under Sections 502.201(a)(2) and 501.505 (c)(2) requiring submittal of integrator information by CAFO contract operations in accordance with Env. Prop. at 29 and 19. We also urge the Board to adopt the new definitions for “contract operation” and “integrator” under Sections 501.239 and 501.264 as proposed herein. These additions to the Board’s proposed regulations are necessary to ensure proper waste management practices by CAFOs by, among other things, identifying who potentially responsible parties are for permitting and enforcement purposes.

[66] The Agricultural Production Contract Code defines “production contract” as “(1) Any written document offered to or executed by a producer, under the provisions of which (i) the producer would sell to a contractor, or the contractor's designee, an identified commodity or commodities and (ii) the contractor has, or exercises some control or direction over, the production process; or (2) any written agreement offered to or executed by a producer under the provisions of which the producer would produce, care for, or raise a commodity or commodities not owned by the producer, using land, equipment, or facilities owned or leased by the producer, in exchange for payment. For purposes of this definition, control or direction over the production process includes (i) the contractor's designation of special commodity characteristics, such as those present in value-enhanced grains, or specific genetics in livestock or (ii) the contractor's designation of a production input, such as a seed variety, to be used by the producer to fulfill the production contract.” 505 ILCS 17/5.

VI. Conclusion

In conclusion, the Environmental Groups (Prairie Rivers Network, Illinois Citizens for Clean Air and Water, Environmental Integrity Project and Environmental Law & Policy Center) appreciate the many improvements to the proposed regulations in the Board's First Notice Rule and we urge the Board to maintain these improvements in the final rule. We also appreciate the Board's consideration of the additional improvements proposed herein.

Dated: January 30, 2014

Respectfully Submitted:

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CERTIFICATE OF SERVICE

I, Jessica Dexter, hereby certify that I have filed the attached **NOTICE OF FILING and ENVIRONMENTAL GROUPS' FIRST NOTICE COMMENTS** (with Attachments 1-4 on CD) upon the attached service list by depositing said documents in the United States Mail, postage prepaid (or via email where indicated) in Chicago, Illinois on January 30, 2014.

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ATTACHMENT 1:

U.S. EPA: *Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality*
(July 2013)

United States
Environmental Protection
Agency

Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality

July 2013

Office of Water (4304T)
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Acknowledgements and Disclaimer

This document is designed to provide technical background information for the USEPA's Office of Water research efforts. This report makes no policy or regulatory recommendations; it does identify information gaps that may help define research needs for USEPA and its federal, state, and local partners to better understand these issues. The Lead USEPA Scientist is Octavia Conerly and Co-Lead Lesley Vazquez Coriano, Health and Ecological Criteria Division, Office of Science and Technology, Office of Water. This document was prepared under USEPA contract No. GS-10F-0105J, Task Order 1107 with The Cadmus Group, Inc. This report received technical expert reviews from many scientists within USEPA and from the U.S. Department of Agriculture, Agricultural Research Service.

This document is not a regulation or guidance. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

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Acronyms and Abbreviations

AFO	Animal Feeding Operation
ARS	Agricultural Research Service
AU	Animal Unit
AWWA	American Water Works Association
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BVDV	Bovine Viral Diarrhea Virus
CAFO	Concentrated Animal Feeding Operation
CDC	Centers for Disease Control
CENR	Committee on Environment and Natural Resources
CFR	Code of Federal Regulations
CIDR	Controlled Internal Drug Release
DNA	Deoxyribonucleic Acid
ECOSAR	Ecological Structure Activity Relationships
EHEC	Escherichia coli O157:H7
EQIP	Environmental Quality Incentives Program
ERS	Economics Research Service
GAC	Granular Activated Carbon
HAB	Harmful Algal Bloom
HEV	Hepatitis E Virus
HUS	Hemolytic-Uremic Syndrome
MCL	Maximum Contaminant Level
NAHMS	National Animal Health Monitoring System
NARMS	National Antimicrobial Resistance Monitoring System
NAS	National Academy of Sciences
NITG	Nutrient Innovations Task Group
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NYSDEC	New York State Department of Environmental Conservation
ODTS	Organic Dust Toxic Syndrome

OST	Office of Science and Technology
PAC	Powdered Activated Carbon
PCIFAP	Pew Commission on Industrial Farm Animal Production
PCR	Polymerase Chain Reaction
PHAC	Public Health Agency of Canada
RNA	Ribonucleic Acid
rBGH	Recombinant Bovine Growth Hormone
RO	Reverse Osmosis
SPARROW	SPAtially Referenced Regressions On Watershed attributes
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
USGAO	United States Government Accountability Office
USGS	United States Geological Survey
WBDO	Waterborne Disease Outbreak
WBDOSS	Waterborne Disease and Outbreak Surveillance System
WHO	World Health Organization
WRI	World Resources Institute

Executive Summary

This *Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality* was prepared by the United States Environmental Protection Agency (USEPA) as part of ongoing efforts to better understand the environmental occurrence and potential effects related to contaminants of emerging concern. Past reviews of animal manure have focused primarily on nutrient issues. This report focuses on summarizing technical information on other components, particularly pathogens and contaminants of emerging concern such as antimicrobials and hormones that may affect water quality. The report makes no policy or regulatory recommendations; it does identify information gaps that may help define research needs for USEPA and its federal, state and local partners to better understand these issues.

Over the past 60 years in the United States (U.S.), farm operations have become fewer in number but larger in size. This has been particularly true in livestock and poultry production. Since the 1950s, the production of livestock and poultry in the U.S. has more than doubled; however, the number of operations has decreased by 80%. Food animal production has shifted to more concentrated facilities with animals often raised in confinement. Production has also become more regionally concentrated. This has been done, in part, to meet the demands for meat and animal products from a growing human population in the U.S. and abroad.

The U.S. Department of Agriculture's (USDA) 2007 Census of Agriculture data are used to estimate beef and dairy cattle, swine, and poultry production. Using standard USDA methods, an estimated 2.2 billion head of livestock and poultry generated approximately 1.1 billion tons of manure in 2007. Manure can be a valuable resource as a natural fertilizer. However, if not managed properly, manure can degrade environmental quality, particularly surface water and ground water resources. The increasing concentration of animal production can lead to concentrations of manure that exceed the beneficial needs of the farmland where it was produced. A 2001 report from the USDA's Economic Research Service found that 60%-70% of the manure nitrogen and phosphorus may not be able to be assimilated by the farmland on which it was generated. As an example of the increasing concentration of production, from 1997 to 2007, the number of swine produced in the US increased by 45%, but the number of swine farms decreased by 30%; over 40% of all swine were produced in just two states, Iowa and North Carolina. Also illustrating the regionalization, Alabama, Arkansas, and Georgia account for over 30% of U.S. broiler (chicken) production.

Livestock and poultry manure can contain a variety of pathogens. Some are host-adapted and, therefore, not a health risk for humans. Others can produce infection in humans and are thus termed zoonotic. The more common zoonotic pathogens in manure include *Escherichia coli* 0157:H7, *Campylobacter*, *Salmonella*, *Cryptosporidium parvum*, and *Giardia lamblia*. Viruses can also be associated with manure, although less is known about their survival in manure. Survival of microorganisms in manure, soils, and water varies greatly (from days to as much as a year) depending upon the organism and the environmental conditions. Risks from manure-associated pathogens can arise when runoff, spills, or infiltration enable microorganisms to reach surface water or groundwater, or when land-applied manure, or irrigation water impacted by manure, comes into contact with food crops. The level of risk to humans depends upon a number of factors that dictate how readily the microorganisms are transported through the environment and how long they remain infectious, as well as the numbers of microbes and their infectious doses. Most outbreaks of waterborne and foodborne gastrointestinal illness, even those caused by zoonotic pathogens, are attributable to human fecal contamination, although agricultural sources have been implicated in a number of cases. With current surveillance, the degree to which manure-related pathogens may be involved in outbreaks is poorly understood due to difficulties in identifying etiologic agents and sources of contamination, and also because many cases of illness go unreported.

It is estimated that most (60%-80%) livestock and poultry routinely receive antimicrobials. Antimicrobials may be administered to treat and prevent diseases and outbreaks, or at sub-therapeutic levels to promote animal growth and feed efficiency. The U.S. Food and Drug Administration (USFDA) reported that 28.8 million pounds of antimicrobials were sold for animal use in 2009; some estimates suggest this is four times greater than what was used for human health protection during that same year. However, available data are

limited and detailed use estimates vary. The overuse and/or misuse of antimicrobials (in general) can facilitate the development and proliferation of antimicrobial resistance, an issue of concern for animal and human health protection. Research indicates that antimicrobial use in livestock and poultry has contributed to the occurrence of antimicrobial-resistant pathogens found in livestock operations and nearby environments. USDA surveys reported that 74% of *Salmonella* and 62% of *Campylobacter* isolates from swine manure were resistant to two or more antimicrobials. Most antimicrobial resistance related to human health is likely the result of overuse and misuse of certain medications in humans. The overlap between livestock and human antimicrobial use is also recognized as an area of concern for human health because the effectiveness of these medications in treating human infections may be compromised. The USFDA banned the use of fluoroquinolones in poultry in 2005 because of human health concerns. The extent to which antimicrobial-resistant human infections are related to the use of antimicrobials in livestock and poultry, is unclear and would benefit from further research.

Hormones are naturally produced by, and in some cases artificially administered to, livestock and poultry. Beef cattle may be treated with hormones to improve meat quality and promote animal growth; dairy cows may be treated to control reproduction and increase milk production. An estimated 720,000 pounds of natural and synthetic hormones were excreted by livestock and poultry in 2000. Research indicates that hormones and their metabolites may be present in environments and surface waters proximal to livestock and poultry operations. While typically detected at low concentrations in water, hormones are biologically active at very low levels and are classified as endocrine disruptors. In aquatic ecosystems, hormones may affect the reproductive biology and fitness of aquatic organisms. Because hormones are excreted by all mammals, including humans, the majority of research has focused on hormone releases from waste water treatment plant discharges. Limited recent research suggests that exposure to hormones from livestock operations and manure may adversely impact the reproductive endocrinology of some fish. More research on the use, occurrence, fate, and transport of natural and synthetic hormones from production facilities and cropland treated with manure is necessary to fully understand their potential impact.

Manure discharges to surface waters can be caused by rain events, spills, storage lagoon and equipment failures, or the improper application of manure, including application to frozen or saturated ground. In some cases, fish mortalities may be caused by oxygen depletion or ammonia toxicity from large loadings of manure. In addition, while cases are limited, nutrients from livestock and poultry manure have been indicated as a cause of harmful algae blooms in surface waters. Harmful algae blooms produce cyanotoxins that may be harmful to animals and aquatic life, as well as to humans when exposed in recreational waters or from drinking water supplies. Proper management and maintenance of lagoons, and minimizing winter land application of manure all help prevent manure discharges to surface waters.

A combination of source water protection, manure management, and water treatment processes can help reduce surface water pollution and remove contaminants from drinking water. While most research has focused on pathogen removal during drinking water treatment, a limited base of recent research has provided some insight into antimicrobial and hormone removal. A stronger understanding of the prevalence and concentrations of antimicrobials and hormones in drinking water, as well as research on which treatment processes best remove these compounds, will help in planning strategies to minimize their consumption and any potential associated health effects.

Good manure management practices, which include the beneficial use of treated manure, linked to sound nutrient management, can help to minimize many problems related to other contaminants. The USDA and their state partners provide technical and financial assistance, as well as conservation practice standards for nutrient and manure management. This report provides a brief introduction to existing programs. The review is not exhaustive, however it provides links to additional information for individuals working in water quality programs.

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1. Introduction

This *Literature Review of Contaminants in Livestock and Poultry Manure and Implications for Water Quality* was prepared as part of the United States Environmental Protection Agency's (USEPA) ongoing efforts to better understand the environmental occurrence and potential effects related to contaminants of emerging concern. The report makes no policy or regulatory recommendations; it does identify information gaps that may help define research needs for USEPA and its federal, state and local partners to better understand these issues.

Over the past 60 years the structure of American agriculture has significantly changed. Across all agricultural sectors, farm operations have expanded – farms have gotten larger and fewer in number. The shift from the "family farm" is perhaps most pronounced in the production of livestock and poultry. Since the 1950s, the production of livestock and poultry in the United States (U.S.) has more than doubled, however the number of operations has decreased by 80% (Graham and Nachman 2010). Food animal production has evolved from largely grazing animals and on-farm feed production to fewer and larger operations and increasingly more to concentrated facilities, often with animals raised in confinement (Ribaudo and Gollehon 2006, MacDonald and McBride 2009). This has been done, in part, to meet the demands for meat and animal products from a growing human population in the U.S. and abroad.

The increase in concentration of livestock and poultry also leads to increased concentration of animal manure that must be managed. As production has shifted to much larger, more concentrated operations, livestock and poultry operations have become separated from the land base that produces their feed (Gollehon et al. 2001). Historically, manure was used as fertilizer on the farm to provide nutrients for plant growth on the cropland, pasture or rangeland that, in turn, partly provided the feed for the animals raised on the farm. Manure can also improve soil quality, when managed appropriately as a fertilizer, where the producer considers the right rate, timing, source, and method of application (NRC 1993). However, while livestock manure can be a resource, it can also degrade environmental quality, particularly surface and ground water if not managed appropriately (Kumar et al. 2005). The geographic concentration of livestock and poultry can lead to concentrations of manure that may exceed the needs of the plants and the farmland where it was produced. A report from the U.S. Department of Agriculture's Economic Research Service (USDA ERS) found that more than 60% of manure nitrogen and 70% of manure phosphorus cannot be assimilated by the farmland on which it is generated (Gollehon et al. 2001). Runoff related to manure is considered a primary contributor to widespread nutrient water quality pollution in the U.S., as described in the 2009 "An Urgent Call to Action" report generated by the Nutrient Innovations Task Group (see also Gollehon et al. 2001, Ruddy et al. 2006, Dubrovsky et al. 2010).

While manure's contributions to nutrient water quality impairment is perhaps its most widely recognized impact, manure and livestock management practices may now also be a source of other contaminants (see Table 1-1). Manure often contains pathogens (many of which can be infectious to humans), heavy metals, antimicrobials, and hormones that can enter surface water and ground water through runoff and infiltration potentially impacting aquatic life, recreational waters, and drinking water systems (Gullick et al. 2007, Rogers 2011). The shift towards concentrated livestock production has led to other practices that can contribute contaminants other than nutrients to the environment. To improve animal production efficiency and counteract the greater potential susceptibility of disease in concentrated and confined living conditions, livestock and poultry may be treated with antimicrobials to treat or prevent diseases and infections or treated sub-therapeutically to promote animal growth (McEwen and Fedorka-Cray 2002). Some livestock and poultry also receive steroid hormones to promote animal growth and/or control reproductive cycles (Lee et al. 2007). Pesticides are used to control insect and fungal infestations and parasites as well as other pests. Heavy metals, such as zinc, arsenic, and copper are sometimes added as micronutrients to promote growth.

Table 1-1. Key pollutants from livestock operations and animal manure.

Pollutant	Description of Pollutant	Pathways to the Environment	Potential Impacts
Nitrogen	Organic forms (e.g., urea) and inorganic forms (e.g., ammonium and nitrate) in manure may be assimilated by plants and algae.	• Overland discharge • Leachate into ground water • Atmospheric deposition as ammonia	• Eutrophication and harmful algal blooms (HABs) • Ammonia toxicity to aquatic life • Nitrate linked to methemoglobinemia
Phosphorus	As manure ages, phosphorus mineralizes to inorganic phosphate compounds that may be assimilated by plants.	• Overland discharge • Leachate into ground water (water soluble forms)	• Eutrophication and HABs
Potassium	Most potassium in manure is in an inorganic form available for plant assimilation; it can also be stored in soil for future plant uptake.	• Overland discharge • Leachate into ground water	• Increased salinity in surface water and ground water
Organic Compounds	Carbon-based compounds decomposed by micro-organisms. Creates biochemical oxygen demand because decomposition consumes dissolved oxygen in the water.	• Overland discharge	• Eutrophication and HABs • Dissolved oxygen depletion, and potentially anoxia • Decreased aquatic biodiversity
Solids	Includes manure, feed, bedding, hair, feathers, and dead livestock.	• Overland discharge • Atmospheric deposition	• Turbidity • Siltation
Salts	Includes cations (sodium, potassium, calcium, magnesium) and anions (chloride, sulfate, bicarbonate, carbonate, nitrate).	• Overland discharge • Leachate into ground water	• Reduction in aquatic life • Increased soil salinity • Increased drinking water treatment costs
Trace Elements	Includes feed additives (arsenic, copper, selenium, zinc, cadmium), trace metals (molybdenum, nickel, lead, iron, manganese, aluminum), and pesticide ingredients (boron).	• Overland discharge • Leachate into ground water	• Aquatic toxicity at elevated concentrations
Volatile Compounds Including Greenhouse Gases	Includes carbon dioxide, methane, nitrous oxide, hydrogen sulfide, and ammonia gases generated during manure decomposition.	• Inhalation • Atmospheric deposition of ammonia	• Eutrophication • Human health effects • Climate change
Pathogens	Includes a range of disease-causing organisms, including bacteria, viruses, protozoa, fungi, prions and helminths.	• Overland discharge • Potential growth in receiving waters	• Animal, human health effects
Antimicrobials	Includes antibiotics and vaccines used for therapeutic and growth promotion purposes.	• Overland discharge • Leachate into ground water • Atmospheric deposition	• Facilitates the growth of antimicrobial-resistance • Unknown human health and aquatic life effects
Hormones	Includes natural and synthetic hormones used to promote animal growth and control reproductive cycles.	• Overland discharge • Leachate into ground water	• Endocrine disruption in fish • Unknown human health effects
Other Pollutants	Includes pesticides, soaps, and disinfectants.	• Overland discharge • Leachate into ground water	• Unknown human health and ecological effects • Potential endocrine disruption in aquatic organisms

Adapted from USEPA (2002a) Exhibit 2-2.

Livestock and poultry operations and related manure management practices account for 18% of all human-caused greenhouse gas emissions (Steinfeld et al. 2006); ruminant livestock and liquid manure handling facilities account for nearly 30% of methane emissions from anthropogenic activities (USEPA 2011a). Besides greenhouse gas emissions, air quality degradation, particularly from concentrated livestock and poultry operations, has been documented, related to releases of toxic as well as odorous substances, particulates, and bioaerosols containing microorganisms and human pathogens (Merchant et al. 2005). Air quality degradation has been related to human health concerns for workers in confined operations and also for neighbors to large facilities (Donham et al. 1995 and 2007, Merchant et al. 2005, Mirabelli et al. 2006).

Recognizing the potential for human and ecological health effects associated with the other contaminants in manure, this report focuses on the growing scientific information related to contaminants of emerging concern – particularly pathogens, antimicrobials, and hormones in manure – and reviews the potential and documented human health and ecological effects associated with these manure contaminants. Many other groups and initiatives are focusing on nutrient water quality issues (i.e., Nutrient Innovation Task Group (NITG) 2009, Dubrovsky et al. 2010), including the relative contributions of animal manure. This report briefly discusses the magnitude of manure generation (which is often highly localized) for perspective on the relationship to these emerging contaminants and their prevalence in the environment, for major livestock types – beef and dairy cattle, swine, poultry and aquaculture. Sections that follow summarize information on pathogens, antimicrobials, and hormones, followed by a review of known or associated impacts related to manure. These sections are followed by a brief review of drinking water treatment methods that can help to deal with contaminants that may be related to manure (and other sources). And the last section of the report provides some direction to other resources and information on manure management. Following good manure management practices which include alternative uses of manure that are both economically and environmentally sustainable, linked to sound nutrient management, can help to minimize many problems related to other contaminants. The USDA NRCS provides technical and financial assistance as well as conservation practice standards for nutrient and manure management.

This report is focused on manure and does not address other waste management issues related to livestock and poultry operations (e.g., disposal of dead animals, spoiled feed). The purpose of this report is to summarize publicly available literature for those involved with watershed protection and management and the linked efforts for source water protection and planning for drinking water systems. As noted in the report, there are very different levels of information available on many of these topics associated with manure. Hence, the report can also help to identify information gaps and guide research needs for the U.S. Environmental Protection Agency (USEPA) and other partners to better understand these issues.

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2. Distribution of Livestock, and Manure Generation and Management

2.1. Background

Livestock and poultry production in the U.S. has changed significantly since the 1960's, transitioning towards larger operations separated from the land base that produces their feed (Graham and Nachman 2010). Also, large operations now typically specialize in production of one animal type, often at one stage of its lifecycle (MacDonald and McBride 2009). For example, in swine production, hogs may be transferred from a farrow-to-feeder farm during the initial life stages, to a feeder-to-finish farm and finally to a slaughter plant, rather than being raised at one facility (MacDonald and McBride 2009). The majority of animals are also now raised in confinement where feed is brought to the animal rather than the animals seeking feed in a pasture or on the range (Ribaudo and Gollehon 2006).

Because of the shift in farming practices towards larger animal feeding operations, livestock and poultry production has become more regionalized, and large volumes of manure are oftentimes generated relative to smaller land areas for application (Gollehon et al. 2001). In some areas, the large quantity of manure generated by large operations relative to the small area available for land application magnifies the potential environmental and human health impacts associated with manure runoff and discharges to surface water and ground water.

> ✓ In 2007, 2.2 billion livestock generated an estimated 1.1 billion tons of manure (as excreted).
>
> ✓ In 1998, USEPA estimated that the livestock manure produced was 13 times greater than all the human sewage produced in the U.S.
>
> ✓ From 1997 to 2007, the number of swine produced in the U.S. increased by 45%, but the number of swine farms decreased by over 30%, resulting in more concentrated manure generation. Over 40% of all swine were produced in just two states: Iowa and North Carolina.
>
> ✓ Cattle (beef, dairy, and other) produce about 80% of all livestock manure in the U.S. – the top 10 producing states produce about 56% of the total.

The mass of manure generated is related to the mass, or size of the animals involved. For example, an average 160-pound human produces approximately two liters of waste per day (feces and urine), whereas an average 1,350-pound lactating dairy cow generates 50 liters of manure (including urine) per day (Rogers 2011). Most animal manure is applied to cropland or grasslands without treatment. Nutrients may be assimilated by the growing plants on cropland and grassland (Graham and Nachman 2010). Through manure storage, handling, and land application, the contaminants associated with manure (i.e., pathogens, antimicrobials, hormones, etc.; see Table 1-1) have the potential to enter the environment (Kumar et al. 2005, Lee et al. 2007, PCIFAP 2008).

2.2. Cattle, Poultry and Swine

This report uses USDA's 2007 Census of Agriculture livestock and poultry inventory counts to illustrate the distribution of the major animal types (beef and dairy cattle, swine, and poultry) in the U.S. and related manure generation. These tables presented below (and in Appendix 1), summarizing this information by state, are simply to provide perspective on the differences that are apparent around the U.S., and to provide insight on the magnitude of the issues at the state and regional level. These comparisons are made using standard conversion factors developed by the USDA's Natural Resources Conservation Service (NRCS); livestock and poultry counts were converted to animal units (AU), which are a unit of measure based on animal weight

(1 AU = 1,000 pounds live animal weight) (see for example Kellogg et al. 2000, Gollehon et al. 2001). For example, one beef cow or steer equals one AU, whereas it takes 250 layer chickens to equal one AU. The amount of manure generated is directly related to animal weight. Therefore, converting animal counts to AUs allows for the estimation of livestock manure generation and is also a method for standardizing farm operation size across livestock types (Gollehon et al. 2001). (For further information on AU and manure generation calculations, refer to Appendix 1). Several USDA and United States Geological Survey (USGS) reports (i.e., Kellogg et al. 2000, Gollehon et al. 2001, Ruddy et al. 2006) have calculated livestock manure generation using the 1997 USDA Census of Agriculture data. Their estimates, and those presented in this report, are very similar in number, scope, and perspective. (These reports, and this current report, all use the same basic conversion factors noted, but the USDA reports also incorporate more detailed livestock marketing data). The USDA and USGS reports present results at a more detailed scale (i.e., county, watershed, or farm-level manure production), and have been focused on nutrients and nutrient management. Livestock and poultry distribution and manure generation are summarized below (more complete and detailed state-by-state livestock inventories and estimates of manure generation are tabulated in Appendix 1).

In 2007, approximately 2.2 billion cattle, swine, and poultry were produced in the U.S. (USDA 2009a), generating an estimated 1.1 billion tons of manure (manure estimates used here are as excreted, wet-weight). Cattle include beef cattle, dairy cattle, and other cattle and calves (such as breeding stock). Swine include market hogs, which are sent to slaughter after reaching market weight, and breeder hogs, which are used for breeding purposes. Poultry includes chickens as broilers (raised for meat), and as layers (produce eggs), and turkeys. Note that the Census of Agriculture numbers do not account for all the marketing of animals that takes place during a year, and end-of-year 2007 counts were used for analyses. Different than cattle, poultry have a high turnover rate throughout the year. For example, broiler chickens are typically sent to slaughter after five to nine weeks (MacDonald and McBride 2009).

Table 2-1. Top ten states with the highest beef cattle production and associated manure generation in 2007.

National Rank	State	Total Beef Cattle AUs	Percent of Total Beef Cattle AUs*	Total Estimated Tons Manure
1	TEXAS	5,259,843	16.0%	60,488,195
2	MISSOURI	2,089,181	6.4%	24,025,582
3	OKLAHOMA	2,063,613	6.3%	23,731,550
4	NEBRASKA	1,889,842	5.8%	21,733,183
5	SOUTH DAKOTA	1,649,492	5.0%	18,969,158
6	MONTANA	1,522,187	4.6%	17,505,151
7	KANSAS	1,516,374	4.6%	17,438,301
8	TENNESSEE	1,179,102	3.6%	13,559,673
9	KENTUCKY	1,166,385	3.6%	13,413,428
10	ARKANSAS	947,765	2.9%	10,899,298
	Top Ten Subtotal	*19,283,784*	*59%*	*221,763,516*
	U.S. TOTAL	**32,834,801**		**377,600,212**

** Animal units (AUs) represent 1,000 pounds of live animal weight, or one beef cattle per AU (see Kellogg et al. 2000, Gollehon et al. 2001). See Appendix 1 for complete listing of all states. Reference: Inventory data from USDA 2009a.*

The changes in livestock and poultry production – the shift towards fewer, larger, more concentrated production facilities – has resulted in regional and local differences in the distribution of the 2.2 billion animals raised in the U.S. These differences will in turn relate to differences in the issues involved in manure management and the potential for environmental impacts of various contaminants. For example, beef cattle are produced predominantly in the Great Plains and Midwest. According to USDA's 2007 Census of Agriculture, Texas alone accounts for 16% of U.S. beef cattle production with an estimated 60.5 million tons of manure generated – two and a half times greater than the amount generated by the second largest beef cattle producing state (Table 2-1). In contrast, swine are largely produced in Iowa and North Carolina, accounting for 27% and 16%, respectively, of total U.S. production (Table 2-2). Broiler production is predominantly based in the southern and eastern U.S., with Georgia, Arkansas, and Alabama accounting for nearly 30% of U.S. production. An estimated 20.3 million tons of manure from broiler chickens was generated in those three states in 2007 (Table 2-3).

Table 2-2. Top ten states with the highest total swine (market and breeder hogs) production and associated manure generation in 2007.

National Rank	State	Total Swine AUs	Percent of Total Swine AUs*	Total Estimated Tons Manure
1	IOWA	2,409,994	27.0%	31,912,337
2	NORTH CAROLINA	1,382,252	15.5%	17,056,820
3	MINNESOTA	999,762	11.2%	12,767,962
4	ILLINOIS	607,844	6.8%	7,289,960
5	INDIANA	486,599	5.5%	6,140,286
6	NEBRASKA	462,548	5.2%	5,543,892
7	MISSOURI	435,930	4.9%	5,252,950
8	OKLAHOMA	367,821	4.1%	4,140,186
9	KANSAS	256,349	2.9%	3,171,100
10	OHIO	243,700	2.7%	3,066,558
	Top Ten Subtotal	*7,652,800*	*86%*	*96,342,051*
	U.S. TOTAL	**8,910,943**		**111,256,177**

** Animal units (AUs) represent 1,000 pounds of live animal weight (see Kellogg et al. 2000, Gollehon et al. 2001). See Appendix 1 for complete listing of all states. Reference: Inventory data from USDA 2009a.*

Manure management is inherently a local issue, related to the number and type of animals, the land base for application of the manure, the type of operations (i.e., confined feeding operations), and many management factors. Detailed information on all these factors is more difficult to come by, and such estimates are not the purpose or within the scope of this report. (The USDA's Census of Agriculture also does not provide this information (Gollehon et al. 2001)). However, in 2002, a comprehensive review of state livestock production programs was conducted on behalf of USEPA to provide estimates of the number of Animal Feeding Operations (AFOs) and Concentrated Animal Feeding Operations (CAFOs) in each state (Tetra Tech, Inc. 2002). According to that study, the states that had the most AFOs with more than 1,000 AUs were Iowa, North Carolina, Georgia, and California.

Table 2-3. Top ten states with the highest broiler chicken production and associated manure generation in 2007.

National Rank	State	Total Broiler AUs	Percent of Total Broiler AUs*	Total Estimated Tons Manure
1	GEORGIA	517,363	14.7%	7,744,926
2	ARKANSAS	444,830	12.6%	6,659,104
3	ALABAMA	391,953	11.1%	5,867,541
4	MISSISSIPPI	330,982	9.4%	4,954,799
5	NORTH CAROLINA	329,498	9.4%	4,932,592
6	TEXAS	260,686	7.4%	3,902,473
7	MARYLAND	143,964	4.1%	2,155,138
8	DELAWARE	112,291	3.2%	1,680,999
9	KENTUCKY	109,399	3.1%	1,637,707
10	MISSOURI	102,537	2.9%	1,534,984
	Top Ten Subtotal	*2,743,505*	*78%*	*41,070,264*
	U.S. TOTAL	**3,522,083**		**52,725,576**

** Animal units (AUs) represent 1,000 pounds of live animal weight, or 455 broilers per AU (see Kellogg et al. 2000, Gollehon et al. 2001). See Appendix 1 for complete listing of all states. Reference: Inventory data from USDA 2009a.*

While manure use and management is a local issue, the state data can also provide some illustrations and valuable perspectives. Table 2-4 summarizes the top ten states related to manure production (this is the sum of the AUs for all livestock, swine, and poultry, and the estimated manure production, as excreted; see Appendix 1). As might be expected, the list is comprised of the major agricultural states, including Texas, Iowa, and California. Texas accounts for about 12% of the AUs and manure produced in the U.S. Total AUs and manure are dominated by beef and dairy numbers because of their body size. Nationally, cattle were responsible for nearly 83% of total livestock manure generation in 2007, followed by swine (10%) and poultry (7%). Refer to Appendix 1 for complete livestock and poultry production and manure generation tables.

As discussed, many of the concerns for environmental impacts of manure generation relate to settings where there is a large mass of manure but a relatively small land base for application of the manure. Even at the state level, these differences can be illustrated. The top livestock states, such as Texas, California, and Iowa (Table 2-4) also have large areas of farm land. Presenting total manure generation on a farmland area basis paints a different picture. Table 2-5 shows the state level estimate for tons of manure generated per farmland acre. Smaller states along the eastern seaboard rise to the top of the list; these states are key poultry and swine producing states but have far more limited farmland than the major farm states. (This tabulation divides the total estimated manure for livestock and poultry by the acreage for "land in farms" from the 2007 Census of Agriculture (USDA 2009a). "Land in farms" is defined by the USDA (2009a) as primarily agricultural land used for grazing, pasture, or crops, but it may also include woodland and wasteland that is not under cultivation or used for grazing or pasture, provided it is on the farm operator's operation. This is an oversimplification at the state level: land in farms is an overestimate of the actual land likely available for application of manure; manure as excreted is likely an overestimate of the mass of manure to be handled, dependent on the management practice. However, it illustrates the differences that are inherent in the distribution of the different types of livestock and poultry settings around the U.S.

Table 2-4. Top ten livestock and poultry manure producing states in 2007.

National Rank	State	Total AUs	Percent of Total U.S. Manure	Total Estimated Tons Manure
1	TEXAS	11,109,770	11.5%	128,048,896
2	CALIFORNIA	5,235,439	6.2%	68,496,143
3	IOWA	5,586,515	6.1%	68,360,493
4	NEBRASKA	5,235,899	5.3%	59,100,556
5	KANSAS	4,932,902	5.0%	55,792,510
6	OKLAHOMA	4,571,012	4.7%	52,036,892
7	MISSOURI	4,178,962	4.3%	48,070,611
8	WISCONSIN	3,213,092	3.8%	42,531,594
9	MINNESOTA	3,268,570	3.6%	39,816,914
10	SOUTH DAKOTA	3,179,772	3.3%	36,358,712
	U.S. TOTAL	**92,969,509**		**1,113,232,385**

** Data estimated from USDA's 2007 Census of Agriculture livestock counts converted to animal units, following USDA's NRCS methodology. Reference: USDA 2009a.*

Table 2-5. Top ten states with the highest manure generation in 2007 on a farmland area basis.

National Rank	State	Estimated Tons Manure/Acre Farmland*
1	NORTH CAROLINA	3.85
2	DELAWARE	3.81
3	VERMONT	3.05
4	PENNSYLVANIA	2.99
5	WISCONSIN	2.80
6	CALIFORNIA	2.70
7	NEW YORK	2.66
8	MARYLAND	2.23
9	VIRGINIA	2.22
10	IOWA	2.22

** Refer to Appendix 1 for further description on livestock manure generation calculations. Reference: USDA 2009a.*

The way in which livestock and poultry are raised differs by animal type as well as the size of the production facility. Chapter 8 provides further information on manure management programs and strategies. Beef cattle tend to be raised outdoors in pens or corrals, where the manure accumulates and is scraped up along with any bedding materials and soil (in pens), stored in a facility, or stockpiled until it can be land applied on or off-site (USEPA 2009a). In larger, concentrated operations, drainage ditches may flow through beef cattle operations, discharging stormwater, manure, animal feed, bedding materials, and other waste to a nearby collection pond or lagoon (Gullick et al. 2007). Dairy cows may be housed in tie stall barns, free stall barns, or outdoor open lots (USEPA 2009b). Dairy cow manure may be scraped from indoor barns and temporarily stored in a solid stack in steel or concrete tanks, or flushed from barn surfaces and discharged to lagoons (Zhao et al. 2008). Swine are typically housed over slatted floors, allowing manure to be washed down and routinely flushed out of the housing facility (Gullick et al. 2007). Swine manure may be flushed to an underground pit (57% of operations), a lagoon (23% of operations), or another storage area, like a manure pile (20% of operations)

(USDA 2002a). Poultry, including broilers, layers, and turkeys, are almost always raised indoors with manure accumulating and mixing with bedding material (Zhao et al. 2008). Most layers are housed in elevated cages, allowing manure to accumulate below or drop onto a conveyer belt that removes the manure from the building (Gullick et al. 2007). Manure from layers is typically washed from the housing facility to a storage pit (Zhao et al. 2008).

Swine and dairy cow production, in particular, have become increasingly concentrated. Between 1997 and 2007, there was a 33% decrease in the number of swine farms yet a 45% increase in the number of swine processed (USDA 2009a). As shown in Table 2-2, 86% of all U.S. swine production in 2007 occurred in the top ten swine producing states, and the top five states alone account for over two-thirds of U.S. production. From 1997 to 2007 there was a 44% decrease in the number of dairy farms in the U.S., yet the number of dairy cows has remained relatively level, increasing by 1% during that time period (USDA 2009a).

2.3. Aquaculture

Aquaculture is a unique component of commercial animal production, very directly related to water resources, and it is also discussed in this report where information is available. The aquaculture sector of U.S. agriculture has been steadily increasing, with a rise in demand for seafood coinciding with declining wild fish and shellfish populations; in providing controlled conditions it may offer production advantages of selective breeding as well as improved disease control (Cole et al. 2009). The USDA's 2005 Census of Aquaculture reported over 4,300 aquaculture farms in the U.S., covering nearly 700,000 acres (USDA 2006). Aquaculture operations may be either freshwater or saltwater, producing an array of aquatic organisms. Aquaculture products include food fish (e.g., catfish, salmon, carp), sport fish (e.g., bass, crappie, walleye), ornamental fish (e.g., goldfish, koi), baitfish (e.g., crawfish, fathead minnows), crustaceans (e.g., crawfish, lobsters, shrimp), mollusks (e.g., mussels, oysters), aquatic plants, and other animals (e.g., alligators, snails, turtles) (USDA 2006). According to the USDA's Aquaculture Census, production in 2005 was situated predominantly in the southern U.S., with Louisiana having the highest total number of freshwater and saltwater operations, as well as the most acres used for aquaculture (USDA 2006). Related to regionalized production and larger but fewer farms, in 2005, the top ten states alone accounted for 95% of the total U.S. aquaculture acreage (see Table 2-6), but less than 50% of the nation's aquaculture farms (refer to Appendix 1 for a complete table).

Catfish production was the dominant commodity in U.S. aquaculture in 2005, with nearly one-third of production occurring in Mississippi (USDA 2006). Trout were the second largest commodity – the majority of which were produced in Idaho (USDA 2006). Catfish are typically raised in ponds, while trout are often reared in flow-through raceways. As defined by the USDA's 2005 Aquaculture Census, flow-through raceways are long, narrow, confined structures in which the water flows into one end and exits the other (USDA 2006). Raceways can be closed systems, in which water flows through a series of ponds prior to discharging into a headwater pond that flows back into the system, or they can be directly linked with a river or stream, using the natural flow to flush water through the system and back into a stream.

Waste produced in aquaculture consists of feces, excess feed, dead fish and other aquatic organisms, nutrients, antibiotics, hormones, pesticides, anesthetics, minerals, vitamins, and pigments (Gullick et al. 2007, Cole et al. 2009). As reviewed by Amirkolaie (2011), up to 15% of feed may be uneaten or spilled, and between 60% and 80% of dietary dry matter may be excreted in intensive aquaculture operations. Aquaculture waste may be managed by removing solids from the water via a settling basin or filtration system, after which the solids may be composted or applied to cropland as fertilizer (Gullick et al. 2007).

Table 2-6. Top ten aquaculture states in 2005.

National Rank	State	Total # of Farms	State	Total Farm Acres
1	LOUISIANA	873	LOUISIANA	320,415
2	MISSISSIPPI	403	MISSISSIPPI	102,898
3	FLORIDA	359	CONNECTICUT	62,959
4	ALABAMA	215	ARKANSAS	61,135
5	ARKANSAS	211	MINNESOTA	41,023
6	WASHINGTON	194	ALABAMA	25,351
7	NORTH CAROLINA	186	WASHINGTON	13,478
8	MASSACHUSETTS	157	VIRGINIA	12,555
9	VIRGINIA	147	CALIFORNIA	9,340
10	CALIFORNIA	118	TEXAS	7,083
Top Ten Subtotal	--	***2,863***	--	***656,237***
U.S. TOTAL	--	**4,309**	--	**690,543**

** See Appendix 1 for complete listing of all states and total aquaculture acreage.*
Reference: USDA 2006.

2.4. Summary and Discussion

Livestock production in the U.S. is a major industry, representing $154 billion in sales in 2007 – nearly a 55% increase since 1997 (USDA 1999, USDA 2009a). In 2007, 77.6 million cattle AUs (beef and dairy), 8.9 million swine AUs, and 6.4 million poultry AUs generated over 1.1 billion tons of manure (see Appendix 1; inventory data from USDA 2009a). Throughout the various stages of livestock production, considerable amounts of manure and associated contaminants can enter the environment, potentially impacting surface water and ground water, through runoff and discharges. According to the USDA, the shift towards large animal feeding operations and confined operations has resulted in the concentration of wastes and other changing production practices (MacDonald and McBride 2009). Livestock and poultry production has become more concentrated, and larger volumes of manure are generated relative to local land areas where it may be applied; with limited farmland available for manure application, the potential for environmental impacts is of increased concern (Gollehon et al. 2001). For example, despite the fact that dairy cow production remained relatively level between 1997 and 2007, the total number of dairy farms in the U.S. decreased by nearly half during that same ten year time period (USDA 2009a), indicative of the shift towards larger livestock production operations.

The remaining chapters of this report focus on livestock excretion of some key contaminants (e.g., pathogens, antimicrobials, hormones), and their stability in the environment. Livestock manure is a source of pathogens that have the potential to cause infections in humans. Widespread livestock antimicrobial use has been shown to facilitate the growth of antimicrobial-resistant bacteria (WHO 2000), and there is evidence of a linkage between antimicrobial-resistant human infections and foodborne pathogens from animals (Swartz 2002). Hormones excreted by livestock also may contribute to risks to aquatic life, potentially impacting fish reproductive fitness and behavior (Lee et al. 2007, Zhao et al. 2008). Chapter 6 of this report provides a review and analysis of the potential human health and ecological impacts of these emerging contaminants associated with manure.

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3. Pathogens in Manure

Manure from livestock and poultry contains a variety of pathogens; some are highly host-adapted and not pathogenic to humans, while others can produce infections in humans (USEPA 2002b). Pathogens that are of animal origin but that can be transmitted to humans are termed "zoonotic" and include prions, viruses, bacteria, protozoa, and helminths (Rogers and Haines 2005). Some may infect one type of livestock, while others may infect several types of animals in addition to humans (Cotruvo et al. 2004). Zoonotic pathogens can have serious public health consequences and garner public attention when major outbreaks occur. Animal agriculture has been implicated as a possible source of contamination in a number of significant outbreaks of human illness (see Section 6.5).

Zoonotic pathogens can be difficult to eradicate from livestock and poultry production facilities because some are endemic to the animal (Rogers and Haines 2005, Sobsey 2006). Furthermore, zoonotic pathogens may have a resistant stage in their life cycle (e.g., a cyst or spore) that enhances their survival in the environment and facilitates transmission to other animals or humans through ingestion of fecal-contaminated water or food. Zoonotic pathogens have the potential for transport to ground water and surface water and may be subsequently ingested through recreation or drinking water (see Section 3.4), with potential implications for human and animal health. They may also contaminate food crops through fecally-contaminated runoff or irrigation water or by contact with soil to which manure has been applied (e.g., Pachepsky et al. 2012, Pachepsky et al. 2011, Rogers and Haines 2005) (see Section 6.5).

This chapter will evaluate manure-associated pathogens that may cause human illness and the various factors contributing to human exposure. Sections 3.1 and 3.2 cover pathogen characteristics, infectious doses, and prevalence by livestock type for important select examples. Section 3.3 briefly discusses the occurrence of pathogens in surface water, ground water, and sediments. Survival of pathogens in various environmental media (manure, soil, sediment, and water) is discussed in Section 3.4, and transport in the environment is discussed in Section 3.5.

3.1. Types of Pathogens Found in Livestock

A number of pathogens are associated with fecal matter from livestock and poultry, but only a few pose a known or potential threat to humans, including (USEPA 2004a, Rogers and Haines 2005, Sobsey et al. 2006, Pappas et al. 2008, Bowman 2009):

Bacteria: *Escherichia coli (E. coli)* O157:H7 and other shiga-toxin producing strains, *Salmonella* spp., *Campylobacter jejuni, Yersinia enterocolitica, Shigella* sp., *Listeria monocytogenes, Leptospira* spp., *Aeromonas hydrophila, Clostridium perfringens, Bacillus anthraxis* (in endemic area) in mortality carcasses

Parasites: *Giardia lamblia, Cryptosporidium parvum, Balantidium coli, Toxoplasma gondii, Ascaris suum* and *A. lumbricoides, Trichuris trichuria*

Viruses: *Rotavirus*, hepatitis E virus, influenza A (avian influenza virus), enteroviruses, adenoviruses, caliciviruses (e.g., norovirus)

In addition to pathogens (and often in lieu of pathogens), environmental samples can be tested for microbial indicator organisms, which indicate the possibility of fecal contamination (and thus, the possibility of pathogens). Commonly used indicator organisms include fecal coliforms, *E. coli*, and enterococci (Perdek et al. 2003). *Clostridium perfringens* and coliphages also show promise as indicators because they are present in manure from all animals (e.g., Perdek et al. 2003) (*C. perfringens* is a spore-forming bacterium that is common on raw meat and poultry and is a common cause of foodborne illness (CDC 2011a)). Testing for indicator organisms is more efficient and less expensive than testing for a suite of pathogens associated with livestock and poultry runoff. Indicator organisms have been detected in manure and slurry as well as in runoff (e.g., Thurston-Enriquez et al. 2005, Wilkes et al. 2009). Indicators can, however, have different survival and transport capabilities than pathogens and do not always correlate well with illness or with the pathogens themselves (Perdek et al. 2003). As rapid molecular genetic methods of pathogen detection and enumeration gain wider use, reliance on microbial indicators will lessen. In addition, research is ongoing to better understand the relationships between indicators, pathogens, and other environmental variables such as hydrological conditions and persistence in soils environments (e.g., Wilkes et al. 2009; Rogers et al. 2011).

Table 3-1. Occurrence, infective doses, and diseases caused by some of the pathogens present in manure and manure slurries from cattle, poultry, and swine.

Pathogen	Occurrence (% of positive manure samples)*			Infective Doses	Human Diseases and Symptoms
	Cattle	Poultry	Swine		
Bacteria					
Salmonella spp.	0.5 - 18	0 - 95	7.2 - 100	100 - 1,000 cells	Salmonella enteritis, Typhoid Fever, Paratyphoid fever (diarrhea, dysentery, systemic infections that spread from the intestinal tract to other parts of the body, abdominal pain, vomiting, dehydration, septicemia arthritis and other rheumatological syndromes)
E. coli 0157:H7	3.3 - 28	0	0.1 - 70	5 -10 cells	Enteric colibacillosis (diarrhea with or without bleeding), abdominal pain, fever, dysentery, renal failure, hemolytic-uremic syndrome , arthritis and other rheumatological syndromes
Campylobacter spp.	5 - 38	57 - 69	14 - 98	< 500 cells	Campylobacter enteritis (diarrhea, dysentery, abdominal pain, malaise, fever, nausea, vomiting, septicemia, meningitis,, Guillain-Barré syndrome (neuromuscular paralysis), arthritis and other rheumatological syndromes
Yersinia enterocolitica	-	-	0 - 65	10,000,00 0 cells	Yersiniosis (Intestinal infection mimicking appendicitis, diarrhea, fever, headache, anorexia, vomiting, pharyngitis, arthritis and other rheumatological syndromes)
Listeria spp.	0-100	8**	5.9 - 20	<10,000 cells	Listeriosis (diarrhea, systemic infections, meningitis headache, stiff neck, confusion, loss of balance convulsions miscarriage or stillbirth)
Protozoa					
Cryptosporidium spp.	0.6 - 23	6 - 27	0 - 45	10 -1,000 oocysts	Cryptosporidiosis (infection that can be asymptomatic, cause acute but short-lived diarrheal illness, cause chronic diarrheal illness, or be quite severe and cholera-like, with cramping, abdominal pain, weight loss, nausea, vomiting, fever, pneumonia, biliary system obstruction and pain)
Giardia	0.2 - 46	-	3.3 - 18	10-25 cysts	Giardiasis (diarrhea, abdominal cramps, bloating, fatigue, hypothyroidism, lactose intolerance, chronic joint pain)

References: Rogers and Haines 2005, Pachepsky et al. 2006, Bowman 2009, USEPA 2010a, Ziemer et al. 2010, and USDA 2007a, 2007b, 2009b, and 2010a. , Ho et al. 2007, Weber et al. 1995, Mohammed et al. 2009.
** Percentage of manure samples testing positive for the pathogen. Range of minimum and maximum percentage as reported in the literature. ** Based on a single study.*

Information on the prevalence, illnesses (primarily gastrointestinal), and infectious doses (numbers of organisms required to cause infection) associated with some of the bacterial and protozoan agents are provided in Table 3-1. Occurrence indicates the percentage of manure samples in which the pathogen was detected. The subsections below provide brief descriptions of selected bacterial, protozoan, and viral pathogens as well as summaries of the pathogens associated with each animal type.

3.1.1. Bacteria

Below are brief summaries of five zoonotic pathogenic bacteria that can cause serious waterborne or foodborne illness and that are associated with animal manure: *Salmonella, E. coli* O157:H7*, Campylobacter, Yersinia enterocolitica, and Listeria monocytogenes*. This list is not comprehensive, but includes some of the organisms that figure prominently in illness and mortality.

3.1.1.1. Salmonella

Nontyphoidal Salmonellae, the type of *Salmonella* typically associated with the human infection salmonellosis, are found in the gastrointestinal tracts of cattle, poultry, and swine. (The typhoid agents *Salmonella typhii* and *paratyphi* are specific to humans and are therefore not zoonotic). A higher prevalence of *Salmonella* has been detected in larger chicken, dairy cow, and swine animal feeding operations related to increased herd density and size as well as increased shedding of *Salmonella* (Bowman 2009, USEPA 2010a). *Salmonella* prevalence also varies with animal age and type (Soller et al. 2010). The infectious dose for *Salmonella* is estimated to range from 100 to 1,000 cells (Ziemer et al. 2010), and in 2009, nearly 50,000 cases of salmonellosis were reported in the U.S. (CDC 2011b), although that number does not distinguish between foodborne and waterborne cases.

3.1.1.2. E. coli O157:H7

Most strains of *E. coli* bacteria are harmless and live in the intestines of healthy humans and other animals (Rosen 2000). *E. coli* O157:H7, however, is a pathogenic strain of the group enterohemorrhagic *E. coli* (EHEC). This strain is an emerging cause of waterborne and foodborne illness and has been implicated in a number of outbreaks (Table 6-3) (Gerba and Smith 2005). *E .coli* O157:H7 is especially dangerous to young children and the elderly. Similarly to *Salmonella*, a higher prevalence of *E. coli* O157:H7 has been detected in larger dairy cow and swine production operations (Bowman 2009). *E. coli* O157:H7 has been found to be more prevalent in the gastrointestinal system and manure of young calves, lambs, and piglets (Hutchinson 2004, Soller et al. 2010) and appears to colonize cattle for one to two months (Rosen 2000). Prevalence tends to vary by season, increasing during warmer, summer months (Hutchison 2004) and decreasing in colder, winter months (Muirhead et al. 2006). In contrast to *Salmonella*, the infectious dose of *E. coli* O157:H7 is quite low, with estimates of 5 to 10 cells (Ziemer et al. 2010).

3.1.1.3. Campylobacter

Campylobacter jejuni bacteria are commonly transmitted to humans via contaminated water and food (Perdek et al. 2003) and may co-occur with *E. coli* (AWWA 1999). *Campylobacter* prevalence appears to vary depending on the age of the animal, though conflicting results among reports suggest that other environmental (i.e., animal feeding operation size) and animal-specific factors likely influence prevalence. For example, Hutchison (2004) reported higher prevalence of *Campylobacter* in wastes generated by livestock containing young animals (calves, lambs, or piglets), whereas Soller et al. (2010) and USEPA (2010a) reported increased prevalence in older animals. Estimates for infectious dose in humans are generally < 500 organisms (Table 3-1) (Rosen 2000, Pachepsky et al. 2006, Bowman 2009).

3.1.1.4. *Yersinia enterocolitica*

Yersinia enterocolitica causes gastroenteritis and is generally known as a foodborne pathogen (Perdek et al. 2003), although *Yersinia* species are also found in water as well as wild and domestic animals (Rosen 2000). *Yersinia enterocolitica* has been detected in swine feces (Olson 2001). In particular, *Yersinia enterocolitica* O:3 is pathogenic to humans and has been found in the tonsils, oral cavities, intestines, and feces of up to 83% of pigs (Olson 2001); pigs are thus considered a primary reservoir for this pathogen (Rosen 2000). The infectious dose may be in the range of millions of bacteria (Rogers and Haines 2005). *Y. enterocolitica* and other *Y. enterocolitica*-like organisms have been isolated from feces of pigs, cattle, and other animals (Brewer and Corbel 1983).

3.1.1.5. *Listeria monocytogenes*

Listeria monocytogenes causes severe illness, including diarrhea and meningitis. This bacterium is resistant to adverse environmental conditions (i.e., heating, freezing, and drying). Pathogenic strains are found in ruminants in which they can cause disease (Bowman, 2009). *Listeria monocytogenes* is also found in poultry (Chemaly et al. 2008) as well as sheep, pigs, and other animals (Weber et al. 1995). Levels of *Listeria* spp. can vary by season; Hutchinson (2004) reports that it is more likely to be isolated during March to June (Hutchinson 2004). Husu et al. (2010) reported that prevalence in fecal samples is higher during the indoor season than when the animals are at pasture. According to the USFDA (2012a), the infectious dose for humans may vary widely and depends upon a number of factors, including the strain, susceptibility of the host, and the matrix in which it is ingested. It has been reported to be <10,000 (Table 3-1), but USFDA (2012a) notes that for susceptible individuals consuming raw or inadequately pasteurized milk, it may be as low as 1,000 cells.

3.1.2. Parasites

Three selected types of illness-causing parasites that may be present in manure, *Cryptosporidium parvum, Giardia lamblia*, and helminthes (worms) are briefly discussed below. *Cryptosporidium* and *Giardia* cause gastrointestinal illness; infection with helminthes can cause problems that include pneumonia, cysts, or intestinal infections.

3.1.2.1. *Cryptosporidium*

Cryptosporidium parvum is a protozoan parasite that can cause cryptosporidiosis, or gastric and diarrheal illness, in humans (Table 3-1) (Rose 1997). Cryptosporidiosis can be contracted through ingestion of small, hardy oocysts from fecally contaminated drinking water supplies, food, recreational waters, pools, and direct contact with animals (Perdek et al. 2003). There is currently no treatment for Cryptosporidiosis, and it can lead to fatality in vulnerable populations such as the immunocompromised. *Cryptosporidium parvum* is shed primarily by relatively young animals (Rosen 2000, Bowman 2009), and upper age estimates for shedding range from 30 days (Rosen 2000) to six months (Atwill 1995). Prevalence is greater during the summer months (Garber et al. 1994, Scott et al. 1994). Cattle can shed substantial quantities of oocysts; estimates include 10 million (Rosen 2000) to more than one billion oocysts per gram of manure (USEPA 2004a), which is orders of magnitude higher than the infectious dose (Table 3-1) (Bradford and Schijven 2002, Pachepsky et al. 2006).

3.1.2.2. *Giardia*

Giardia lamblia is the most common cause of protozoan infection in humans (Perdek et al. 2003), causing a gastrointestinal illness known as Giardiasis. Giardiasis can be treated with drugs, and it is not considered a fatal illness. *Giardia lamblia* forms a durable egg-like cell called a cyst through which infection is transmitted, typically via ingestion of fecal-contaminated water (Ziemer et al. 2010). *Giardia* may be present in cattle as young as five days old, up to adults, although prevalence peaks when the calves are young. Prevalence has been reported to range from less than 14% to 100% in calves less than six months old (Rosen 2000, Soller et al. 2010). As with *Cryptosporidium*, the infectious dose for *Giardia* is low (10 to 25 cysts) (Pachepsky et al., 2006), and *Giardia* cysts can be shed in large numbers. According to one study, concentrations of *Giardia* cysts can be over 1,000 cysts/g in swine lagoon wastewater (Ziemer et al. 2010).

3.1.2.3. Helminthes

Helminthes are worms that may be parasitic in plants and animals or may be free-living (NRCS/USDA, 2012). Parasitic worms of concern include Platyhelminthes (flatworms) and Nematoda (roundworms). Some (e.g., most flatworms) have complex lifecycles that require several hosts (Rogers and Haines 2005). The most common parasite in humans is *Ascaris lumbricoides*, a large parasitic roundworm for which humans are the definitive host (NRCS/USDA/2012, Ziemer et al. 2010). Important helminthes that infect livestock include *Ascaris suum* and *Trichuris suis* (cattle and pigs) (Bowman 2009). *Ascaris suum* is associated with swine in particular (Ziemer et al. 2010); its eggs are hardy and can survive in soil and feces for years (Olsen 2001). Illnesses caused by *Ascaris* sp. include pneumonia when the worms invade the lungs or intestinal infection (NRCS/USDA 2012). Infection of humans with zoonotic helminthes generally occurs via consumption of raw or undercooked meat rather than through exposure to feces (Ziemer et al. 2010); these organisms are not discussed further in this chapter.

3.1.3. Viruses

A number of viruses, including prevalent enteric viruses that cause gastroenteritis, are present in livestock and poultry and have zoonotic potential. Below are brief descriptions of three common viruses: rotavirus, norovirus, and hepatitis E virus.

3.1.3.1. Rotavirus

Rotavirus is an enteric virus that causes millions of cases of diarrhea in the U.S., primarily in infants and children less than two years of age (Perdek et al. 2003). It has been found in swine, cattle, lambs, and other animals (Cook et al. 2004). There is evidence for zoonotic transmission in that serotypes and genotypes of animal strains have been found in humans, and there is evidence for reassortment (mixing) of genetic material between human and animal rotaviruses (Laird et al. 2003, Cook et al. 2004, Ziemer et al. 2010). The estimated infectious dose for rotavirus is low (10 to 100 virus particles) (Grieg and Todd 2010).

3.1.3.2. Norovirus

Noroviruses are enteric viruses that cause diarrhea in humans as well as livestock in swine and cattle. They are a leading cause of non-bacterial gastroenteritis, estimated to cause more than 90% of outbreaks worldwide (Wang et al. 2006). Swine are believed to serve as an important reservoir for human norovirus, which is closely related to porcine norovirus. Also, there may be reassortment between human and porcine strains (Mattison et al. 2007). A study by Wang et al. (2006) found that noroviruses are found only in finisher hogs, (those ready for slaughter), with a prevalence of 20%. The infectious dose is estimated at 10 to 100 virus particles (Moe et al. 1999).

3.1.3.3. Hepatitis E

Hepatitis E virus (HEV) causes liver inflammation. Humans are the primary reservoir, but swine are also an important reservoir (Perdek et al. 2003, Kasorndorkbua et al. 2005). According to one study, up to 100% of swine tested seropositive for HEV in commercial herds in the Midwestern U.S. (Meng et al. 1997). Another study identified HEV ribonucleic acid (RNA) in about 23% of hogs (Fernández-Barredo et al. 2006). Swine shed the virus for three to four weeks, primarily weaners (hogs being weaned from nursing) and hogs in their first month of feeding (Kasorndorkbua et al. 2005). Swine and human HEV are closely related (Meng et al. 1997). Researchers have noted cross-species infections of human and swine HEV (e.g., Ziemer et al. 2010). The infectious dose is not known (PHAC 2010), nor is its survival in manure known (Ziemer et al. 2010).

3.2. Pathogens by Livestock Type

Several of the major zoonotic pathogens, including those described in the previous section, are associated with more than one type of livestock, although the health risks that they pose may vary depending upon the species and prevalence. The following subsections briefly summarize which pathogens associated with cattle, swine, and poultry may cause illness in humans.

3.2.1. Cattle

Beef and dairy cattle are carriers of several zoonotic pathogens including *E. coli* O157:H7, *Cryptosporidium parvum*, *Giardia lamblia*, *Campylobacter*, *Leptospira*, various enteroviruses, norovirus, *Listeria monocytogenes*, and *Salmonella* (Cotruvo et al. 2004, Bowman 2009) (Table 3-1). The prevalence of some pathogens has been found to be greater in larger herds (e.g., Bowman 2009, USEPA 2010a; subsections 3.1.1 and 3.2.1). Cattle are an important reservoir of *E. coli* O157:H7, and any herd may contain asymptomatic animals. Estimates of *E. coli* O157:H7 prevalence vary widely. According to a study published for the World Health Organization (WHO), an estimated 30% to 80% of cattle carry *E. coli* O157:H7 (Cotruvo et al. 2004). In contrast, a study of cattle in 13 U.S. states showed that less than 2% of cattle tested positive for the organism (Dargatz 1996). Other estimates range from about 3% to 28% (Table 3-1; see text box). Cattle are also considered to be a significant source of potential human infection with *Giardia lamblia* (Bowman 2009) and *Cryptosporidium parvum* (Table 3-1).

E. Coli O157:H7 in Cattle

E. coli is found frequently among cattle operations. A 1997 survey of 100 feedlots in the U.S. found *E. coli* O157:H7 in 63% of the feedlots tested. However, only 1.8% of manure samples tested positive at these feedlots. Another study found that as many as 28% of beef cattle were shedding *E. coli*. O157:H7, and more than 43% of carcasses tested positive for the bacterium (References: Hancock et al. 1997, Bowman 2009).

3.2.2. Swine

Swine are hosts to a large number of pathogens including *Campylobacter*, *Yersinia enterocolitica*, *Giardia*, *Salmonella*, *Cryptosporidium, E. coli* O157:H7, *Leptospira*, *Balantidium coli*, *Listeria,* and viruses (rotavirus, norovirus, HEV) (Perdek et al. 2003, Rogers and Haines 2005, Mattison et al. 2007, Ziemer et al. 2010, USEPA 2010a). A U.S. survey found that about 80% of pigs older than three months test positive for HEV (Bowman 2009). Swine urine is a potentially important source of *Leptospira*, which has been implicated in waterborne infections (Bowman 2009). Swine *Cryptosporidia* present a lower risk to humans because the species they carry are specifically adapted to swine as a host (USEPA 2010a). These pathogens may be transmitted to humans either through direct contact with swine waste (e.g., workers at an animal feeding operation) or indirectly through the environment (e.g., swimming in manure-contaminated water or consuming contaminated drinking water).

3.2.3. Poultry

Salmonella and *Campylobacter jejuni* are highly prevalent among poultry in the U.S. (USEPA 2010a), and the serotypes are similar to those implicated in human infections (Ziemer et al. 2010; Rogers and Haines 2005). *Campylobacter butzleri*, now *Arcobacter butzleri*, has also been isolated in poultry (Houf et al. 2003). Chickens do not pose a risk for humans with respect to *Cryptosporidium* and *Giardia;* the *Cryptosporidium* species that infect chickens are a low risk to humans, and chickens do not appear to carry *Giardia* (USEPA 2010a).

Campylobacter in Poultry

Campylobacter is found in the intestines of both wild and domestic animals, especially poultry. Flocks may approach 100% infection rates in poultry facilities. *Campylobacter* is commonly (>50%) found in chicken manure and is also associated with swine and, to a lesser degree, cattle manure. The pathogen is typically transmitted via contaminated water and food. *Campylobacter* may co-occur with *E. coli.* (References: AWWA 1999, Cox et al. 2002, Perdek et al. 2003, USEPA 2010a).

3.3. Occurrence of Pathogens in Water Resources

In the USEPA's 2004 National Water Quality Inventory (USEPA 2009c), microbial contamination was a leading cause of impairment in rivers and streams, with agriculture identified as an important contamination source. Microbial constituents may reach surface water bodies via wet weather flows from animal feeding operations or areas where manure has been land applied or when lagoons are breached. A number of studies have specifically documented effects from pathogens and indicator organisms (see Section 3.1). For example, fecal coliforms and *Streptococcus,* both indicators, have been found in agricultural runoff (Simon and Makarewicz 2009), through which these microorganisms may reach surface water bodies, sometimes contributing to exceedances of water quality standards and possibly to exceedances of permit limits (Baxter-Potter and Gilliland 1988, USEPA 2002b). Work by Kemp et al. (2005) documented *Campylobacter* in surface water due to runoff from dairy farming. In grazing areas, free access of cattle to streams allows manure to reach the water and has been associated with elevated stream bacterial concentrations, with up to 36-fold increases in *E. coli* reported in stream water samples compared to upstream levels (Schumacher 2003, Vidon et al. 2008, Wilkes et al. 2009). Among the protozoa, *Cryptosporidium* oocysts may be carried in runoff, especially after rain events, and *Giardia* cysts have been detected in surface waters as well as ground water (Cotruvo et al. 2004). A study of *Giardia* and *Cryptosporidium* in 66 surface water drinking water sources revealed *Giardia* cysts in 81% of raw water samples and *Cryptosporidium* oocysts in 87% of raw water samples (LeChevallier et al. 1991). Although in general, contamination of water bodies from viruses in manure is less well understood, some authors (e.g., Payment 1989, Rosen 2000, Ziemer et al. 2010) have noted that runoff or waste from lagoons can supply viruses to water bodies (Payment 1989, Rosen 2000, Ziemer et al. 2010). Microbial populations are also found in bottom sediments. They can be present in higher concentrations than in the overlying water column because of the tendency of microbes to associate with particles that settle and because of their improved survival in sediments (see subsection 3.4.2 on factors influencing pathogen survival) (van Donsel and Geldreich 1971, Davies-Colley et al. 2004). *E. coli* and fecal coliform concentrations in sediments have been reported as high as 10^5 colony forming units per 100 mL (Crabill et al. 1999). When resuspension occurs due to rainstorms or dredging, microorganisms can be released from sediments to the water column (Kim et al. 2010). Spikes in waterborne fecal indicator bacteria have been observed after rainfall (Cho et al. 2010).

Although soil cover and the unsaturated zone provide protection to ground water with respect to pathogen contamination (see subsection 3.5.2), microorganisms can reach ground water. When they do, they may travel downgradient, with the rate of travel depending upon the geologic and hydrogeologic properties of the aquifer. Enteric viruses have been observed to be transported via ground water (Rogers and Haines 2005), and a nationwide survey of drinking water wells revealed enteroviruses in 15% of samples (Abbaszadegan et al. 2003). Bacteria and *Cryptosporidium* oocysts are also believed to have the potential to be transported in ground water; one study documented *E. coli* contamination of ground water downgradient from an unlined cattle manure lagoon (Withers et al. 1998). Ground water in karst areas is particularly vulnerable to contamination because of the channelized nature of the rock, which allows rapid flow and may transport pathogens greater distances. While shallow unconfined aquifers are most vulnerable to contamination, deep, confined aquifers may also be vulnerable to pathogen contamination where there are fractures in the confining layer or from transport along poorly cemented wells (Borchardt et al. 2007).

Table 3-2. Survival of selected bacterial and parasitic pathogens found in manure, soil, and water.

Pathogen	Survival (days)*		
	Soil	Water	Manure
Bacteria			
Salmonella spp.	16 - 196	35 to >186	20 to 250
E. coli 0157:H7	2 to >300	35 to >300	50 to >300
Campylobacter sp.	7 to 56	2 to >60	1 to 56
Yersinia enterocolitica	10 to >365	6 to 448	10 to >365
Listeria sp.	<120	7 to >60	>240
Protozoa			
Cryptosporidium spp.	28 to >365	70 to >450	28 to >400
Giardia	< 1 to 28	< 1 to 77	< 1 to 77

**The range shows the shortest and the longest survival time the organisms can survive at different temperatures for all types of manure (cattle, swine and poultry) and water (surface, ground, and drinking water). References: Rogers and Haines 2005, and Bowman 2009.*

3.4. Survival of Pathogens in the Environment

The potential adverse impacts on humans from zoonotic pathogens is directly related to the organisms' survival in various environmental media such as manure, soil, sediments, surface water, and ground water (Cotruvo et al. 2004). Survival of zoonotic pathogens in animal manure and in the environment can range from days to years (Ziemer et al. 2010) depending upon the characteristics of the pathogen and the environmental conditions (Rogers and Haines 2005). The survival capabilities of *Cryptosporidium* oocysts deserve particular mention because of their long survival times in the environment (Ziemer et al. 2010), their resistance to conventional drinking water disinfection processes (chlorine and chlorine dioxide; see Chapter 7) (Edzwald 2010), and the lack of any treatment for human infection. *Cryptosporidium* oocysts can remain viable in a range of environmental settings and can persist in damp conditions for months (Brookes et al. 2004, Ziemer et al. 2010).

The persistence of pathogens in environmental media depends on environmental conditions and the survival characteristics of the microbes present. The factors influencing pathogen survival include temperature, ultraviolet (UV) radiation, moisture, pH, nutrient availability, ammonia concentration in the medium, predation, and competition for nutrients (Rogers and Haines 2005). The sections below include a brief overview of the factors that affect the survival of pathogens in manure, soil, sediments, and water, providing examples relevant to bacteria, protozoa, and viruses.

3.4.1. Manure

Manure can provide a favorable environment for pathogen survival and even re-growth due to the availability of nutrients as well as protection from UV radiation, desiccation, and temperature extremes (Rogers and Haines 2005). Conversely, several factors promote die-off in manure, including predation, competition, and the concentration of inorganic ammonia (Rogers and Haines 2005). Temperature in particular is a critical factor in pathogen survival, with cooler temperatures generally enabling longer survival times. Bacterial pathogens such as *Salmonella* and *E. coli* O157:H7 can survive for several months in manure when environmental conditions are favorable (low temperatures, good moisture level) (Rogers and Haines 2005). Increased temperatures, on the other hand, hasten die-off. The extent of this effect varies by organism, but survival in manure generally drops markedly at temperatures exceeding 20 to 30°C compared with survival at cool temperatures (1 to 9°C) (Rogers and Haines 2005). This dependence of survival times on temperature results in seasonal trends; for example, a study of *Salmonella typhimurium* in swine slurry showed survival times of 26 days during summer and 85 days during winter (Venglovsky et al. 2009). As described further in Chapter 8, microorganisms can be inactivated when using certain manure management practices, such as composting, which produces elevated temperature (Olson 2001, Schumacher et al. 2003).

The effects of freezing on pathogen survival vary by organism. Viruses can maintain infectiousness after freezing (Ziemer et al. 2010). *Cryptosporidium* oocysts have been shown to survive freezing in manure and soil for more than three months to one year, but *Giardia* cysts are inactivated (Olson 2001, Rogers and Haines 2005). *Salmonella* is also not inactivated by freezing (Olson 2001). However, the stress of repeated freeze-thaw cycles does generally reduce microbial survival (Rosen 2000).

Compared to bacteria and protozoa, less research has been conducted on the survival of viruses in manure. The available literature, however, suggests that viruses may survive longer than bacteria (Rogers and Haines 2005). For example, extended manure storage (two years) may be required to achieve a 4-log (10,000 fold) reduction in the concentrations of some viruses such as rotavirus (Pesaro et al. 1995). More research is needed on virus survival in manure given the potential for viruses to enter into soil when manure is spread on land and there is a possibility of transport to water and drinking water sources via runoff.

3.4.2. Soils

In soils, pathogen survival is influenced by temperature, moisture content, pH, predation, nutrient availability, competition with native soil microorganisms, and organic matter content (Rosen 2000, Unc and Goss 2004). Aside from temperature, moisture exerts an important control, with increased moisture promoting survival (Reddy et al. 1981, Unc and Goss 2003, Venglovsky et al. 2009). Fecal coliform bacteria survive longer in organic soils than in mineral soils, possibly due to the greater capacity of organic soils to hold water (Unc and Goss 2003). Desiccation decreases the survival of *Cryptosporidium*, *Giardia*, fecal bacteria such as *Campylobacter* (Olson 2001, Rogers and Haines, 2005, Bowman 2009), and viruses (Bosch et al. 2006). Predation by native soil organisms can contribute to pathogen removal and has been identified as one of several biological factors in pathogen inactivation that merit further study (Bosch et al. 2006, Rogers and Haines 2005). For viruses, survival in soils has been found to be increased by adsorption to soil as well as decreased soil pH; the pH effect is likely due to greater adsorption of viruses to particles at lower pH (Hurst et al. 1980). For bacteria, however, low pH reduces survival (Unc and Goss 2004).

Exposure to UV light from direct sunlight, such as during land application, can contribute to microbial die-off and is discussed further below. In manure and in soil, microorganisms will associate with particulates, where they are protected from sunlight within the soil profile (e.g., Thurston-Enriquez 2005), especially if manure is worked into soil during application. At the soil surface, however, microbes will be vulnerable to inactivation due to sunlight as well as desiccation (Tyrrel and Quinton 2003).

3.4.3. Sediments

Bottom sediments in manure lagoons or natural waters can serve as a very effective reservoir for pathogens because the sediment environment provides moisture, soluble organic matter, and nutrients as well as protection from UV light, desiccation, and predation by protozoa (Rogers and Haines 2005, Cho et al. 2010, Kim et al. 2010). Microorganisms can survive in this environment for long periods of time; fecal bacteria have been shown to survive in sediments from weeks to months (Schumacher et al. 2003, Cho et al. 2010).

3.4.4. Water Resources

Pathogen survival in water depends upon a variety of factors including water quality (e.g., turbidity, dissolved oxygen, pH, organic matter content) and environmental conditions (i.e., temperature, predation by zooplankton). Survival times for *Giardia* and *Cryptosporidium* can be quite long (Ziemer et al. 2010); *Cryptosporidium* oocysts can survive from months to more than a year in cold water (5°C) (Ziemer et al. 2010; Olson 2001, Cotruvo et al. 2004, Rogers and Haines 2005). Giardia cysts survive less than 14 days at 25°C but could survive up to 77 days at 4 to 8°C (Ziemer 2010). Enteric viruses, such as the hepatitis E virus and hepatitis A virus tend to be stable in water, especially in colder temperatures (Cotruvo et al. 2004).

Some bacteria (e.g., *Campylobacter* and *E. coli)* can enter a viable but non-culturable state, in which the bacteria's metabolism slows and it cannot be grown in culture media, but it retains infectiousness (Perdek et al. 2003). The viable but non-culturable state can be brought about by low temperatures and stress from starvation, but the cells will reactivate under favorable conditions (e.g., increased temperature). This state has implications for monitoring and may cause contamination to be missed during sampling if culture methods are used for analysis.

As with pathogen survival in manure and soil, exposure to UV light is a key factor in bacterial, viral, and protozoan die-off in surface waters (Rosen 2000, Cotruvo et al. 2004, Fong and Lipp 2005). For example, UV light can cause a reduction of up to four orders of magnitude in the viability of *Cryptosporidium* (Bowman 2009). Ultraviolet light has also been demonstrated to be effective against human enteric viruses and bacteriophages (Kapuscinski and Mitchell 1983, Fujioka and Yoneyam 2002, Battigelli et al. 1993). Greater turbidity of the water, however, affords microorganisms some protection from UV light, and an aquifer environment also protects pathogens against UV exposure and facilitates their survival in ground water.

3.5. Transport of Pathogens in the Environment

Pathogens and indicator organisms associated with manure can be transported to surface water and ground water through runoff, discharges, infiltration, and atmospheric deposition (Jawson et al. 1982, USEPA 2002b, Soupir and Mostaghimi 2011). Lagoon spills and flooding of constructed treatment wetlands during severe rainstorms or lagoon leaks and equipment failures during dry weather may also release waste and associated pathogens into the environment (Marks 2001, USEPA 2002b, Rogers and Haines 2005). Tile drainage may also provide a route for microbes in ground water to reach surface waters (Rogers and Haines 2005). The sections below briefly discuss considerations related to transport in runoff, soil infiltration, and transport in ground water.

3.5.1. Runoff and Transport to Surface Water

A key mechanism of pathogen transport to surface waters is via runoff (overland flow from rain or snowmelt, or releases from manure pond leaks/overflows). During a rain event, for example, the partitioning of flow between surface runoff and infiltration through the soil depends upon a number of factors. Storm intensity and duration, soil hydraulic characteristics (e.g., permeability, antecedent moisture and temperature), land slope, and soil cover have all been shown to influence runoff and therefore pathogen transport (Rosen 2000, USEPA 2002b). If rainfall intensity exceeds the capacity of the soil to infiltrate water, overland flow occurs, and microorganisms can be carried rapidly in surface runoff (Tyrrel and Quinton 2003, Unc and Goss 2003). Clay-rich soils also tend to promote surface runoff due to their low permeability. Additionally, bare soil with heavy animal traffic can contribute substantial pathogen loads to runoff through erosion of pathogen-laden soil particles (Rosen 2000).

To be available for transport in runoff, pathogens are released from the manure. Most pathogens do remain associated with the fecal deposit during rain events (NRCS/USDA 2012). The amount of pathogens that are released from manure depends upon a number of factors related to the manure itself and the method of application. Important factors include the loading of pathogens in the manure, the pathogen types and survival characteristics, and the age and source of the manure. Aging can greatly reduce the amount of microorganisms that leach out of the manure, due at least in part to declines in the fecal loads in the manure with time and environmental exposure (NRCS/USDA 2012).

The form of manure (solid versus liquid) may affect how easily pathogens reach waterways (e.g., Thurston-Enriquez et al. 2005), with liquid application permitting ready transport via runoff. Also, the amount applied and the style and timing of application will have effects. If manure is applied to frozen ground or immediately before or after a rain event, there will be a greater chance for pathogen transport in runoff. There is uncertainty and limited information, however, regarding whether the method of application (surface application vs. injection) affects runoff quality. Injection may limit runoff from the surface, but UV radiation, heat, and desiccation on the surface would promote die-off. Tyrrel and Quinton (2003) note that some studies have shown no difference in water quality but that their own unpublished data for small scale rain simulation events showed greater (10-fold) fecal coliform transport if waste is surface-applied.

Once pathogens and indicator organisms reach rivers and streams, their transport will be governed by a number of factors including channel morphology, streambed composition, and turbulence and flow regimes (NRCS/USDA 2012). Transport of up to 21 kilometers has been reported for bacteria that were experimentally added to a stream. Microorganisms can be transported either as free organisms (Soupir and Mostaghimi 2011) or associated with soil or manure particles (USEPA 2002b, Pachepsky et al. 2006, Bowman 2009), with free cells in suspension having the potential to travel farther because their small size minimizes settling (Tyrrel and Quinton 2003). Free-living organisms may be added to the streambed sediments when water infiltrates into the streambed (NRCS/USDA 2012).

The amounts of pathogens that become associated with particulates in runoff and surface waters will vary by organism, source, and the particulates available. Studies of stormwater as well as stream and estuarine settings have reported 15% to 35% of bacteria to be associated with particles (Characklis et al. 2005, Cizek et al. 2008, Suter et al. 2011). Also, large fractions of *Giardia* and *Cryptosporidium* (60% and 40%, respectively) have been found to be bound to sediment in streams (Cizek et al. 2008). Microorganisms attached to larger soil particles may settle, especially in quiescent waters, contributing to pathogen loads in bottoms sediments (Rogers and Haines 2005). Microorganisms associated with colloids (very small particles that do not settle) will continue to be transported downstream.

3.5.2. Transport through Soil to Ground Water

Transport through the soil profile and in ground water involves an extremely complex interplay of physical and chemical processes that depend upon the size and surface properties of the microorganism; the composition, mineral surface properties, and texture of the soil or aquifer material; the composition of the aqueous medium; and the hydraulic conditions (e.g., saturated vs. unsaturated flow). The following subsections briefly describe some of the features controlling microbial transport and retention.

3.5.2.1. Physical Processes (Filtration and Flow through Soil)

Soil generally provides some degree of protection to ground water resources from pathogens by retaining them through physical processes (straining/filtering) and/or through adsorption, particularly in the upper layers of the soil (see subsection 3.5.2.2) (Bicudo and Goval 2003). Fine-grained soils, such as those with greater silt and clay, are most effective at filtering larger bacteria and protozoa (Rosen 2000, Jamieson et al. 2002). Because of their small size, viruses are less likely to be retained in the soil by filtration than bacteria or protozoa (Rosen 2000, USEPA 2004a), although they may be removed by adsorption (see subsection 3.5.2.2). Their small size also renders viruses relatively mobile in ground water (USEPA 2004a).

During heavy rainfall, transport through the soil may be rapid if there is enough water to fill the pore spaces, and microbes may reach the water table more quickly than during lighter rainfall (Unc and Goss 2003, Rosen 2000, USEPA 2004a). Preferential transport may occur through macropores, wormholes, and root channels (Jamieson et al. 2002, USEPA 2004a), bypassing the filtering effect of the soil matrix (Rosen 2000). Wormholes and root channels can be reduced by conventional tillage, but they are not disturbed by conservation tillage or in pasturelands (Bowman 2009). Conditions especially conducive to microbial contamination of ground water include a combination of recent manure application on land with coarse, sandy soil or soil with macropores and a shallow water table (USEPA 2004a, Bowman 2009). Once in ground water, pathogen transport may be particularly rapid in fractured rocks or karst areas because of large channels in the rock.

3.5.2.2. Retention by Adsorption in Soil and Aquifers

Adsorption/desorption interactions are extremely important in governing the mobility of microbes. For example, viruses may be removed by adsorption in the first few inches of soil during infiltration, although rainfall can later cause desorption of viruses from the soil, allowing for continued transport and continued contamination (Landry et al. 1979, Goyal and Gerba 1979). Parasites may also be retained. In an experimental study with intact soil cores, *Cryptosporidium parvum* oocysts were mostly retained in the soil within the upper 0.75 inch of soil (Mawdsley et al. 1996), although the authors note that the study was done using purified oocysts, which may not be representative of oocysts in the environment. A number of studies have focused on understanding bacterial sorption to soils and aquifer sediments, with soil and ground water chemistry both playing important roles (e.g. Hendricks et al. 1979, Scholl and Harvey 1992, Banks et al. 2003).

The soil and aquifer characteristics that promote microbial adsorption are: a high clay content, high iron oxyhydroxide and aluminum oxide content, high organic matter, and pH below 7 (e.g., Goyal and Gerba 1979, Rosen 2000). Bacteria tend to adsorb well to ferric oxyhydroxide coatings on clay minerals or quartz through electrostatic attraction (Mills et al. 1994). Organic carbon in the soil contributes to retention of viruses and bacteria due to hydrophobic partitioning (e.g., Rogers and Haines 2005). Furthermore, manure application changes soil pH and adds salts as well as soluble and insoluble organic compounds, altering properties of both the soil and microbes and potentially affecting retention of microbes by the soil (Unc and Goss 2004).

Soil water or ground water characteristics that affect adsorption include pH, ionic strength, divalent cation concentrations, and dissolved organic carbon. Adsorption of viruses to soil particles is enhanced by low pH or increased ionic strength of the water (Rogers and Haines 2005). For bacteria, an increase in ionic strength, particularly due to high divalent cation concentrations, has been shown to increase retention in a sandy medium (e.g., Mills et al. 1994). Dissolved organic matter, on the other hand, has been found to hinder virus adsorption (e.g., Goyal and Gerba 1979, Lance and Gerba 1984). If application of liquid manure or leaching of solid manure by rainfall changes the ionic strength and/or organic carbon content of the soil water or ground water, the capability of the soil or aquifer system to retain microorganisms may change.

3.6. Summary and Discussion

Livestock and poultry manure can carry an array of zoonotic pathogens, which can be transported to recreational and drinking water resources. The most common pathogens of concern are *E. coli* 0157:H7, *Campylobacter*, *Salmonella*, *Cryptosporidium parvum*, and *Giardia lamblia*. Other zoonotic organisms include *Listeria* and *Yersinia*, and several viruses may have zoonotic potential (see text box). Infectious doses vary widely among pathogens, and some doses are very low, especially those for *E. coli* O157:H7 (5 to 10 cells) and the protozoa *Cryptosporidium parvum* and *Giardia lamblia* (as low as 10 cysts or oocysts; Table 3-1).

Selected Key Pathogens Associated with Livestock

Pathogen	Cattle	Poultry	Swine
E. coli O157:H7	X		X
Salmonella spp.	X	X	X
Campylobacter spp.	X	X	X
Yersinia entercolitica			X
Listeria spp.			X
Cryptosporidium parvum	*X*		
Giardia lamblia	X		X
Rotavirus	X		X
Norovirus	X		X
Hepatitis E virus			X

Minimizing the potential for human illness from pathogens in manure requires understanding the survival characteristics of the various pathogens. Survival times in manure and in the environment can range from days to years depending on the pathogen, the medium, and environmental conditions. Among the common zoonotic pathogens, however, *Cryptosporidium* is noteworthy because of its persistence, resistance to disinfection, and the lack of treatment for the illness it causes. It has been the causative agent of several large outbreaks for which manure has been identified as a possible source. Less is known about virus survival, and continued research is needed on virus occurrence, survival, and transport in environmental media.

Because of the different survival capabilities of the various pathogens, different manure management methods may be needed depending upon the pathogens anticipated; this is an area where further research is warranted. Composting of manure, especially when properly aerated, is an effective management practice that can generate the heat needed to inactivate a number of pathogens, including *Salmonella*, *Campylobacter*, *E. coli*, and protozoa. Ultraviolet light promotes die-off, and spreading manure on the surface during land application can promote greater die off through exposure to UV light and desiccation, although the manure is more susceptible to mobilization via runoff. Additional discussion of management methods is provided in Chapter 8.

Transport of pathogens may occur via runoff, air deposition, or infiltration into soils. The likelihood of significant transport of pathogens in runoff is increased where soils have low permeability or moderate to high antecedent moisture conditions, temperatures are below freezing, there is tile drainage, the slope of the land is steep, and rainfall is intense. Timing of manure land application is an important factor in minimizing pathogen transport via runoff. For example, avoiding application on frozen or snow-covered ground, during early spring runoff, when the land is saturated, or when the forecast calls for sufficient precipitation to produce runoff will help minimize pathogen loadings to surface water (Olson 2001). Transport of microorganisms in runoff is more likely if excess manure is applied or if manure is misapplied (USEPA 2002a). Once runoff reaches surface water bodies, microbes may become associated with bottom sediments if they are adsorbed to particles large enough to settle. Pathogens can, however, be reintroduced to the water column by resuspension after heavy rain events or human activities such as dredging.

During infiltration through soil, the upper layers of soil generally provide some removal of microbes through adsorption. The possibility of removal during transport through soil depends upon hydraulic conditions, soil texture and structure, soil composition, soil water composition, and microbial size and properties. Ground water is most vulnerable to contamination when manure is applied before a heavy rainstorm in an area with coarse, sandy soil and a shallow water table. Clayey soils may also promote transport to ground water if they have macropores and root channels.

4. Antimicrobials in Manure

Livestock and poultry are often given antimicrobials (i.e., antibiotics and vaccines) to treat and prevent diseases, as well as to promote animal growth and feed efficiency. Many of the antimicrobials administered to livestock and poultry are also used in human clinical medicine. Research indicates that sub-therapeutic use of antimicrobials can select for antibiotic resistance in bacteria. The purpose of this chapter is to provide estimates of the quantity and types of antimicrobials administered to livestock and poultry, and on aquaculture operations. Section 6.3 is a follow-up to this chapter, providing information on the extent of, and potential risks associated with, antimicrobial resistance related to livestock antimicrobial use.

4.1. Introduction

Antimicrobials have been administered to livestock and poultry for over 60 years (Libby and Schaible 1955). At therapeutic doses, antimicrobials help treat and prevent diseases and outbreaks. Administering antimicrobials at sub-therapeutic levels can enhance nutrient adsorption and limits the growth of microorganisms that may compete for nutrients, allowing the animal to grow to market weight more quickly, with less feed (MacDonald and McBride 2009).

Approximately 60% to 80% of livestock and poultry routinely receive antimicrobials through feed or water, injections, or external application (NRC 1999, Carmosini and Lee 2008). The majority of the antimicrobial use is estimated to be used for animal growth rather than for medicinal reasons, and many of these medications are also used in human clinical medicines (Mellon et al. 2001). Estimates suggest that as many as 55% of antimicrobial compounds administered to livestock and poultry are also used to treat human infections (Table 4-1) (Benbrook 2001, Kumar et al. 2005, Lee et al. 2007). The sub-therapeutic use of antimicrobials in livestock and poultry can facilitate the development and proliferation of antimicrobial resistance (Sapkota et al. 2007). Additionally, according to Boxall (2008) and Zounková et al. (2011), antimicrobials and their biologically active degradates may be discharged to the environment from livestock and poultry manure or, in the case of aquaculture, discharged directly to surface waters, potentially impacting aquatic life. The overlap between livestock and human antimicrobial use has been noted by the WHO and others as an area of concern for human health, because the effectiveness of these medications in treating human infections may be compromised (WHO 2000, Levy and Marshall 2004, Sapkota et al. 2007).

- ✓ Over 29 million pounds of antimicrobials were sold for livestock use in 2010 in the US – an estimated 3 to 4 times more than the amount used by humans.
- ✓ 60% to 80% of livestock routinely receive antimicrobials, the majority of which are estimated to be used for animal growth, rather than for medicinal purposes.
- ✓ The WHO has noted that sub-therapeutic antimicrobial use by livestock and poultry is an area of concern because of the selection for antimicrobial resistance.
- ✓ Antimicrobials generally do not biodegrade easily and may be more mobile in aquatic environments.

Table 4-1. Select antimicrobials that are approved for use by the U.S. Food and Drug Administration for use in humans, livestock, and poultry.

Class/Group	Antimicrobial	Humans	Beef Cattle	Dairy Cows	Swine	Poultry	Aquaculture
Aminocyclitol	Spectinomycin	X	X	X	X	X	
Aminoglycoside	Apramycin	X			X		
	Gentamicin	X	X		X	X	
	Neomycin	X	X	X	X	X	X
	Streptomycin	X	X	X	X	X	
β-lactam	Amoxicillin	X	X	X	X		
	Ampicillin	X	X		X		
	Cloxacillin	X	X	X			
	Penicillin	X	X	X	X	X	
Lincosamide	Lincomycin	X			X	X	
Macrolide	Erythromycin	X	X	X	X	X	
Polypeptide	Bacitracin	X	X		X	X	
Polyene	Nystatin	X				X	
Sulfonamide	Sulfadimethoxine	X	X	X		X	X
Tetracycline	Oxytetracycline	X	X	X	X	X	X
	Tetracycline	X	X	X	X	X	

**This table is not meant to be all-inclusive, and not all antimicrobials included in this table are listed in the individual livestock tables that follow. For a complete listing of antimicrobials approved for human and livestock use, visit the USFDA's website.*

4.2. Estimates of Antimicrobial Use

Quantifying livestock antimicrobial use is challenging and estimates vary widely because there are no publicly-available, reliable antimicrobial use data for food-producing animals (USGAO 2011a). Pharmaceutical companies are also not required to disclose veterinary drug sales information (Shore et al. 2009), and the types used at operations may be deemed proprietary information (Sapkota et al. 2007). Furthermore, use estimates based on dose rates can be complicated. While recommended antimicrobial doses for individual livestock and poultry range from 0.05 to 3.5 ounces per 1,000 pounds of feed (depending on the animal type and life stage), it is not uncommon for feed to contain more than the recommended dose (McEwen and Fedorka-Cray 2002, Kumar et al. 2005). For example, Dewey et al. (1997) reported that 25% of over 3,000 swine facilities studied in the U.S. supplied antimicrobials at concentrations greater than the recommended dose.

Estimating livestock and poultry antimicrobial use is also challenging because of the varying degrees of usage on different farms. For therapeutic applications, animals may be treated individually or as groups. Group application can be related to increased disease susceptibility in larger operations where livestock and poultry live in close confinement, facilitating infection and disease transfer (McEwen and Fedorka-Cray 2002, Kumar 2005, Becker 2010). In large livestock and poultry operations, antimicrobials may be administered to animals continuously or for extended periods of time at sub-therapeutic doses (e.g., in feed and water), because this approach is more efficient and sometimes the only feasible method of production (McEwen and Fedorka-Cray 2002). According to the USDA, 20% of swine feeder/finisher farms with less than 100 swine administered antimicrobials sub-therapeutically, whereas 60% of operations with 2,500 or more swine administered antimicrobials (MacDonald and McBride 2009). Antimicrobial use in aquaculture operations involves administration to the entire group by adding the antimicrobials directly to the water or via medicated feed pellets, which are added to the water (Zounková et al. 2011).

Recognizing the importance of quantifying livestock and poultry antimicrobial use, the U.S. Government Accountability Office (USGAO) has been advocating for better tracking and reporting mechanisms of antimicrobial use in livestock and poultry since 1999 (USGAO 2011a). In accordance with a 2008 amendment to the Animal Drug User Fee Act, the USFDA released estimates of the annual amount of antimicrobial drugs sold and distributed for use in livestock and poultry in 2009 and 2010 (USFDA 2010 and 2011a). The USFDA estimates that approximately 29.2 million pounds of antimicrobials were sold for livestock and poultry use in the U.S. in 2010 (USFDA 2011a), or a 62% increase over 1985 use estimates (U.S. Congress, OST 1995). Tetracyclines and ionophores were the largest class of antimicrobials reported, accounting for over 70% of all livestock and poultry antimicrobials sold during that year (USFDA 2011a). Overall, estimations of annual antimicrobial use in food animals in the U.S. range from 11 to 29.2 million pounds as reviewed in Table 4-2.

Given that many human health antimicrobials are also administered to livestock and poultry, and subtherapeutic use can select for resistance (Sapkota et al. 2007), it is important to understand the ratio between livestock and human antimicrobial use. The USFDA's (2010) reported sales of livestock and poultry antimicrobial use (approximately 28.8 million pounds in 2009) is estimated to be four times greater than what is used for human health protection (approximately 7.3 million pounds in 2009) (Loglisci 2010). A slightly higher ratio between livestock and human antimicrobial use was reported by Mellon et al. (2001), which estimated that livestock and poultry antimicrobial use in 1997 represented 87% of all antimicrobials used in the U.S.

The following subsections review antimicrobial use for cattle (beef and dairy), swine, poultry, and aquaculture to provide information on common diseases and infections that affect each animal type, and also provide estimates of the extent of antimicrobial use for therapeutic and sub-therapeutic purposes. Table A-10 in Appendix 2 summarizes animal life stages and definitions.

Table 4-2. Estimates of antimicrobial use or sales for livestock in the U.S.

Total Mass Used/Sold	Specific Use	Source
11 million pounds sold (in 1985)	Not Reported	Swartz 1989
18 million pounds used (in 1985)	12.2% for treating disease 63.2% for disease prevention 24.6% for growth promotion	U.S. Congress, Office of Technology Assessment 1995
29.6 million pounds used (in 1997)	7% for treating disease 93% for growth promotion and disease prevention	Mellon et al. 2001
17.8 million pounds used (in 1998)	83% for prevention and treating disease 17% for growth promotion	Animal Health Institute 2000
28.8 million pounds sold (in 2009)	Not Reported	U.S. Food and Drug Administration 2010
29.2 million pounds sold (in 2010)	Not Reported	U.S. Food and Drug Administration 2011a

Adapted from Rogers and Haines (2005).

4.2.1. Cattle (Beef and Dairy)

Beef cattle can be administered antimicrobials to treat or prevent common ailments such as respiratory disease (shipping fever and pneumonia), liver abscesses, bacterial enteritis (diarrhea), and coccidiosis (Table 4-3). Farming operations also administer prophylactic antimicrobials to beef cattle to promote feed efficiency and animal growth. An estimated 83% of beef cattle operations administered antimicrobials through animal feed or water for either animal growth or therapeutic purposes in 1999 (USDA 2000). During that same year, nearly all small (99%) and all large (100%) cattle feedlots used at least one parasiticide (USDA 2000). Parasiticides, such as ivermectin and doramectin, for example, are not antimicrobials but are used to kill parasites. A more recent USDA survey found that nearly 70% of beef cattle and calf operations vaccinated their animals and almost 70% of operations administered oral or injectable antimicrobials for disease treatment during 2007-2008 (USDA 2010b). Beef cattle operations with 200 or more cattle are more than twice as likely to vaccinate for bovine viral diarrhea virus (BVDV) than smaller operations with less than 50 cattle (USDA 2010b). Table 4-3 presents commonly used antimicrobials in beef cattle and their intended use.

Table 4-3. Commonly used antimicrobials administered to beef cattle.

Class/Group	Antimicrobial	Life stage	Intended Use
Aminoglycoside	Gentamicin*, Neomycin*, Streptomycin*	Cattle	• Treat bacterial enteritis and pink eye
β-lactam	Amoxicillin*, Ampicillin*, Penicillin*	Cattle and calves	• Treat respiratory disease, bacterial enteritis, and foot rot • Promote animal growth
Bambermycin	--	Cattle (slaughter, feedlot)	• Promote feed efficiency and animal growth
Fluoroquinolone	Enrofloxacin	Cattle	• Treat respiratory disease
Ionophore	Lasalocid, Monensin	Unspecified	• Control coccidiosis • Control liver abscesses • Promote feed efficiency and animal growth
Macrolide	Erythromycin*, Tilmicosin, Tylosin	Calves	• Control calf diphtheria
		Cattle	• Control metritis and liver abscesses • Treat foot rot and respiratory disease • Promote feed efficiency and animal growth
Polypeptide	Bacitracin*	Feedlot	• Control liver abscesses
		Growing	• Promote feed efficiency and animal growth
Sulfonamide	Sulfamethazine	Calves	• Treat calf diphtheria
		Cattle	• Treat respiratory disease, bacterial sores, foot rot, acute metritis, coccidiosis • Promote animal growth in the presence of respiratory disease
Tetracycline	Chlortetracycline, Oxytetracycline*	Calves	• Treat bacterial pneumonia, bacterial enteritis, and diphtheria • Promote feed efficiency and animal growth
		Cattle	• Control liver abscesses and anaplasmosis • Treat bacterial enteritis, foot rot, wooden tongue, and acute metritis • Prevent bacterial pneumonia • Promote feed efficiency and animal growth

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: USGAO 1999, Herrman and Stokka 2001, McGuffey et al. 2001, Apley 2004, and USFDA 2011b.

Similarly to beef cattle, dairy cows may be treated for respiratory disease and bacterial enteritis, but dairy cows may also be treated for other common ailments such as lameness and mastitis, which is a teat infection (Table 4-4; USDA 2008a). Most antimicrobials are prohibited for use on lactating cows when producing milk for human consumption (Watanabe et al. 2010). In 2007, 90% of dairy operations administered intramammary antimicrobials (e.g., lincosamide) during non-lactating periods, and 80% of those operations treated all cows at the facility (USDA 2008a). Approximately 85% of dairy operations used antimicrobials to treat mastitis, administering the antimicrobials to 16% of the cows on those operations (USDA 2008a). Preweaned heifers tend to be treated with antimicrobials more often than weaned heifers due to their increased susceptibility to diseases (USDA 2008a). Approximately 11% of preweaned heifers received antimicrobials to treat for respiratory disease, compared to 6% of weaned heifers (USDA 2008a). For growth promotion and disease prevention, 58% of dairy operations fed preweaned heifers dairy milk replacer, which was typically a combination of neomycin and oxytetracycline (USDA 2008a). In weaned heifers, approximately 45% of dairy operations used ionophores in feed for growth promotion and disease prevention (USDA 2008a).

Table 4-4. Commonly used antimicrobials administered to dairy cows.

Class/Group	Antimicrobial	Life stage	Intended Use
Aminoglycoside	Neomycin*, Streptomycin*	Preweaned	• Treat bacterial enteritis and other digestive problems • Promote animal growth
		Unspecified	• Treat mastitis • Prevent Staphylococcus aureus
β-lactam	Amoxicillin*, Cephalosporin, Penicillin*	Preweaned	• Treat bacterial enteritis and other digestive problems
		Non-lactating	• Treat mastitis and lameness
		Unspecified	• Treat respiratory disease and foot rot
Fluoroquinolone	Enrofloxacin	Non-lactating	• Treat respiratory disease
Ionophore	Lasalocid, Monensin	Weaned	• Treat for respiratory disease and bacterial enteritis • Improved feed efficiency and growth promotion • Increased milk production efficiency
Lincosamide	Pirlimycin Hydrochloride	Non-lactating	• Treat mastitis
Macrolide	Tilmicosin, Tylosin	Non-lactating	• Treat respiratory disease, foot rot, and metritis.
Sulfonamides	Sulfadimethoxine*, Sulfamethazine	Dairy calves and heifers	• Treat bacterial enteritis and other digestive problems • Treat calf diphtheria, shipping fever complex, and foot rot
		Non-lactating	• Treat acute mastitis and metritis
Tetracycline	Chlortetracycline, Oxytetracycline*	Preweaned	• Treat bacterial enteritis and other digestive problems • Promote animal growth
		Non-lactating	• Treat mastitis and lameness • Treat bacterial enteritis and pneumonia

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: USDA 2008a and USFDA 2011b.

4.2.2. Swine

Swine can be treated with antimicrobials to promote animal growth and to treat or prevent common infections such as respiratory diseases, swine dysentery, and bacterial enteritis (Table 4-5). According to the USDA, most hogs are raised in confinement, and large operations with 10,000 hogs or more typically administer antimicrobials through feed to promote animal growth, particularly in starter and grower hogs

(USDA 2002b, USDA 2008b). As with other types of livestock, antimicrobial administration varies by life stage (see Table 4-5). An estimated 89% of operations administer antimicrobials to grower/finisher pigs (hogs grown to market weight for slaughter) (USDA 2002b) and 85% of operations use antimicrobials in feed for nursery pigs (USDA 2008b). In the USDA (2008b) study, over half (54%) of the operations administered antimicrobials in the nursery pig feed continuously, while 33% of operations did so for grower/finisher pigs.

Table 4-5. Commonly used antimicrobials administered to swine.

Class/Group	Antimicrobial	Life stage	Intended Use
Aminoglycoside	Gentamicin*	Preweaned	• Treat colibacillosis
β-lactam	Amoxicillin*, Ampicillin*, Penicillin*	Unspecified	• Promote feed efficiency and animal growth • Treat bacterial enteritis, porcine colibacillosis, and salmonellosis
Bambermycin	--	Growing/Finishing	• Promote feed efficiency and animal growth
Macrolide	Erythromycin*, Lincomycin, Tylosin	Starting/Growing/ Finishing	• Promote feed efficiency and animal growth • Treat bacterial enteritis and infectious arthritis • Control swine dysentery and the severity of swine mycoplasmal pneumonia
Pleuromutilin	Tiamulin	Unspecified	• Treat swine dysentery and pneumonia
Polypeptide	Bacitracin*	Growing/Finishing	• Promote feed efficiency and animal growth • Control swine dysentery
		Pregnant	• Control clostridial enteritis
Tetracycline	Chlortetracycline, Oxytetracycline*	Growing	• Promote feed efficiency and animal growth • Prevent/treat cervical lymphadenitis (jowl abscesses)
		Breeding	• Prevent/treat leptospirosis
		Unspecified	• Treat bacterial enteritis and pneumonia • Reduce incidences of cervical abscesses
Streptogramin	Virginiamycin	Swine excluding breeders	• Promote feed efficiency and animal growth • Treat swine dysentery
Sulfonamide	Sulfamethazine	Unspecified	• Promote feed efficiency and animal growth • Control Bordetella bronchiseptica rhinitis • Prevent swine dysentery and pneumonia • Treat porcine colibacillosis and bacterial pneumonia

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: Herrman and Sundberg 2001, Mellon et al. 2001, Kumar et al. 2005, and USFDA 2011b.

4.2.3. Poultry

Poultry may be treated with antimicrobials to promote growth and to cure or prevent respiratory disease and infections, including *E. coli* and protozoan parasites such as coccidiosis (Table 4-6). The extensive use of antimicrobials in poultry, much of which is used for non-therapeutic purposes, has sparked consumer interest related to public health and antimicrobial resistance. For example, 3-Nitro (Roxarsone), the most commonly used arsenic-based drug for animals, promotes animal growth, improves pigmentation, and prevents coccidiosis in poultry (USFDA 2011c). In 2011, an USFDA study reported higher levels of inorganic arsenic (a known carcinogen) in broiler chickens treated with Roxarsone than non-treated broiler chickens, prompting the company producing the drug to suspend sales of Roxarsone for use in poultry (USFDA 2011c). Other arsenic-based drugs are still approved for use in poultry and swine, including nitarsone, arsanilic acid, and carbarsone (USFDA 2011c). In another instance, the use of fluoroquinolones in poultry was effectively banned by the USFDA in 2005 after research indicated an increase in human infections with fluoroquinolone-resistant *Campylobacter* related to poultry consumption (see Chapter 2 and Section 6.3 for further information) (Nelson et al. 2007).

Table 4-6. Commonly used antimicrobials administered to poultry.

Class/Group	Antimicrobial	Life stage or Poultry Category	Intended Use
Aminocyclitol	Spectinomycin*	Chickens (not laying eggs for human consumption)	• Promote feed efficiency and animal growth • Treat chronic respiratory disease • Prevent mortality associated with Arizona group infection
Aminoglycoside	Gentamicin*, Neomycin*	Chickens and turkeys	• Prevent bacterial contamination and omphalitis • Prevent early mortality caused by *E. coli* and *Salmonella typhimurium*
β-lactam	Penicillin*	Chickens/turkeys (not laying eggs for human consumption)	• Promote feed efficiency and animal growth
Bambermycin	--	Broilers/growing turkeys	• Promote feed efficiency and animal growth • Prevent coccidiosis • Improve pigmentation
Ionophore	Lasalocid, Monensin	Broilers/turkeys	• Control of coccidiosis
Macrolide	Erythromycin*, Tylosin	Broilers/replacement chickens	• Control chronic respiratory disease
		Layers	• Increase egg production
		Chickens and turkeys	• Promote feed efficiency and growth promotion
Polypeptide	Bacitracin*	Broilers/replacement chickens	• Promote feed efficiency and animal growth • Prevent necrotic enteritis
		Layers	• Increase egg production • Promote feed efficiency
		Growing turkeys	• Promote feed efficiency and animal growth
Streptogramin	Virginiamycin	Broilers/turkeys	• Promote feed efficiency and growth promotion
Tetracyclines	Chlortetracycline	Chickens	• Promote feed efficiency and animal growth • Control synovitis, chronic respiratory disease, air sac infections, and *E. coli* infections
		Growing turkeys	• Promote feed efficiency and animal growth
		Turkeys	• Control synovitis, hexamitiasis, and bacterial organisms associated with bluecomb

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: Tanner 2000, McGuffey et al. 2001, Mellon et al. 2001, Apley 2004, Kumar et al. 2005, and USFDA 2011b.

Estimates of antimicrobial use in poultry are limited. The 2010 poultry survey conducted by USDA's National Animal Health Monitoring System (NAHMS) program includes limited data on vaccine administration in breeder facilities, and no information is available on the types of drugs used or the extent of antimicrobial use in the poultry industry (USDA 2011a). According to the USDA's survey, in 2010, an estimated 80% of breeder chicken farms in the U.S. vaccinated pullets against *Salmonella*, bronchitis, and coccidiosis, among other infectious diseases (USDA 2011a). While the types of antimicrobials, including vaccines, were not reported in the USDA's poultry survey, as of 2009, at least 50 active pharmaceutical ingredients had been approved by the USFDA for use in poultry (USFDA 2009). Mellon et al. (2001) estimates that nearly 40% (10.5 million lbs.) of all antimicrobials used for non-therapeutic purposes in livestock and poultry during 1997 were administered to poultry. The study also suggests that the majority of poultry receive antimicrobials during at least one life stage. For example, layer eggs may be dipped in gentamicin to minimize bacterial contamination, and day-old chicks may be injected with gentamicin or other antimicrobials to prevent omphalitis, a yolk sac infection (Tanner 2000). Table 4-6 provides further information about commonly used antimicrobials in the poultry industry.

4.2.4. Aquaculture

Antimicrobials may be used in aquaculture to prevent and treat bacterial infections and diseases (McEwen and Fedorka-Cray 2002). Primary antimicrobials used in aquaculture include oxytetracycline, sulfamerazine, sulfadimethoxine-ormetoprim combination, and formalin (Table 4-7). Estimates of total antimicrobial use in U.S. aquaculture vary widely. MacMillan et al. (2003) estimates that 54,000 to 72,000 pounds per year of antimicrobials are used in aquaculture, while Benbrook (2002) estimates that use is closer to 200,000 to over 400,000 pounds per year. Both estimates are significantly less than livestock and poultry antimicrobial use estimates; however, in contrast to livestock and poultry use, antimicrobials used in aquaculture enter surface waters directly, since they are added to the water through simple addition or via feed pellets (Lee et al. 2007, Zounková et al. 2011). Research suggests that, an estimated 70% to 80% of drugs administered in aquaculture operations are released into the environment, related to over-feeding and poor adsorption in the gut (Boxall et al. 2003, Gullick et al. 2007). As noted by Daughton and Ternes (1999) and Zounková et al. (2011), antimicrobials are designed to kill bacteria and may do so at multiple trophic levels, potentially impacting other, non-target, aquatic organisms. An assessment of the aquatic toxicity of 226 antimicrobials using USEPA's Ecological Structure Activity Relationships (ECOSAR) Class Program, predicted that a large portion of antimicrobials are toxic to aquatic life – algae, crustaceans, and fish (Sanderson et al. 2004). This is an area that needs further research.

Table 4-7. Commonly used antimicrobials and parasiticides in aquaculture.

Class/Group	Antimicrobial	Life Stage or Species	Intended Use
Parasiticide (formaldehyde solution)	Formalin	Salmon, salmonids, and salmon eggs; trout and trout eggs; catfish, largemouth bass, bluegill, other fin fish, and shrimp	• Control of external protazoa, fungi, and protazoan parasites
Sulfanomide	Sulfadimethoxine*-Ormetoprim Combination, Sulfamerazine	Trout, salmonids, catfish	• Control furunculosis and enteric septicemia
Tetracycline	Oxytetracycline*	Salmonids, catfish, lobster	• Control ulcer disease, furunculosis, bacterial hemorrhagic septicemia, and pseudomonas disease

(*) indicates that the antimicrobial is approved for use in humans.
This table is meant to provide general antimicrobial use information. Antimicrobials listed within each class may be used for different purposes during particular animal life stages. Consult the USFDA's website for more specific information about livestock antimicrobial use. References: Benbrook 2002 and USFDA 2011b.

According to the USDA's 2005 Census of Aquaculture, catfish production is the dominant sector in U.S. aquaculture (USDA 2006). Approximately 50% of catfish hatcheries treated egg masses to control fungal and bacterial infections in 2009, with larger facilities more likely to administer antimicrobials than smaller ones (USDA 2010c). Additionally, approximately 29% of catfish fingerling operations administered antimicrobials in 2009 to treat and prevent enteric septicemia, a common bacterial infection in farm-raised catfish (USDA 2010c, USDA 2011b). Table 4-7 provides further information on antimicrobials used in aquaculture.

4.3. Antimicrobial Excretion Estimates

Antimicrobials are often only partially metabolized in livestock and poultry and can be excreted virtually unchanged as the parent compound (Kumar et al. 2005, Boxall 2008, Khan 2008, Pérez and Barceló 2008). For example, up to 80% of tetracyclines may be excreted by swine and poultry as the parent compound (Kumar et al. 2005, Khan 2008). Additionally, up to 67% of the macrolide tylosin, which is approved for use in beef cattle, dairy cows, swine, and poultry (see Table 4-3 to Table 4-6), may be excreted by livestock and poultry when the antimicrobial is administered orally (Feinman and Matheson 1978).

Several challenges are presented when attempting to estimate the types of antimicrobials present in livestock manure (i.e., dairy cow vs. beef cattle manure). First, as evidenced in the preceding tables (Table 4-3 to Table 4-7), the types of antimicrobials used at each operation differ depending on animal life stage and which ailments are most common at the operation. Second, dosage differs by operation, and excretion estimates vary by compound (McEwen and Fedorka-Cray 2002, Kumar et al. 2005). Finally, while hundreds of antimicrobial agents are approved for animal use, our understanding of which compounds are excreted is partly a function of which antimicrobials are tested for their presence in manure, as well as analytical detection limits. For example, Sapkota et al. (2007) estimated which antimicrobials to test for in ground water and surface water near a swine operation based on the types of antimicrobials approved for use by the USFDA. The actual antimicrobials used at the operation were deemed proprietary information, presenting a challenge to researchers in the environmental health field. Despite these limitations, recent research indicates that the most common antimicrobial classes found in manure include tetracyclines, macrolides, sulfonamides, ionophores, and β-lactams, some of which are also used for human health (Kumar et al. 2005, Lee et al. 2007).

4.4. Antimicrobial Stability and Transport in the Environment

After excretion, antimicrobials and their degradates can enter the environment in a variety of ways, including through direct land application via excretion from grazing animals or application of manure or lagoon slurry on cropland (Boxall 2008, Klein et al. 2008). Spills and overflow from manure lagoons, wash-off from indoor animal housing facilities or hard surfaces, and wash-off from animals treated externally also present pathways for antimicrobial transport to the environment (Boxall 2008, Klein et al. 2008). Additionally, antimicrobials can enter the atmosphere during the spraying of manure on fields, dust from scraping solid manure, or when antimicrobials bind to air particles during animal excretion (Boxall 2008, Chee-Sanford et al. 2009).

Antimicrobials are chemically diverse, though they tend to be hydrophilic and do not easily biodegrade; therefore these compounds tend to be more mobile in aquatic environments (Chee-Sanford et al. 2009, Zounková et al. 2011). However, because antimicrobials are organic compounds with a range of chemical properties, their stability and mobility in the environment varies considerably, with half-lives ranging from a few days to over a year (Kumar et al. 2005). Generally, antimicrobials tend to have a high affinity for soils and clays (Chee-Sanford et al. 2009). Tetracyclines, fluoroquinolones, and lincosamides are not considered to be very mobile related to their high sorption potential, while sulfonamides appear to be the most mobile of antimicrobials (Chee-Sanford et al. 2009). Antimicrobials with a high sorption potential may be less mobile in the environment, potentially persisting in cropland soil or at the bottom of manure lagoons for longer periods of time (Boxall et al. 2003, Lee et al. 2007, Adams et al. 2008, Carmosini and Lee 2008). Additionally, environmental factors such as pH, temperature, oxygen availability, and microbial populations can influence antimicrobial behavior and degradation in the environment (Gu and Karthikeyan 2005, Kumar et al. 2005, Carmosini and Lee 2008). Antimicrobials tend to degrade during manure storage, and the process appears to be more rapid under higher temperatures and aerobic conditions (Kumar et al. 2005, Lee et al. 2007, Boxall et al. 2008). Therefore, prolonged manure storage and avoiding manure land application during colder winter months may allow for further degradation, potentially reducing antimicrobial transport to the environment and surface waters. Given the limited number of field studies, further research in this area is warranted to determine optimal conditions for antimicrobial degradation in manure.

The majority of research on antimicrobial stability in the environment has been conducted in controlled laboratory experiments (Kumar et al. 2005, Lee et al. 2007). Some researchers are concerned that findings from these studies may not be directly applicable to actual conditions in the field since environmental factors, such as temperature and pH, fluctuate both spatially and temporally, influencing the behavior of antimicrobials in the environment (Sarmah et al. 2006). Further research on antimicrobial excretion and degradation in differing medias, including manure, soil, and water, may help researchers better quantify the amount of antimicrobials that enter the environment each year.

4.5. Antimicrobial Occurrence in the Environment

The occurrence of antimicrobials in soils, sediment, surface water, and ground water has been documented, particularly in close proximity to livestock and poultry operations. Campagnolo et al. (2002) found antimicrobial compounds present in 67% of ground water and surface water samples collected near poultry operations and 31% of ground water and surface water samples collected near swine operations. In that study, Campagnolo et al. (2002) detected lincomycin, chlortetracycline, and sulfadimethoxine, among other antimicrobials near both the swine and poultry operations. In another study, tetracyclines were detected in soils, and sulfonamides were detected in shallow ground water near large dairy livestock production facilities, which, in general, use significantly fewer antimicrobials per unit animal weight than other large livestock and poultry production facility types since most antimicrobials are prohibited for use on lactating cows (Watanabe et al. 2010). Additionally, Batt et al. (2006) detected two types of sulfonamides, which are approved only for veterinary use, in private drinking water wells near a large beef cattle livestock production facility and irrigated agriculture fields in Idaho. Lincomycin was measured in a ground water well near a swine lagoon in North Carolina (Harden 2009). In a study of North Carolina drinking water systems, fluoroquinolones as well as sulfonamides, lincomycin, tetracyclines, and macrolides were the most frequently detected antimicrobials in source water (Weinberg et al. 2004). In addition to livestock wastes, suspected sources also included wastewater treatment plants.

The concentrations of antimicrobials measured in the environment vary considerably, ranging from non-detectable concentrations to levels in the mg/L range. Overall, concentrations in soil tend to be much higher than in water because most antimicrobials bind well to soil (Lee et al. 2007). However, because antimicrobials tend to be hydrophilic, they can be transported in aquatic systems (Chee-Sanford et al. 2009, Zounková et al. 2011). It is important to note that our understanding of the occurrence of antimicrobials in the environment is limited by the fact that research tends to focus on the most commonly used antimicrobials (e.g., tetracyclines, sulfonamides), rather than degradates and less commonly used compounds. Numerous antimicrobial agents have been approved for livestock use, though many have not yet been researched in terms of their prevalence in the environment.

4.6. Summary and Discussion

Antimicrobial use is widespread in livestock and poultry production – both to treat infections and diseases, and also to increase feed efficiency and animal growth. An estimated 60% to 80% of livestock and poultry routinely receive antimicrobials (NRC 1999, Carmosini and Lee 2008), and several USDA surveys and publications suggest that larger, confined livestock and poultry operations rely more heavily on antimicrobial use than smaller facilities (MacDonald and McBride 2009, USDA 2010b). There are currently no reporting requirements for antimicrobial use on livestock and poultry operations, though according to the USFDA, an estimated 29.2 million pounds of antimicrobials were sold for livestock use in 2010 (USFDA 2011a). Gaining a more thorough understanding of the quantity of antimicrobials used in livestock and poultry production as well as the behavior and stability of antimicrobials in the environment may provide guidance for manure management to promote antimicrobial degradation prior to land application, thereby potentially reducing antimicrobial transport to the environment and surface waters. The possible link between livestock and poultry antimicrobial use and the proliferation and evolution of antimicrobial resistance (WHO 2000, Swartz 2002, USGAO 2011a) is discussed in Section 6.3.

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5. Hormones in Manure

Hormones are endocrine disruptors that are naturally produced by, and in some cases artificially administered to, livestock and poultry. As with all mammals including humans, livestock and poultry excrete hormones in their waste, which has the potential to enter water resources through runoff and discharges from animal production facilities and fertilized cropland. The purpose of this chapter is to provide estimates of livestock and poultry hormone use and excretion rates as well as the occurrence and mobility of hormones in the environment. Section 6.4 provides information on endocrine disruption and potential impacts to aquatic life and human health.

5.1. Introduction

✓Livestock excreted an estimated 722,852 pounds of endogenous hormones in 2000.

✓Beef cattle feedlot operations may administer synthetic hormones as implants and feed additives to promote animal growth.

Hormones are naturally synthesized in the endocrine systems of all mammals and regulate metabolic activity and developmental processes. Beef cattle may also be administered additional natural and synthetic exogenous hormones to improve beef quality and promote animal growth. Dairy cows may be treated with additional hormones to control reproduction and increase milk production (USFDA 2002, Bartelt-Hunt et al. 2012). The USFDA has not approved the use of exogenous steroid hormones for growth promotion purposes in swine, poultry, veal calves, or dairy cows (USFDA 2011d). Natural hormones include estrogens, androgens, and progestogens (Table 5-1), and their synthetic versions include zeranol, trenbolone acetate, and melengestrol acetate (Table 5-2).

Table 5-1. Natural hormones and select metabolites as well as the functional purpose of the hormone.

Hormone	Select Hormone Metabolites	Purpose
Estrogens	Estrone, 17β-estradiol, and estriol	• Natural reproductive hormone • Stimulates and maintains female characteristics
Androgens	Testosterone, 5α-dihydrotestosterone, 5α-androstane-3β, 17β-diol, 4-androstenedione, dehyroepiandrosterone, and androsterone	• Natural reproductive hormone • Stimulates and maintains male characteristics
Progestogens	Progesterone	• Natural reproductive hormone • Produced during the estrous cycle • A metabolic precursor to estrogens

Hormones are naturally excreted by livestock and poultry in manure and bile (USEPA 2004a, Zhao et al. 2008). Therefore, hormones and their metabolites can enter aquatic ecosystems through runoff from pasture and rangeland used by grazing cattle and cropland fertilized with manure, as well as via leaks/overflow from manure lagoons (Kolodziej and Sedlak 2007, Bartelt-Hunt et al. 2012). Because hormones are endocrine disrupting compounds, Lee et al. (2007) and Zhao et al. (2008), among others, have noted concern regarding the potential adverse impacts of aquatic organism exposure to manure. Specifically, hormones can affect the reproductive biology, physiology, and fitness of fish and other aquatic organisms (Zhao et al. 2008). It is important to note that all mammals excrete hormones, thus other possible sources of steroid hormones to the environment include wastewater treatment plant discharges and leaky septic systems (Shore and Shemesh 2003).

Table 5-2. Synthetic hormones that may be administered to and excreted by beef cattle and/or dairy cows.

Synthetic Hormone	Mimics the Behavior of Which Natural Hormone Metabolite?	Purpose
Zeranol	17β-estradiol	• Administered as an implant (typically without other hormones) • Used to improve feed efficiency and animal growth
Trenbolone acetate	Testosterone	• Administered as an implant either alone or with 17β-estradiol • Used to improve feed efficiency and animal growth
Melengestrol acetate	Progesterone	• Administered as a feed additive • Used for estrous synchronization and to induce lactation • Used to improve feed efficiency and animal growth

5.2. Estimates of Exogenous Hormone Use

The USFDA has approved the use of patented forms of natural hormones and synthetic steroid hormones for use in beef and dairy cattle, as included in the Code of Federal Regulations (CFR), Title 21, Parts 522, 556, and 558 (see also Table 5-1 and Table 5-2). Hormones may be administered through implants, or pellets containing doses of one or more hormones that are implanted into the ear of an animal (USFDA 2011d). Typical implants on beef cattle feedlots contain doses of approximately 140 mg of trenbolone acetate and 14 mg of 17β-estradiol benzoate (Bartelt-Hunt et al. 2012). Beef cattle on feedlots may also receive daily doses of approximately 0.45 mg of melengestrol acetate in feed (Bartelt-Hunt et al. 2012). Intravaginal controlled internal drug release (CIDR) inserts, which contain progesterone, may be used in dairy operations to control estrous (menstrual cycle), or to treat anestrous (non-menstruating) females and females with cystic ovaries (USDA 2009c).

The USFDA has also approved the use of the genetically engineered hormone, recombinant bovine growth hormone (rBGH), also referred to as recombinant bovine somatotropin, to increase milk production in dairy cows (USFDA 2011e). Estimates of rBGH use in dairy cows are unknown; however, a 2006 USDA article reported that 33 million doses are sold annually by the manufacturer (Gray 2006) (note that this estimate may include sales outside of the U.S.). Information on the extent of rBGH treatments at U.S. dairy operations would allow for an understanding of trends in usage.

Estimates of hormone use in beef and dairy cattle are limited because there are no reporting requirements; however, recent USDA NAHMS surveys have provided insight into common practices in beef and dairy operations. Approximately 39% of steers and heifers weighing less than 700 pounds and 82% of those weighing 700 pounds or more received at least one hormonal implant in 1999 (USDA 2000). Of those, livestock operations with 8,000 or more cattle were more likely to use implants than smaller ones. Additionally, approximately 33% of dairy operations used CIDR inserts in 2007 (USDA 2009c). The USDA's NAHMS 2007 Dairy Survey mentions that rBGH is the most common production enhancement injection used in dairy operations, though use estimates are not provided (USDA 2009d). Beyond these estimates, research to-date (though limited) has focused primarily on livestock and poultry excretion, since hormones are also produced naturally, and use estimates therefore would not necessarily accurately reflect amounts entering the environment.

5.3. Hormone Excretion Estimates

Approximately 2.2 billion cattle, swine, and poultry generated an estimated 1.1 billion tons of manure in 2007 (see Chapter 2), and livestock excrete hormones that are naturally-produced and synthetic (in the case of cattle). Quantifying the total amount of hormones excreted by livestock and poultry is challenging because daily excretion rates vary by animal type, season, diet, age, gender, breed, health status, reproductive state, and whether or not the animal is castrated (Schwarzenberger et al. 1996, Lange et al. 2002, Khan et al. 2008). One of the most extensive estimates of hormone excretion currently available suggests that cattle, swine, and poultry (excluding turkeys), excreted approximately 722,852 lbs. of estrogens, androgens, and progestogens (excluding synthetic hormones) during the year 2000 (Table 5-3) (Lange et al. 2002). Cattle account for the majority of estrogen and progestogen excreted by livestock (93% and 92%, respectively), related to differences in excretion rates and the higher quantity of manure generated by cattle compared to other animal types. Androgens are predominantly excreted by cattle and poultry, followed by swine. Lange et al. (2002) estimate that adding excretion of exogenous hormones to the above figures may increase the total excretion values by as much as 0.2% for estrogens and 20% for androgens. Using these estimates, livestock excreted an estimated 724,900 lbs. of hormones in 2000 (an approximate 0.3% increase over the estimates in Table 5-3).

Table 5-3. Estimated livestock and poultry endogenous hormone excretion in the U.S. in 2000.

Animal Type	Estrogens		Androgens		Progestogens		Total	
	Lbs.	% of Total	Lbs.	% of Total	Lbs.	% of Total	Lbs.	% of Total
Cattle	99,208	92.7%	4,189	43.7%	557,770	92.0%	661,166	91.5%
Swine	1,830	1.7%	772	8.0%	48,502	8.0%	51,103	7.1%
Poultry (broilers, layers)	5,952	5.6%	4,630	48.3%	--	--	10,582	1.5%
Total	***106,990***	***100%***	***9,590***	***100%***	***606,271***	***100%***	***722,852***	***100%***

(--) indicates that no estimate is available from Lange et al. (2002). Adapted from Lange et al. (2002).

The following subsections provide information on hormone excretion rates for different animal types and aquaculture. Overall, limited data are available on hormone excretion, particularly for swine and poultry, and few studies have investigated aquaculture hormone contributions. Also, the majority of research has focused on estrogen excretion and, to a lesser extent, androgen excretion. Limited information is available on livestock progesterone and synthetic hormone excretion. Importantly, identifying trends and comparing data between livestock types is difficult because hormone excretion rates vary depending on the animal type and life stage.

5.3.1. Cattle (Beef and Dairy)

Hormone excretion in cattle varies by life stage and reproductive state, among other factors. For example, androgen excretion ranges from 0.0003 lbs./yr (120 mg/yr) in calves to 0.001 lbs./yr (390 mg/yr) in bulls (Lange et al. 2002). The majority (58% to 90%) of estrogen excreted by cattle is via feces, most of which is excreted during the final three months of pregnancy (Ivie et al. 1986, Lange et al. 2002, Shore et al. 2009). While pregnant cows produce significantly more hormones than non-pregnant cows, mean estrogen excretion rates within the first 80 days of pregnancy (first trimester) are similar to those of non-pregnant cattle (Hoffman et al. 1997). Pregnant cattle are estimated to excrete 0.01 lbs./yr (4,400 mg/yr) of progestogens (Lange et al. 2002).

Regarding excretion of synthetic, exogenous hormones, an estimated 8% of applied trenbolone acetate may be recovered in heifer liquid manure, and 3% to 42% may be recovered in solid dung (feces and straw)

(Schiffer et al. 2001). An estimated 12% of applied melengestrol acetate is excreted by heifers via feces (Schiffer et al. 2001). Limited information is available on zeranol and rBGH hormone excretion.

5.3.2. Swine

In contrast to cattle, which excrete the majority of total estrogen in feces, swine excrete nearly 96% of total estrogen in urine (Palme et al. 1996). Estrogen concentrations in swine manure tend to increase after three to four weeks of pregnancy (Choi et al. 1987, Szenci et al. 1997). Progestogen excretion can be as high as 0.009 lbs./yr (3,900 mg/yr) for pregnant swine, and 0.004 lbs./yr (1,700 mg/yr) for pigs in estrous (Lange et al. 2002).

5.3.3. Poultry

Similar to swine, the majority (69%) of total estrogen released into the environment by poultry is excreted via urine rather than feces (Ainsworth et al. 1962). Layers generally excrete more estrogen than broiler hens: 0.000016 lbs./yr (7.1 mg/yr) compared to only 0.00000075 lbs./yr (0.34 mg/yr) from broiler hens (Lange et al. 2002). Broilers generally excrete fewer androgens than laying hens and cocks. Androgen excretion by broilers is estimated to be 0.0000015 lbs./yr (0.7 mg/yr), while laying hens excrete 0.0000075 lbs./yr (3.4 mg/yr) and cocks excrete 0.0000196 lbs./yr (8.9 mg/yr) (Lange et al. 2002).

5.3.4. Aquaculture

As with mammals, fish and other aquatic organisms also naturally excrete hormones, though hormone contributions from aquaculture operations have been far less studied than livestock. Kolodziej et al. (2004) estimates that hormone discharge from a standard aquaculture operation (i.e., 55 to 220 tons of fish) may be comparable to the amount of hormones produced by several hundred cattle, *or* a wastewater treatment plant serving several thousand people. Hormone excretion may be higher during spawning periods, though further research is needed. In a study of hormone concentrations in aquaculture operations, Kolodziej et al. (2004) found that concentrations of estrone, testosterone, and androstenedione (a precursor to sex steroid hormones) ranged from 0.1 to 0.8 ng/L in hatchery effluents. Note that the rate of effluent production was not reported in the Kolodziej et al. (2004) study; therefore an estimate of hormone production reported as mass per year, cannot be calculated for these hatcheries. Effluent from aquaculture operations may enter natural surface waters untreated, either through direct discharge or overflow (Kolodziej et al. 2004).

5.4. Hormone Stability and Transport in the Environment

Because mammals, including livestock, poultry, and humans, produce and excrete hormones, key sources of hormones to the environment include manure and bile from livestock and poultry operations as well as biosolids and discharges from wastewater treatment facilities. As previously discussed, manure and biosolids are often land applied, which can lead to concentrated releases of hormones and other compounds (e.g., nutrients, pathogens, and antimicrobials) to the environment (Bevacqua et al. 2011). Related to the typically higher total weight of manure compared to biosolids, as well as the more extensive treatment of biosolids, the contribution of hormones to the environment from manure compared to biosolids can be higher. A recent analysis estimated that poultry litter application to farmland in Maryland is nearly two times greater than biosolids application, contributing approximately two times more progesterone (35.27 lbs./yr versus 17.6 lbs./yr) and six times more estrone (24.3 lbs./yr versus 4.2 lbs./yr) to the environment (Bevacqua et al. 2011).

The occurrence and stability of hormones in the environment have only recently been investigated, partly related to improvements in laboratory methods allowing for the detection of hormones at low (ng/L) concentrations. However, available monitoring data indicate that hormones and their metabolites have been detected in the environment in close proximity to livestock and poultry operations and generally degrade at different rates depending on the media and environmental conditions. Both estrogens and testosterone may degrade to other compounds after excretion (Zhao et al. 2008). While estrogens may be degraded by biotic or abiotic processes under either aerobic or anaerobic conditions, a key route of degradation for testosterone is through microbial activity (Zhao et al. 2008). Limited information is available on progesterone degradation, though some studies indicate that they may be actively transformed by spores and vegetative cells of microorganisms in soil, as well as some fungi (Plourde et al. 1974, Pokorna and Kasal 1990).

Hormones are lipophilic (fat soluble) organic molecules that generally do not readily dissolve in water (Casey 2004, Arnon et al. 2008). Because of these characteristics, hormones tend to sorb to sediment, soil particles, and organic matter (Arnon et al. 2008). Sorption potential measures how tightly the compound binds with soil particles and can thus be an indication of how likely the compound will leach from the soil. In a study of soil sorption potentials of estrogens in a range of soil types on cultivated land, Caron et al. (2010) found a significantly positive correlation between sorption potential and soil organic carbon content. While further research is needed, this finding suggests that hormone leaching and contributions to runoff may be minimized in soils with higher carbon content.

Hormones in the environment typically degrade over time. The extent and rate of degradation can depend on a variety of factors such as the media's moisture content, temperature, and organic carbon content, as well as the availability of light (Zhao et al. 2008). Microbial breakdown also appears to be a key route for the degradation of hormones; therefore, it is possible that hormones may persist for longer periods of time during colder, winter temperatures when microbial activity tends to be slower than during warmer months (Zhao et al. 2008).

Table 5-4. Half-lives of natural and synthetic hormones in the environment.

Hormone (Metabolite)	Half-Life (days)	Media	Source
Estrogen (17β-estradiol)	69	Poultry manure compost	Hakk et al. 2005
	24	Anaerobic soil	Ying and Kookana 2005
	0.2-9	River	Jürgens et al. 2002
Androgen (Testosterone)	43	Clay-amended compost	Hakk et al. 2005
Zeranol	56	Manure	USFDA 1994
	49-91	Soil	USFDA 1994
Trenbolone acetate	267	Liquid manure	Schiffer et al. 2001
Trenbolone acetate (17α-trenbolone)	0.2-2	Aerobic soil	Khan and Lee 2010
Trenbolone acetate (17β-trenbolone)	0.2-.6	Aerobic soil	Khan and Lee 2010
Melengestrol acetate	0.16-1	Water	USFDA 1996

Adapted from Zhao et al. (2008), Table 13.11.

Manure storage may facilitate the degradation of natural and synthetic hormones. For example, the degradation of estrogen in manure during storage has been observed in broiler litter (Shore et al. 1995), manure from pregnant and non-pregnant cows (Schenkler et al. 1998), and dairy manure (Raman et al. 2001). However, research suggests that synthetic hormones may persist at low concentrations even after months of storage and land application. Schiffer et al. (2001) measured the fate of trenbolone acetate and melengestrol acetate in solid and liquid lagoon manure from cattle that had received hormone implants. Trenbolone acetate and melengestrol acetate were detected in the solid manure after excretion and also after 4.5 months of storage. Likewise, trenbolone was detected in the liquid manure, decreasing in concentration after 5.5 months of storage. However, trenbolone was still detected in the soil up to two months after the liquid manure was applied to corn fields and had an estimated half-life of 267 days during storage. As shown in Table 5-4, half-lives of natural and synthetic hormones vary considerably, ranging from several hours to over 260 days depending on the type of hormone and media.

5.5. Hormone Occurrence in the Environment

While limited, recent studies have detected hormones in manure, runoff, and in surface waters near livestock and poultry operations (e.g., Durhan et al. 2006, Kolodziej and Sedlak 2007, Bartelt-Hunt et al. 2012). However, analyzing trends and making definitive statements about hormone occurrence is challenging because many studies focus on the occurrence of one type of hormone or metabolite in one type of medium rather than researching the occurrence of an array of natural and synthetic hormones in the same study. Further, most studies involve the use of bioassay methods, which quantify total concentrations of 17β-estradiol and testosterone; in contrast, chemical identification liquid chromatography-tandem mass spectrometry allows for more precise quantification of specific hormone compounds including estriol, 17α-estradiol and progesterone (Bevacqua et al. 2011).

Estrogen content in poultry litter (manure and bedding materials) is variable, ranging from 14,000 to 500,000 ppb (μg/kg) (Shore et al. 1993, 1995). Likely related to the higher portion of total estrogen that is excreted by poultry via urine (69%) rather than feces (Ainsworth et al. 1962), estrogen levels detected in dry broiler litter are substantially lower, at 28 ppb (Shore et al. 1995). The concentration of estrogen in manure from pregnant cows is around 36 ppb, with the estrogen content in bull manure estimated to be nearly four times lower (Shore 2009). The level of testosterone in dairy cow manure is estimated to be 25 ppb; concentrations in broiler litter vary from 30 to 133 ppb; in breeder layer litter, concentrations range from approximately 20 to 250 ppb (Shore et al. 1995, Lorenzen et al. 2004). The variability may be attributed to differences in breed, manure treatment, and age (Zhao et al. 2008). Progesterone levels in manure have been far less studied than other hormone compounds. However, Bevacqua et al. (2011) reported an average progesterone concentration of 63.4 ppb in poultry litter from 12 broiler chicken farms in the Mid-Atlantic.

Relatively few studies have focused on concentrations of synthetic hormones in manure, though a recent controlled experiment on feedlot beef cattle conducted by Bartelt-Hunt et al. (2012) provides insight into concentrations of synthetic hormones in manure. In that study, feedlot cattle were treated with exogenous hormones via implants and feed additives during two study seasons in 2007 and 2008. Average concentrations of melengestrol acetate ranged from 1.7 to 6.5 ppb in fresh manure, with concentrations generally decreasing from day seven of the study to day 109 (Bartelt-Hunt et al. 2012). The average concentration of 17α-trenbolone (a metabolite of trenbolone acetate) in fresh manure after 46 days was 31 ppb; average concentrations of α-zearalanol and α-zearalenol (metabolites of the synthetic hormone zeranol) were 47 ppb and 46 ppb respectively after 46 days.

Both natural and synthetic hormones and their metabolites have also been measured in runoff from livestock and poultry operations. Runoff from a Nebraska beef cattle feedlot with hormone-treated cattle had concentrations of testosterone of up to 420 ng/L, 17α-estradiol up to 720 ng/L, and estrone up to 1050 ng/L (Bartelt-Hunt et al. 2012). In another study, concentrations of 17α-trenbolone were detected in 67% of runoff samples from a beef cattle feedlot in Ohio with concentrations ranging from <10 to approximately 120 ng/L (Durhan et al. 2006).

A USGS nationwide reconnaissance survey of streams known, or suspected to be, susceptible to human, animal, or industrial impacts, reported that nearly 6% of streams had measureable concentrations of 17α-estradiol, with a median concentration of 30 ng/L (Kolpin et al. 2002). According to Hanselman et al. (2003) and Kolodziej and Sedlak (2007), the source of 17α-estradiol is likely cattle operations, given that this steroid is predominantly excreted by cattle and not by other types of livestock or humans. Shore et al. (1995) reported concentrations of up to 5 ng/L of estrogen and 28 ng/L of testosterone in small streams draining fields which had recently been fertilized with poultry litter. Runoff from cattle grazing rangeland may also contribute hormones to surface waters. Kolodziej and Sedlak (2007) detected steroid hormones in 86% of samples from rangeland creeks where cattle had access to the creeks. Though few studies are available, hormones have also been detected in ground water impacted by dairy farms (Arnon et al. 2008) and swine CAFOs (Harden et al. 2009). Concentrations of estrone and 17β-estradiol have been detected in manure storage ponds, with higher concentrations at increasing depths (Raman et al. 2004), and testosterone and estrogen have been detected in sediments below a dairy wastewater lagoon at depths of up to 148 ft and 105 ft, respectively (Arnon et al. 2008). Few studies have investigated the presence and stability of progesterone in the environment, though Zheng et al. (2008) found that progesterones were present in dried manure piles on a dairy operation, but not in dairy lagoon samples.

5.6. Summary and Discussion

Hormones are naturally synthesized by all mammals, including livestock and poultry. Estimates suggest that over 720,000 lbs. of natural and synthetic hormones were excreted in manure and bile by cattle, swine and poultry (excluding turkeys) in 2000 (Lange et al. 2002) (Table 5-3). Research (while limited) indicates that hormones and their metabolites may be present in the environment proximal to livestock and poultry operations, including streams, creeks draining cattle grazing rangeland, and surface waters downstream from beef cattle feedlots (Kolpin et al. 2002, Durhan et al. 2006, Kolodziej and Sedlak 2007, Arnon et al. 2008, Harden et al. 2009, Bartlet-Hunt et al. 2012). While hormones are typically detected at low concentrations, such chemicals are biologically active at low levels (ng/L) and are classified as endocrine disruptors (see Section 6.4). Manure storage prior to land application may promote hormone degradation (see Chapter 8), possibly minimizing the amount that enters the environment (Shore et al. 1995, Raman et al. 2001, Schiffer et al. 2001). However, the nature of the degradation products is not completely understood yet. More research on the use, occurrence, fate, and transport of natural and synthetic hormones is necessary in order to fully understand their potential impact on human and ecological health.

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6. Potential Manure-Related Impacts

Manure from livestock and poultry is a source of a number of contaminants including nutrients, pathogens, hormones, and antimicrobials (see Table 1-1). As reviewed in the previous chapters, these contaminants have been detected in manure and environmental media such as soil, sediment, and water resources near livestock and poultry operations. Manure can be viewed as a source of nutrients to water, and it may be related to the development of harmful algal blooms (HABs) in some cases. HABs can produce cyanotoxins – also contaminants of emerging concern. The purpose of this chapter is to review the potential and documented human health and ecological impacts associated with these contaminants. This is not a comprehensive discussion of human health issues related to manure and livestock and poultry operations. Additional health issues for people living in the vicinity of large animal feeding operations or working in livestock and poultry operations and handling manure are associated with air quality (see Donham et al. 2007, Merchant et al. 2005, Mirabelli et al. 2006, PCIFAP 2008).

6.1. Harmful Algal Blooms and Cyanotoxin Production

Nitrogen and phosphorus (nutrients) are perhaps the most widely researched pollutants from livestock and poultry manure. Nutrients from manure may reach surface water and ground water through runoff from pasture and cropland, infiltration through soil, or volatilization during manure decomposition leading to atmospheric deposition of nitrogen (Jordan and Weller 1996, Bouwman et al. 1997, Aneja et al. 2001). Nutrients are necessary for all biological growth, but excess nutrients may lead to eutrophication in aquatic ecosystems. Characterized in part by excessive algal growth and potentially harmful algae blooms (HABs), eutrophication can alter the biology, chemistry, and aesthetic quality of the waterbody. HABs can also produce toxins, which may be harmful to wild animals and aquatic life as well as to humans and pets when exposed to them from drinking water supplies or recreational waters (see Grand Lake St. Marys case study) (Lopez et al. 2008).

While livestock and poultry manure contributes nutrients to the environment, there have been limited cases where manure has been documented as the primary cause of HABs and associated formation of cyanotoxins. Additionally, livestock and poultry manure must be placed in context relative to all the nutrients used in agricultural production. The National Research Council (NRC) estimated nitrogen and phosphorus balances for croplands by USDA Region and for the U.S. The NRC reported that in the U.S., 45% of nitrogen and 79% of phosphorus inputs to cropland may be attributed to synthetic fertilizers, whereas 8% of nitrogen and 15% of phosphorus inputs are from livestock and poultry manure (NRC 1993). However, because manure production is more localized (refer to Chapter 2), associated nutrient contributions can be higher in particular watersheds. For example, a USGS study found that animal manure was the primary

Manure-Related Harmful Algal Blooms in Grand Lake St. Marys, Ohio

Grand Lake St. Marys (GLSM) is a public drinking water supply in Ohio that has experienced recurring HABs since 2009 related to livestock manure runoff and nutrient loading (OEPA 2009). The watershed is 90% agricultural, with nearly 300,000 animal units of poultry, swine, and cattle. The HABs have caused fish kills, waterfowl and pet deaths, and have also been linked to over 20 cases of human illness. The state of Ohio has issued recreation, boating, and fish consumption advisories related to the blooms. The $150 million annual lake-based recreational and tourism industries have been compromised, park revenues have decreased by more than $250,000 per year, and several lakeside businesses have closed. To date, millions of state, federal, and local dollars had been leveraged toward lake restoration and watershed management projects. Technical assistance and funding programs have also been developed to minimize manure runoff to the lake. (References: OEPA 2007, OEPA 2009, OEPA 2011, Gibson 2011).

source of nitrogen in several Mid-Atlantic and southern watersheds, contributing 54% and 56% of total nitrogen loads to the Susquehanna River in Pennsylvania and the White River in Arkansas, respectively (Puckett 1994).

The majority of HABs in freshwater in the U.S. and throughout the world are caused by cyanobacteria, commonly referred to as blue-green algae. USEPA's 2007 National Lakes Assessment found that microcystin, a hepatotoxin produced by cyanobacteria that is harmful to animals and humans, was detected in approximately one third of the lakes studied (USEPA 2010b). It is important to note that the presence of cyanobacteria is not necessarily an indication of cyanotoxins because not all cyanobacteria, and not all blooms produce toxins. Table 6-1 reviews the various types of nuisance and harmful algae, the toxins they can produce, and the associated adverse human health and aquatic life impacts.

Table 6-1. Types of harmful or nuisance inland algae, toxin production, and potential adverse impacts.

Algae Group	Genera/Taxa	Toxins	Potential Adverse Impacts
Cyanobacteria	Anabaena, Aphanocapsa, Hapalosiphon, Microcystis, Nostoc, Oscillatoria, Planktothrix, Nodularia spumigena, Aphanizomenon, Cylindrospermopsis, Lyngbya, Umezakia	Hepatotoxins, neurotoxins, cytotoxins, dermatoxins, endotoxins, respiratory and olfactory irritant toxins	• Human and animal health impacts (i.e., gastrointestinal disorders, liver inflammation/failure, tumor promotion, cardiac arrhythmia, skin irritation, respiratory paralysis, etc.) • Water discoloration • Unpleasant odors and aesthetics • Hypoxia from high biomass blooms • Taste and odor problems in drinking water and in farm-raised fish
Haptophytes	Prymnesium parvum, Chrysochromulina polylepis	Ichthyotoxins	• Fish mortalities
Chlorophytes, Microalgae	Volvox, Pandorina	--	• Water discoloration • Localized hypoxia
Macroalgae	Cladophora	--	• Unpleasant odors and aesthetics • Localized hypoxia • Clogged water intakes
Euglenophytes	Euglena sanguinea	Ichthyotoxins	• Water discoloration • Fish mortalities
Raphidophytes*	Chattonella	Ichthyotoxins	• Fish mortalities
Dinoflagellates	Peridinium polonicum	Ichthyotoxins	• Fish mortalities
Cryptophytes	Cryptomonas, Chilomonas, Rhodomonas, Chroomonas, Hemiselmis, Proteomonas, Teleaulax[Ω]	--	• Water discoloration • Localized hypoxia
Diatom	Didymosphenia geminata	--	• Produce large quantities of extracellular stalk material resulting in ecosystem and economic impacts

** Raphidophytes are a marine algae, but can bloom in inland saline waters*
Ω Information from Marin et al. (1998).
Adapted from Lopez et al. 2008.

6.2. Fish Kills

Manure discharges to surface waters have been implicated in fish kills nationwide (Mulla et al. 1999). Such discharges can be caused by rain events, equipment failures (e.g., lagoon ruptures/leaks), or the application of manure to frozen ground or to tile drained fields, and subsequent discharges to surface waters. Fish mortalities from runoff containing manure may be caused by ammonia toxicity and/or oxygen depletion with large loadings of manure.

In Minnesota, a top swine producing state, an estimated 20 manure spills occur annually, one of which involved 100,000 gallons of liquid hog manure washing into Beaver Creek, killing nearly 700,000 fish (DeVore 2002). Similarly, in Lewis County, New York, millions of gallons of manure from a dairy CAFO spilled from a lagoon in 2005, contaminating approximately 20 miles of the Black River and killing approximately 375,000 fish (NYSDEC 2007). In 1995, spills from poultry and swine lagoons entered Cape Fear River basin in North Carolina, causing fish kills, algal blooms, and microbial contamination (Mallin and Cahoon 2003). Osterburg and Wallinga (2004) reported over 300 manure spills within ten years in Iowa alone, 24% of which were caused by manure storage overflow and equipment failures. Large livestock and poultry operations often store large volumes of untreated manure in lagoons, which can rupture or overflow, leading to a greater potential for fish kills (Armstrong et al. 2010). Between 1995 and 1998 alone, there were an estimated 1,000 manure spills at animal feedlots in ten states and 200 manure-related fish kills in the U.S. (Marks 2001). Proper management and maintenance of lagoons and minimization of winter land application of manure will help prevent manure discharges to surface waters.

6.3. Antimicrobial Resistance

Antimicrobials are typically administered to livestock therapeutically for disease treatment, control, and prevention, as well as sub-therapeutically for growth promotion (refer to Chapter 3) (Kumar et al. 2005). The USFDA estimates that 29.2 million lbs. of antimicrobials were sold for livestock and poultry use in 2010 (USFDA 2011a). The use of antimicrobials in livestock and poultry has been increasing over the past four decades (Pérez and Barceló 2008). This increase is partly related to the shift towards fewer, larger confined animal facilities, which may increase disease susceptibility among livestock because the livestock are routinely in close contact (Pérez and Barceló 2008). The overuse and/or misuse of antimicrobials (in general) can facilitate the development and proliferation of antimicrobial resistance (i.e., when bacteria have the ability to survive exposure to certain types of antimicrobials) (Levy and Marshall 2004). Research conducted by the WHO and others suggest that antimicrobial use in livestock and poultry, which is typically administered at low doses for extended periods of time for sub-therapeutic purposes, has contributed to the prevalence of antimicrobial-resistant pathogens found in food animal operations and nearby environments (WHO 2000, Swartz 2002, Hayes et al. 2004, Levy and Marshall 2004, Nelson et al. 2007, USGAO 2011a). However, antimicrobial resistance can develop in a number of ways, and while resistant infections in humans have been linked to livestock and poultry production (Swartz 2002), the relationship between livestock and poultry antimicrobial use and resistant infections in humans is not well understood. This section focuses on antimicrobial resistance and the potential human health implications. Note that research also indicates that antimicrobials are toxic to aquatic life; this topic has been reviewed elsewhere (e.g., Sanderson et al. 2004, Kümmerer 2009a and 2009b) and is not the focus of this chapter.

6.3.1. Development and Spread of Antimicrobial Resistance

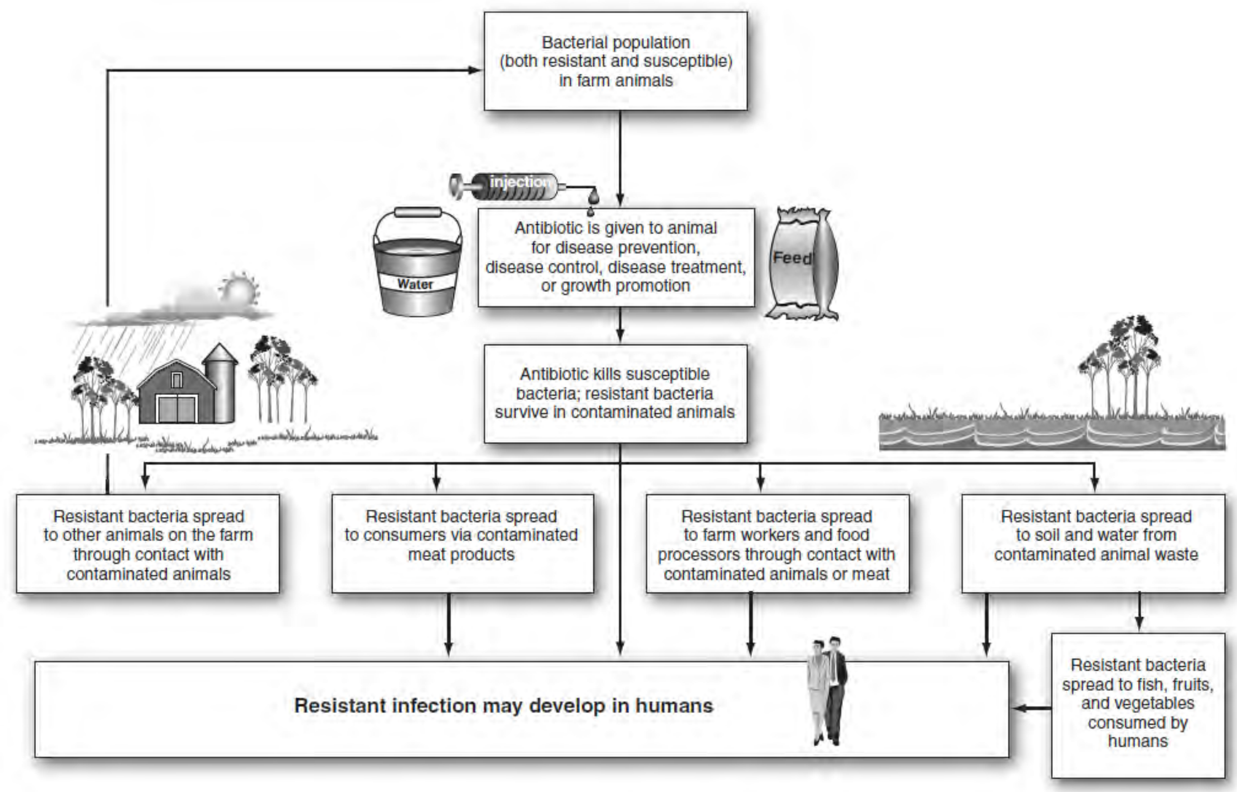
Each class of antimicrobials operates differently: some attack cell walls and membranes, some act on cellular components responsible for protein synthesis, and others interrupt biochemical pathways within the cell (Rogers and Haines 2005). Bacteria may develop resistance to antimicrobials when their deoxyribonucleic acid (DNA) changes through the mutation of existing genetic material. Bacteria may also develop resistance through conjugation (i.e., the transfer of genetic material between living bacteria), transformation (i.e., obtaining genetic material from the environment), or transduction (i.e., the transfer of genetic material between bacteria via a bacteriophage) (Rogers and Haines 2005). Because of the multiple methods by which resistance can spread, exposure of bacteria to increasingly large pools of antimicrobial resistant genes can further expand the pool of resistant strains of pathogens.

Antimicrobial-resistant bacteria are generally shed in animal manure, but they may also be present in the mucosa of livestock animals. Once a resistant strain is present in a bacterial community, it can spread among livestock, wild animals, pets, and humans (Figure 6-1). For example, resistance can spread between herds of animals, particularly when in close confinement, or via vectors such as insects and rodents (McEwen and Fedorka-Cray 2002). Antimicrobial-resistant pathogens can also survive on food products, such as vegetables and fruit grown on fields fertilized with manure containing resistant pathogens, or meat from slaughterhouses; such pathogens can also spread through soil or water that has been contaminated with manure containing resistant bacteria (USGAO 2011a). It is important to note that ingested bacteria will not always cause illness, in part because many strains of bacteria are naturally present in the human and/or animal digestive tract (e.g., certain strains of *E. coli*) (USGAO 2011a).

- ✓ The sub-therapeutic use of antimicrobials in livestock contributes to the development of antimicrobial resistant pathogens.
- ✓ The U.S. Department of Agriculture reported that 74% of *Salmonella* and 62% of *Campylobacter* isolates from swine manure were resistant to two or more antimicrobials.
- ✓ Resistant strains of pathogens tend to be less responsive to treatment and can cause more severe and prolonged illness in humans than susceptible strains.
- ✓ The U.S. Food and Drug Administration banned the use of fluoroquinolones in poultry in 2005 related to human health concerns; livestock antimicrobial use has previously been banned in European countries related to perceived human health concerns.

Most antimicrobial resistance related to human health is likely the result of overuse and misuse of certain medications in humans (Levy and Marshall 2004). However, evidence suggests that the use of antimicrobials in livestock and poultry operations selects for antimicrobial resistance in certain pathogens and bacteria such as *Salmonella* and *Enterococcus* (McEwen and Fedorka-Cray 2002). These bacteria may be transferred to humans through the food chain and via contaminated water (McEwen and Fedorka-Cray 2002).

Figure 6-1. Potential pathways for the spread of antimicrobial-resistance from animals to humans.



**As indicated in the figure, antimicrobial-resistant pathogens can spread to humans through several pathways. Certain pathogens with resistance can infect humans, increasing the severity and decreasing the treatability of the resulting illness/infection. Source: USGAO (2011a), Figure 1.*

6.3.2. Antimicrobial Resistance in Manure and the Environment

Antimicrobial-resistant pathogen strains can be shed by livestock and poultry and are therefore generally found in manure and nearby environments such as surface water, ground water, and fertilized cropland. Antimicrobial-resistant *Enterococcus* spp. isolates were found to be prevalent in broiler and layer chicken operations in the Netherlands, with over 90% of isolates resistant to oxytetracyline or erythromycin (van den Bogaard et al. 2002). In that study, 80% of *Enterococcus* spp. isolates from broiler litter were also resistant to vancomycin, which is typically the first line drug used in humans to treat *Enterococcus* infections. Note that vancomycin has not been approved by the USFDA for use by livestock and poultry in the U.S. In a separate survey of poultry litter from more than 80 broiler operations, approximately 99% of *Enterococcus* spp. isolates were resistant to lincomycin, 68% were resistant to tetracycline, 54% were resistant to erythromycin, and 27% were resistant to penicillin (Table 6-2) (Hayes et al. 2004). Each of these medications is also used to treat human infections, and some may be used to treat infections from *Enterococcus*, specifically. Importantly, whether or not antimicrobial use in the poultry was a direct cause of the high prevalence of resistance is unclear because the types and quantities of antimicrobials used on the farms in the Hayes et al. (2004) study were not known/reported.

Research indicates that increased use of antimicrobials in livestock and poultry may be related to a greater prevalence of resistant pathogens in manure. Jackson et al. (2004) reported that 59% of *Enterococcus* spp. isolates were erythromycin-resistant in manure from a swine farm administering tylosin continuously through feed for animal growth, compared to 28% in a swine farm that administered tylosin for disease treatment for only five days (both tylosin and erythromycin are macrolides). The percent occurrence of erythromycin-resistant isolates was only 2% on a swine farm that did not use tylosin. Similarly, Sapkota et al. (2011) reported a significantly lower occurrence of antimicrobial-resistant strains of *Enterococcus* spp. on organic, antimicrobial-free poultry farms compared to conventional poultry operations. On the conventional operations, 42% of *Enterococcus faecalis* (*E. faecalis*) and 84% of *Enterococcus faecium* (*E. faecium*) isolates were multidrug-resistant (Table 6-2), compared with only 10% of *E. faecalis* and 17% of *E. faecium* isolates on the organic operations.

Results from USDA's NAHMS studies on the occurrence of antimicrobial-resistant pathogens in livestock and poultry manure, suggest a higher prevalence of antimicrobial-resistant pathogens in manure from swine, compared to other animal types (see USDA sources in Table 6-2). This finding was also reported by Sayah et al. (2005), which researched antimicrobial resistance patterns in livestock and poultry, companion animals, human septage, wildlife, surface water, and farm environments (e.g., manure storage facilities, lagoons, and livestock holding areas) in a watershed in Michigan. In that study, *E. coli* isolates from livestock manure were resistant to the greatest number of antimicrobials, and multidrug resistance was most common in isolates from swine manure (Table 6-2). Resistance was demonstrated most frequently to tetracycline, sulfisoxazole, streptomycin, and cephalothin (a type of cephalosporin that has since been voluntarily withdrawn from the U.S. market by the drug manufacturer). In terms of *Salmonella* and *Campylobacter,* the USDA's NAHMs studies also indicate that antimicrobial-resistant strains of these pathogens are less prevalent in beef cattle manure compared to dairy cow and swine manure (Table 6-2).

Table 6-2. Occurrence of antimicrobial-resistant isolates in livestock and poultry manure from conventional livestock operations.

Pathogen	Animal Type	% of Resistant Isolates	Source
Salmonella spp.	Beef cattle	0% resistant to any antimicrobials	USDA 2009e
	Dairy cows	2% resistant to 1 antimicrobial 6% resistant to ≥ 2 antimicrobials	USDA 2009f
	Swine	80% resistant to 1 antimicrobial 74% resistant to ≥ 2 antimicrobials	USDA 2009g
Escherichia coli	Swine	32% resistant to 1 antimicrobial 60% resistant to ≥ 2 antimicrobials	USDA 2009h
		31% resistant to 1 antimicrobial 15% resistant to > 3 antimicrobials	Sayah et al. (2005)
	Dairy cows	28% resistant to 1 antimicrobial 6% resistant to > 3 antimicrobials	
	Beef cattle	28% resistant to 1 antimicrobial 6% resistant to > 3 antimicrobials	
	Poultry (broilers)	28% resistant to 1 antimicrobial 12% resistant to > 3 antimicrobials	
Enterococcus spp.	Poultry (broilers)	53% resistant to 4 antimicrobials	Hayes et al. (2004)
	Poultry (broilers)	42% (*E. faecalis*) resistant to ≥ 3 antimicrobials 84% (*E. faecium*) resistant to ≥ 3 antimicrobials	Sapkota et al. 2011
Campylobacter sp.	Beef cattle	8% resistant to ≥ 2 antimicrobials	USDA 2009i
	Dairy cows	62% resistant to 1 antimicrobial 2% resistant to ≥ 2 antimicrobials	USDA 2009f
	Swine	91% resistant to 1 antimicrobial 62% resistant to ≥ 2 antimicrobials	USDA 2008c

Antimicrobial-resistant pathogens have also been detected in surface water and ground water near livestock and poultry operations. In the Sayah et al. (2005) study previously described, antimicrobial-resistant isolates of

E. coli were detected throughout the farm environment as well as in surface water near farming operations. Among the surface water samples, 81% of *E. coli* showed resistance to cephalothin (Sayah et al. 2005). Ash et al. (2002) reported that over 40% of bacteria in 16 rivers in the U.S. were resistant to at least one antimicrobial. Chee-Sanford et al. (2001) reported resistant bacteria in swine lagoons and underlying ground water, with the bacteria detected over 800 ft. down-gradient from the lagoons. In a study of the presence of resistant bacteria near a concentrated swine operation, median levels of enterococci and *E. coli* were up to 33 times higher in surface water and ground water down-gradient from the operation. A higher percentage of the enterococci were resistant to erythromycin and tetracycline in surface water samples, and a higher percentage of resistance to tetracycline and clindamycin were observed in down-gradient ground water samples. The surface water was used for recreational purposes, and the ground water had been used as a primary drinking water source but was taken offline due to pollution from the swine operation (Sapkota et al. 2007). The presence of antimicrobial-resistant bacteria in flowing systems such as streams, rivers, and ground water may facilitate the spread of resistant bacteria in the environment (McEwen and Fedorka-Cray 2002).

The presence of antimicrobial-resistant bacteria in drinking water source water and tap water has been documented. Bacteria resistant to amoxicillin, chloramphenicol, ciprofloxacin, gentamicin, sulfisoxazole, and tetracycline were found in surface water sources of drinking water in Michigan and Ohio (Xi et al. 2009). The percent of resistant bacteria ranged from 1.66% to 14.42% in source water, and from 1.17% to 47.98% in finished (treated) water. The study found that the levels of antibiotic-resistant bacteria were higher in tap water compared to finished water, suggesting that bacteria continued to grow in the drinking water distribution system (Xi et al. 2009).

The presence of antimicrobial-resistant bacteria in air, soil, and on cultivated land has also been documented. Gibbs et al. (2004) detected antimicrobial-resistant bacteria in air samples inside and downwind of a concentrated swine operation, but not upwind, suggesting that the swine operation was the source of the resistant bacteria. Multidrug-resistant bacteria have also been detected in topsoil from dairy farms, demonstrating resistance to chloramphenicol, penicillin, nalidixic acid, and tetracycline (Burgos et al. 2005). In soil from farmland amended with swine manure slurry, there was an increase in tetracycline-resistant bacteria following manure application, though the amount of resistant bacteria decreased during the eight months of the study (Sengeløv et al. 2003).

The period of time between antimicrobial introduction and the emergence of antimicrobial-resistant pathogens on a livestock operation varies. Because of the numerous ways in which bacteria can gain resistance (see subsection 6.3.1), once the pool of resistant genes reaches a certain magnitude, reversal of the problem can be challenging (Swartz 2002). While limited, available research suggests that certain antimicrobial-resistant pathogens may be more persistent in the environment than others. However, research on the persistence of resistant pathogens appears to be focused primarily on *Campylobacter* and *Enterococcus* in the poultry industry, so there is a strong need for more research in this area.

The USFDA Bans Prophylactic Use of Cephalosporin in Livestock

Cephalosporins are antimicrobials used to treat pneumonia, pelvic inflammatory disease, and skin infections in humans. They are also widely used in livestock production; the USFDA reported that over 54,000 lbs. were sold for use in food-producing animals in 2010. Also, a USDA survey reported that in 2007, over half (53%) of dairy operations administered cephalosporins to treat mastitis (an increase from 37% of operations in 2002). There has been growing concern over the increased prevalence of cephalosporin-resistant pathogens (i.e., *Salmonella* and *E. coli*) related to widespread livestock use. To preserve the effectiveness of cephalosporins for human use, the USFDA has moved to ban their prophylactic use (among other uses) in cattle, swine, and poultry. The new rule became effective in April, 2012. (References: USDA 2008a, USFDA 2011a and 2012, Gilbert 2012).

Fluoroquinolone-resistant *Campylobacter* appears to be persistent in poultry operations. Price et al. (2005, 2007) researched the prevalence of resistant strains of *Campylobacter* in chicken meat products from two prominent poultry companies that had discontinued the use of fluoroquinolones in drinking water to treat entire flocks. In the study, even one year after discontinuing the use of the drug, fluoroquinolone-resistant *Campylobacter* was detected in 43% to 96% of the chicken products from the two producers. Chicken products from one of the producers were over 450 times more likely to carry fluoroquinolone-resistant *Campylobacter* than products from an antimicrobial-free poultry operation involved in the study (Price et al. 2005). There was no significant change in the proportion of resistant *Campylobacter* strains three years later (i.e., four years after the operations had discontinued the use of fluoroquinolones) (Price et al. 2007). The persistence of fluoroquinolone-resistant *Campylobacter* is of interest, because this pathogen is a primary cause of bacterial gastroenteritis in the U.S., causing approximately 1.4 million infections annually (Nelson et al. 2007). Fluoroquinolones are commonly prescribed to adults infected with *Campylobacter* (Nelson et al. 2007). Thus, resistance compromises the effectiveness of these antimicrobials in treating *Campylobacter* infections in humans. As described in subsection 6.3.3, the USFDA has since banned the use of fluoroquinolones in poultry due to fluoroquinolone resistance and human health concerns.

Research conducted in the U.S. and in Europe indicates that antimicrobial-resistant *Enterococcus* spp. may be less persistent than *Campylobacter*. For example, one study found that five newly organic and antimicrobial-free large-scale poultry operations in the U.S. experienced a substantial drop in the prevalence of antimicrobial-resistant *Enterococcus* spp. in feed, litter, and water samples, compared to five conventional operations (see subsection 6.3.2) (Sapkota et al. 2011). Similarly, tylosin-resistant *Enterococcus* spp. isolates detected in swine manure in Denmark were high (around 90% occurrence) prior to Denmark's ban of the use of tylosin for growth promotion (Aarestrup et al. 2000). However, the percent occurrence of tylosin-resistant *Enterococcus* spp. isolates decreased to 28% and 47% for *E. faecalis* and *E. faecium*, respectively, three years after the ban. It is important to note that a more substantial drop in occurrence may not have been observed because macrolides, such as tylosin, were still being administered to swine for therapeutic purposes (Aarestrup et al. 2000). In the same study, similar drops in occurrence were observed for erythromycin- and virginiamycin-resistant *Enterococcus* spp. isolates in broilers, and for glycopeptides-resistant *E. faecium* isolates in swine (Aarestrup et al. 2000). These findings were further confirmed by similar research conducted by Emborg et al. (2003) in Denmark on the occurrence of antimicrobial resistant *Enterococcus* spp. in broilers. One of the ways in which resistant pathogens can be transferred to humans is via the consumption of meat products, which is beyond the scope of this report. The National Antimicrobial Resistance Monitoring System (NARMS), a collaboration between the USFDA, the USDA, and the Centers for Disease Control and Prevention (CDC), conducts annual surveys of the prevalence of resistant pathogens on meat products (see NARMS, 2009) and provides further information.

Research indicates a higher prevalence of antimicrobial-resistant strains of pathogens in livestock and poultry handlers compared to the general public (Swartz 2002). Levy et al. (1976) found that after tetracycline-supplemented feed was introduced on a poultry farm, tetracycline-resistant *E. coli* isolates increased in fecal samples from both the poultry and farm family members. After introducing the medicated feed, 80% of the isolates in the family members were tetracycline-resistant, compared to only 7% of isolates from neighbors. The percent of resistant isolates found in the family members decreased to levels closer to the percent detected in neighbors approximately six months after discontinuing the use of tetracycline in the animal feed. Similar findings were reported by van den Bogaard et al. (2002), who found significant correlations between the prevalence of antimicrobial-resistant *Enterococcus* spp. in broilers and broiler farmers and also between broilers and poultry slaughterers.

6.3.3. U.S. and International Responses to Livestock Antimicrobial Use

Making the direct link between livestock and poultry antimicrobial use and resistant infections in humans is challenging and controversial, in part because bacteria can develop resistance naturally or from antimicrobial use in humans (Levy and Marshall 2004). However, in specific cases, years of research and evidence have demonstrated the link between livestock and poultry antimicrobial use and resistant infections in humans, leading to limitations or bans on certain antimicrobials. Most recently, because of the relationship between livestock and poultry antimicrobial use and the evolution and proliferation of antimicrobial-resistant pathogens, a federal court ordered the USFDA to evaluate the human health risks associated with livestock and poultry antimicrobial use (see Federal Court Ruling text box). The USFDA also recently banned the use of cephalosporin in livestock and poultry, related to antimicrobial resistance (see Cephalosporin text box). In 2005, the USFDA banned the use of fluoroquinolone in the poultry industry because substantial data and research indicated that an increase in human infections caused by fluoroquinolone-resistant *Campylobacter* was associated with poultry consumption (Nelson et al. 2007). The fluoroquinolone ban is anticipated to reduce the selective pressure not only on fluoroquinolone-resistant *Campylobacter* but also on non-typhodial *Salmonella* species and other foodborne pathogens that can cause infections in humans (Nelson et al. 2007).

Federal Court Ruling Requires USFDA to Evaluate Human Health Risks Associated with Livestock Antimicrobial Use

Recent federal court decisions ordered the USFDA to re-evaluate the human health implications of the use of antimicrobials in livestock feed. The U.S. District Court for the Southern District of New York rulings came in response to a suit brought by the Natural Resources Defense Council, the Union of Concerned Scientists, and others. In a March, 2012 ruling, which USFDA is currently appealing, the federal judge required USFDA to withdraw its approval for most non-therapeutic uses of tetracyclines and penicillin in livestock feed, unless the practices are proven to be safe for humans. Following the court order, USFDA called for drug manufacturers to voluntarily place restrictions on the use of certain drugs in livestock feed. The most recent ruling, in June, 2012, requires USFDA to withdraw its approval of the use of antimicrobials in livestock unless industry can prove they are safe. (References: Jacobs 2012,

In other countries, bans on the use of certain antimicrobials in livestock and poultry related to human health concerns have been in effect for decades. The sub-therapeutic use of antimicrobials in food animals has been banned in Sweden since 1986 and in Denmark since 1998 (Emborg et al. 2003, PCIFAP 2008). In 2006, the European Union banned the use of all growth-promoting antimicrobials after having already previously banned the use of human medicines from being added to livestock feed (Europa 2005). Studies conducted by Aarestrup (2000) and Emborg et al. (2003) suggest that, as a result of these bans, there have been demonstrated reductions in the occurrence of antimicrobial-resistant pathogens in livestock and poultry. However, the European Union still considers the prevalence of antimicrobial resistance a growing health problem. In November 2011, it published the Action Plan on Antimicrobial Resistance, which, among other goals, calls on European Union countries to ensure that antimicrobials are only available via prescription and to better track cases of resistance (Europa 2011).

6.3.4. Summary and Discussion

Livestock and poultry antimicrobial use in the U.S. is an estimated four times greater than the amount used to treat human infections (Loglisci 2010). Research conducted by the USGAO, the WHO, and others demonstrate that overuse and misuse of antimicrobials – in humans and/or livestock and poultry – may contribute to the prevalence of antimicrobial resistance (WHO 2000, Levy and Marshall 2004, USGAO 2011a). Research has demonstrated an increased prevalence of antimicrobial-resistant bacteria on and near livestock and poultry production facilities related to the use of antimicrobials (Hayes et al. 2004, Kumar et al. 2005, Sapkota et al. 2011). Antimicrobial-resistant pathogens have been detected in meat products (NARMS 2009). What is less clear is the extent to which antimicrobial-resistant human infections are related to the use of antimicrobials in livestock and poultry. Making that connection is challenging – USFDA reviewed decades of scientific research before banning fluoroquinolone use in poultry in 2005 and prohibiting prophylactic use of cephalosporin in certain types of livestock in 2012 (Nelson et al. 2007, USFDA 2012b).

As noted by Kumar et al. (2005), significant costs incur when antimicrobials used to treat human, pet and/or livestock and poultry bacterial infections become ineffective because of resistant bacteria. These costs are related to increased health costs and loss of livestock and poultry, as well as the need to develop new drugs. More representative data about the occurrence of antimicrobial resistance in different types of livestock and food products will help researchers and agencies identify trends and better understand the relationships between livestock and poultry antimicrobial use, the prevalence of resistant pathogens, and the occurrence of human infections caused by resistant pathogens.

6.4. Endocrine Disruption

Livestock excrete natural hormones (i.e., estrogens, androgens, and progestogens), and synthetic hormones (i.e., trenbolone acetate, zeranol, and melengestrol acetate in the case of some cattle). These hormones can enter aquatic ecosystems through runoff following manure land application, wash-off from farming operations, or via spills, overflow, and leaks from manure lagoons (Pérez and Barceló 2008). To regulate metabolic and developmental processes in animals, hormones are naturally biologically active at very low concentrations (ng/L). Even low levels of hormones detected in surface water have been implicated in endocrine disruption, adversely impacting the reproductive biology, physiology, and fitness of fish and other aquatic organisms (Zhao et al. 2008). To date, the majority of research has been conducted on the environmental impacts of hormones from human waste streams (e.g., municipal wastewater treatment plant discharges). However, recent research suggests that exposure to animal manure can also have endocrine-disrupting effects on aquatic organisms (Lee et al. 2007, Ciparis et al. 2012).

> ✓ Hormones are endocrine system regulators that are biologically active even at low concentrations.
>
> ✓ Fish exposure to estrogens can cause defeminization in females and demasculinization in males, reducing reproductive fitness.
>
> ✓ The biological activity of the synthetic hormone melengestrol acetate is estimated to be nearly 125 times greater than that of natural progesterone.

Sex steroids regulate the differentiation and structural development, as well as behavior and function, of the reproductive system in vertebrates (Lange et al. 2002). Specifically, estrogens are responsible for the development and maintenance of female sex organs and characteristics, while androgens are responsible for male organs and characteristics. Progestogens are involved in the female menstrual cycle and pregnancy. An investigation into the ecological toxicity of 92 types of hormones using USEPA's ECOSAR program found that hormones exhibited the greatest toxicity to aquatic biota, compared to several other classes of pharmaceuticals (Sanderson et al. 2004). The study predicted that 80% of the compounds were very toxic and 52% extremely toxic to fish based on impacts on species survival and reproduction. The study found that only 1% of hormone compounds were non-toxic to fish, daphnids, or algae, illustrating the potential ecological effects associated with hormones in surface waters.

The majority of research on hormones in surface waters has been conducted on estrogens, which can cause physiochemical changes in sensitive fish and other aquatic organisms. Fish exposure to exogenous estrogens can induce the production of egg yolk precursor proteins (vitellogenin) and eggshell proteins (zona radiata), which are associated with reduced testicular growth, reduced testicular and ovary size, decreased egg production, and liver and kidney damage (Lange et al. 2002). Exposure to exogenous estrogen can also lead to reduced reproductive fitness, intersex (the presence of both male and female sex characteristics), skewed population sex ratios, abnormal spawning behavior, and compromised immune systems in fish (Iwanowicz and Blazer 2011). The most potent estrogen metabolite is 17β-estradiol, which has been associated with adverse impacts on gamete production, maturation, spawning, and sexual differentiation in a variety of fish species (Lange et al. 2002, Zhao et al. 2008).

Exposing fish to animal manure containing natural hormones has also been shown to cause adverse impacts on fish, though research on hormones in manure is limited at this time (the majority of research is focused on aquatic life impacts from hormones in wastewater treatment plant discharges). Orlando et al. (2004) found that exposure of wild fathead minnows to animal feedlot effluent caused defeminization in females and demasculinization in males (i.e., reduced testicular size and testosterone synthesis, and altered head morphometrics). As suggested by the author, results from this study indicate that there were potent androgens and estrogens in the feedlot effluent. A separate study reported a high intersex prevalence in male smallmouth bass in the Potomac River Basin in the Mid-Atlantic region. This was partly explained by hormone contributions from runoff containing livestock (primarily poultry) manure within the watershed (Blazer et al. 2007).

Exposure to synthetic hormones and their metabolites from livestock and poultry manure can also adversely impact the reproductive endocrinology of some fish. Fathead minnow fecundity can be reduced when exposed to 17β-trenbolone and 17α-trenbolone (metabolites of trenbolone acetate) at concentrations greater than 27 ng/L, and 16 ng/L for 21 days, respectively (Ankley et al. 2003, Jensen et al. 2006). For perspective, concentrations of 17β-trenbolone have been detected in runoff from beef cattle feedlots at concentrations of up to 20 ng/L, which is slightly lower than the documented levels of concern (Durhan et al. 2006). However, 17α-trenbolone has been documented at concentrations ranging from <10 to 120 ng/L, which are high enough levels to potentially have adverse impacts (Durhan et al. 2006). Importantly, this information is based on a limited number of studies, and further research is needed to truly understand whether levels observed in surface waters are sufficient to cause adverse effects on aquatic life.

The hormone 17β-trenbolone is considered a potent androgen because it binds with greater affinity to the androgen receptor of fathead minnows than naturally-produced testosterone (Ankley et al. 2003). Research conducted by Jensen et al. (2006) suggests that 17α-trenbolone may be just as potent as 17β-trenbolone. Exposure to the trenbolone acetate metabolites can also result in the formation of dorsal (nuptial) turbercles on females: these tubercles are normally present on spawning males (Ankley et al. 2003, Jensen et al. 2006). In another study, male fathead minnows exposed to fecal slurry from cattle implanted with trenbolone acetate and estradiol experienced demasculinizing and feminizing effects (Sellin et al. 2009). Currently, there are no published studies on the potential adverse impacts of synthetic progestins on aquatic organisms. However, Schiffer et al. (2001) and Lee et al. (2007) provide evidence suggesting that the progestinal activity of melengestrol acetate is estimated to be nearly 125 times greater than that of progesterone.

The presence of hormones in aquatic ecosystems is not new since all mammals naturally produce and excrete hormones. In the past decade, a number of studies, most of which have been focused downstream from wastewater treatment plant discharges, have suggested potential adverse impacts of hormones on the endocrinology of fish (Lee et al. 2007). Additionally, a limited number of case studies suggest that hormones from manure specifically, may have similar endocrine-disrupting impacts on aquatic life (i.e., Blazer et al. 2007). Little is known about the potential adverse impacts of long-term exposure to hormone doses lower than those exhibiting a response over a 21 day test, such as in the previously discussed studies conducted by Ankley et al. (2003) and Jensen et al. (2006). Importantly, the detection of hormones in the environment is relatively new because recent advancements in laboratory methods and analytical techniques have made it possible to detect hormones, which are often present in low concentrations (ng/L) in the environment (Lee et al. 2007). The ability to detect hormones in the environment has allowed for more research on the potential impacts of hormones from human and animal waste streams on aquatic organisms. Given the adverse impacts of exogenous hormones on aquatic organisms, the increasing amount of both natural and synthetic hormones entering the environment through livestock animal manure needs additional review, particularly because some synthetic hormones (e.g., trenbolone acetate) appear to be more stable in the environment than natural hormones (Ankley et al. 2003, Lee et al. 2007).

6.5. Waterborne Disease Outbreaks

Livestock and poultry manure can contain pathogens with zoonotic potential (transferred to humans from other animals) (e.g., Rogers and Haines 2005). Land application of manure presents opportunities for those pathogens to enter recreational waters and drinking water sources, potentially leading to a waterborne disease outbreak (see Chapter 3). Exposure of crops to manure or contaminated water can also lead to foodborne illness.

Although the majority of waterborne disease outbreaks have been attributed to human fecal contamination (Rosen 2000), investigations have identified pathogens in manure as a possible or confirmed source in a number of outbreaks (Rosen 2000, Guan and Holley 2003). A number of examples of outbreaks are briefly described in Table 6-3, which also includes outbreaks caused by contamination of food with manure. This chapter reviews waterborne disease outbreaks, presents examples of notable outbreaks, and notes informational gaps, particularly in the ability to trace the origin of waterborne diseases in many cases.

Table 6-3. Waterborne and foodborne disease outbreaks. *(Table 6-3 continues on the following page.)*

Location	Year	Pathogen	Suspected Source of Contamination	Predominant Illness and Impact	References
Nova Scotia, Canada	1981	*Listeria monocytogenes*	Cabbages grown on a farm fertilized with *Listeria*-contaminated sheep manure.	41 cases of listeriosis, 18 deaths	Health Canada 2009
Carrollton, GA	1987	*Cryptosporidium parvum*	Runoff from cattle grazing areas and a sewage overflow-contaminated river water used for drinking water supply. Also, drinking water treatment deficiencies.	13,000 cases of cryptosporidiosis	Solo-Gabriele et al. 1996, USEPA 2004a
Ayrshire, UK	1988	*Cryptosporidium parvum*	Post-treatment contamination of a municipal drinking water tank with runoff; cattle manure slurry sprayed nearby.	27 confirmed cases, hundreds more suspected	Smith et al. 1989
Swindon & Oxfordshire, UK	1989	*Cryptosporidium parvum*	Oocysts in runoff from fields with cattle entered water supply (Thames River) after heavy rains.	516 cases of cryptosporidiosis over 5 months, mostly children, 8% hospitalized	Richardson et al. 1991, USEPA 2004a
Cabool, MO	1990	*E. coli* O157:H7	Contamination of distribution system with human sewage overflow via water main breaks and meter replacements. Community practices dairy farming.	243 cases of diarrhea, including 86 with bloody diarrhea, 32 hospitalized, 2 Hemolytic-uremic syndrome (HUS), 4 deaths	Geldreich et al. 1992, Swerdlow et al. 1992, Cotruvo et al. 2004
Bradford, UK	1992	*Cryptosporidium parvum*	*Cryptosporidium* oocysts in the water supply after heavy rains in the catchment area. Also, deficiencies in drinking water treatment.	125 cases of cryptosporidiosis	Atherton et al. 1995, USEPA 2004a

Location	Year	Pathogen	Suspected Source of Contamination	Predominant Illness and Impact	References
Maine	1992	*E. coli* O157:H7	Cow manure spread in a vegetable garden.	4 cases of bloody diarrhea, one adult and 3 children	Cieslak et al. 1993, USEPA 2004a
The Netherlands	1993	*E. coli* 0157:H7	Illness was contracted swimming in a semi-natural shallow lake. Possible sources include human excrement and water from ditches draining meadows with cattle.	12 cases of enteritis, 5 children with HUS	Cransberg et al. 1996, Cotruvo et al. 2004
Milwaukee, Wi	1993	*Cryptosporidium parvum*	*Cryptosporidium* oocysts in drinking water source, related to heavy rain and increased turbidity. Source may have been animal manure and /or human excrement.	403,000 cases of cryptosporidiosis, 54 deaths	MacKenzie et al. 1994, Hoxie et al. 1997
Sakai City, Japan	1995	*E. coli* O157:H7	Animal manure used in fields growing alfalfa sprouts.	12,680 cases among schoolchildren, most with diarrhea or bloody diarrhea. 121 cases of HUS, 425 hospitalized, 3 deaths	Fukushima et al. 1999, USEPA 2004a, Rogers and Haines 2005
Connecticut and Illinois, USA	1996	*E. coli* O157:H7	Consumption of mesclun lettuce. Cattle were found near the lettuce fields.	53 cases, 40 with bloody diarrhea, and 3 HUS cases	Hilborn et al. 1999
Washington Co., NY	1999	*E. coli* O157:H7 and *Campylobacter* spp.	Contamination of un-chlorinated water supply well used by food vendors for ice and drinks. Possible sources are of cattle or human origin.	Bopp et al. cite 775 cases, 65 hospitalized, 11 HUS cases, 2 deaths CDC cites 921 persons with diarrhea after attending fair	CDC 1999, Bopp et al. 2003, Cotruvo et al. 2004
California, USA	1999	*E. coli* 0157:NM	Recreational exposure to lake water; fecal contamination may have been from humans, cattle, or deer.	7 cases of diarrhea in children	Feldman et al. 2002, Cotruvo et al. 2004
Walkerton, Canada	2000	*E. coli* O157:H7 and *Campylobacter spp.*	Runoff from farm fields entering a shallow well used for the town's water supply.	2,300 cases of diarrhea, more than 100 hospitalized, 27 HUS cases, 6 deaths	Valcour et al. 2002, Hrudey et al. 2003, Cotruvo et al. 2004, USEPA 2004a, PHAC 2000
Cornwall, U.K.	2004	*E. coli* 0157:H7	Exposure to a freshwater stream crossing a seaside beach; the stream had cattle grazing upstream.	7 cases in children, diarrhea and bloody diarrhea, 4 hospitalized	Ihekweazu et al. 2006

6.5.1. Routes of Exposure and Example Outbreaks

A waterborne disease outbreak is defined by two criteria: 1) two or more persons experience an illness and are linked epidemiologically by time, location of exposure to water, and illness characteristics, and 2) the epidemiological evidence implicates water as the source of illness (Hlavsa et al. 2011). Humans may be exposed to waterborne pathogens via contact with treated or untreated recreational water or ingestion of drinking water (Bowman 2009). Although exposure may also occur through inhalation of some organisms (e.g., *Legionella pneumophila, Naegleria fowleri, Acanthamoeba*), this method of exposure is outside of the scope of this report and is not discussed further. Surface waters may become contaminated by zoonotic pathogens from agricultural or urban runoff, although dilution and die-off can help mitigate the possibility of illness (Rosen 2000). Ground water may become contaminated through infiltration of agricultural runoff or leaching of land-applied manure (Marks et al. 2001), with shallow aquifers and fractured rock and karst aquifers being especially vulnerable. Agricultural or urban runoff may also enter inadequately protected private or municipal wells (Rosen 2000).

Large and/or intense precipitation events can increase the likelihood of contamination of water with microorganisms carried in runoff and/or through impacts on drinking water treatment processes. Such hydrologic conditions in an agricultural watershed raise the possibility of waterborne disease outbreak due to zoonotic organisms in manure. Curriero et al. (2001) analyzed the relationship between precipitation and waterborne disease based on all reported waterborne disease outbreaks in the U.S. from 1948 to 1994. Of 548 waterborne disease outbreaks analyzed, 51% were observed to coincide with extreme precipitation events. A number of examples can be found in which a combination of heavy rainfall and deficient treatment of a surface water supply resulted in a waterborne disease outbreak; some were outbreaks in which manure was a suspected source. For example, insufficient chlorination related to increased turbidity from heavy precipitation was implicated in a 1978 *Campylobacter* outbreak in Bennington, Vermont, with 3,000 cases (Vogt et al. 1982). In this outbreak, the main water source for the town was vulnerable to deficient sewer systems as well as animal excrement on the banks (animal type unknown); increased runoff from the watershed provided contamination, and the additional turbidity decreased the effectiveness of the disinfection.

- ✓ Many waterborne disease outbreaks are undetected or unreported.
- ✓ From 1991-2002, the pathogens for almost 40% of gastrointestinal illness outbreaks associated with drinking water were not identified.
- ✓ Many if not most outbreaks for which the pathogen is known are attributable to human sources of infection.
- ✓ The number of manure-related outbreaks is not known, but contamination from manure has been suggested as a possible causative agent in a number of outbreaks involving zoonotic pathogens.

The Milwaukee outbreak (March and April, 1993) was the largest drinking water-related *Cryptosporidium* outbreak on record and was related to heavy precipitation and drinking water treatment deficiencies. An estimated 403,000 people were affected, and 54 deaths were reported (Hoxie et al. 1997). Milwaukee uses water from Lake Michigan and has two treatment plants; the locations of cases of illness suggested that one of the two plants (Howard Avenue) was responsible (USEPA 2004, Bowman 2009). It is believed that heavy rainfall and snow runoff may have transported *Cryptosporidium* oocysts to Lake Michigan in addition to causing high turbidity (Rosen 2000). Plant operators may not have used adequate coagulant to treat the water (MacKenzie et al. 1994, Bowman 2009). Also, the plant recycled its filter backwash water, possibly concentrating oocysts in the plant. At the time of the outbreak, the plant met all drinking water quality standards (MacKenzie et al. 1994, Rosen 2000), but the treatment processes were not adequate to remove or inactivate *Cryptosporidium* oocysts. After the outbreak, the intake was moved and the plant was upgraded to prevent future *Cryptosporidium* outbreaks by the addition of ozone for disinfection and enhanced filter beds with continuous turbidity meters (MacKenzie et al. 1994, Bowman 2009). Also, the practice of recycling filter backwash water has been discontinued (MacKenzie et al. 1994). Possible sources of the *Cryptosporidium* include cattle manure in the watershed, slaughterhouse waste, and sewage overflow (MacKenzie et al. 1994). Genetic testing has implicated human sewage, but the analysis was based on only four isolates and may not be representative of the entire outbreak (Peng et al. 1997). Thus, the sources of the oocysts remain unclear.

Contamination of ground water supplies has also resulted in waterborne disease. In August of 1999, a large outbreak of *E. coli* O157:H7 and *Campylobacter jejuni* occurred in association with the Washington County Fair in New York State. According to the CDC (1999), 921 individuals reported diarrhea after attending the fair. *E. coli* O157:H7 was cultured from stools from 116 persons, with 13 also infected with *Campylobacter*. Two deaths were reported. Water at the fairgrounds was supplied by six shallow wells, four of which were un-chlorinated (Bopp et al. 2003). One of the un-chlorinated wells was implicated in the outbreak. Two possible sources of contamination were located near the well: a cow manure storage site and a dormitory septic tank. The well may have been contaminated by runoff resulting from a heavy rainfall that occurred during one day of the fair.

An *E. coli* O157:H7 outbreak linked to cattle manure contamination of a ground water supply occurred in May 2000 in Walkerton, Ontario, resulting in more than 2,000 cases. Of those, 27 people developed hemolytic-uremic syndrome (HUS), and there were six deaths. Both *E. coli* O157:H7 and *Campylobacter* were confirmed in stool samples from those infected (PHAC 2000). Testing of one of the town's production wells and the distribution system demonstrated evidence of fecal contamination of the drinking water, and DNA analyses by polymerase chain reaction (PCR) confirmed the presence of *E. coli* O157:H7 (PHAC 2000). To determine the origin of the *E. coli* O157:H7, 13 livestock farms were investigated in the area. *Campylobacter* was found on nine farms, and both *E. coli* O157:H7 and *Campylobacter* were found on two farms, including a farm near the tested drinking water well (PHAC 2000). Typing of isolates, including the use of genetic fingerprinting, matched the isolates from the farm near the well to those found in most of the patients (PHAC 2000, Clark et al. 2003). The analysis indicates that the outbreak was caused by a combination of factors including flooding from heavy rainfall, runoff contaminated by cattle manure, a well vulnerable to surface water contamination (as further indicated by historic records), and decreased disinfection efficacy due to increased turbidity (PHAC 2000, Clark et al. 2003).

Contamination can also occur post-treatment, as was the case with a *Cryptosporidium* outbreak in Ayrshire, England in 1988. Twenty-seven cases of cryptosporidiosis were confirmed, although inquiries by local health authorities suggested that there may have been hundreds of cases. The contamination was traced to intermittent seepage of runoff into a clay pipe that fed into a water tank. Cattle manure slurry had been sprayed nearby, and there had been heavy rain, which would have increased water leakage into the tank (Smith et al. 1989).

If contaminated irrigation water or runoff reaches crops or if manure is applied to fields, foodborne outbreaks may also occur; two thirds of deaths from food-borne outbreaks are attributed to zoonotic bacterial pathogens: *Salmonella* sp., *Listeria monocytogenes, Campylobacter*, and *E. coli* O157:H7 (Bowman 2009). A variety of fresh fruits, vegetables, and nuts may be affected (Rogers and Haines 2005, CDC 2013).

6.5.2. Outbreak Statistics

Data on waterborne disease outbreaks in the U.S. are compiled and reported by the CDC, the Council of State and Territorial Epidemiologists, and the USEPA through the Waterborne Disease and Outbreak Surveillance System (WBDOSS), a voluntary system in place since 1978. Reports are published by the CDC as surveillance summaries, allowing for an assessment of trends in the prevalence of different types of pathogens in recreational and drinking waters. Although these reports do not identify potential animal vs. human sources for outbreaks, they do provide information on the types of illness and the etiologic agents, some of which can be zoonotic. These reports, however, are recognized as underestimates of the true number of outbreaks because of unreported or unrecognized cases (see subsection 6.5.3).

During 2007 and 2008, 36 drinking water-related disease outbreaks were reported to the CDC (Hlavsa et al. 2011); 12 were related to untreated ground water used for drinking, and seven were attributed to treatment failures; these 19 outbreaks all resulted in acute gastrointestinal illness. For recreational water, 134 outbreaks causing nearly 14,000 cases of illness were reported in the same time period (Hlavsa et al. 2011). Outbreaks of acute gastrointestinal illness can be caused by pathogens with zoonotic potential (Rosen 2000). For example, among 21 bacterial outbreaks associated with drinking water during 2007-2008, four were caused by *Campylobacter*, three by *Salmonella* (including one outbreak with 1,300 cases), and one by *E. coli* O157:H7. (Other bacterial outbreaks were caused by *Legionella pneumophila*, which is not considered zoonotic). Two of the three parasitic outbreaks were caused by *Giardia intestinalis* (synonymous with *Giardia lamblia*). Norovirus was responsible for four of the five viral outbreaks. Among 134 recreational water disease outbreaks in 2007-2008, *Cryptosporidium* caused 60 outbreaks, most of which were caused by exposure to treated water such as chlorinated swimming pools and spas (Hlavsa et al. 2011).

6.5.3. Limitations Associated with Detection of Zoonotic Waterborne Disease Outbreaks

Determining the pathogen and tracing the origin of a waterborne disease outbreak can be challenging. Therefore, the causes of outbreaks often remain unknown, including those that may be related to livestock and poultry operations. Between 1991 and 2000, for example, the pathogens associated with nearly 40% of drinking water outbreaks were not identified (Craun et al. 2006). Without knowing which pathogen is responsible for the outbreak, it is even more difficult to trace the pollution source. Livestock and poultry manure is a source of pathogens, but because of the limitations associated with tracing an outbreak back to the source, manure-related outbreaks may be left undetected or attributed to another source incorrectly or by default. For example, if an outbreak cannot be traced to water or if the route of transmission is unclear, the source may be attributed to food (Bowman et al. 2009). It is also generally recognized that reported outbreaks represent only a small portion of total outbreaks (Craun et al. 2006); more research as well as better monitoring and surveillance are needed to better understand the possible extent of underestimation.

Several factors affect whether an outbreak is recognized. Not all infected patients seek medical attention, making the number of cases difficult to track. The local health department needs to have adequate resources for surveillance and investigation (Craun et al. 2006). Also, many outbreaks may simply be too small to notice. Importantly, by the time an outbreak is discovered, the contamination may have already flushed through the water source, making it difficult to conclusively link the outbreak to water or identify the source of pollution (e.g., Hunter et al. 2003, Perdek et al. 2003). Pathogen detection methods also present challenges in terms of time requirements, method sensitivities, the abilities of the pathogens to grow in culture, and indications of viability (Perdek et al. 2003, Cotruvo et al. 2004, Yu and Bruno 1996, Pyle et al. 1999, Hunter et al. 2003, Perdek et al. 2003). These factors compound the difficulty in assessing to what degree (and where) waterborne illnesses may be caused by zoonotic pathogens transported in manure. A number of serotyping methods and molecular methods, however, may be used to attempt to determine the source of a pathogen (e.g., Hunter et al. 2003). An example of a useful development has been the identification of *Cryptosporidium* genotypes that can help determine if the source is zoonotic (e.g., Royer et al. 2002).

6.5.4. Summary and Discussion

Waterborne disease outbreaks can occur from exposure to contaminated recreational water or ingestion of contaminated drinking water. Although many, if not most, outbreaks are believed to be associated with human fecal contamination, livestock and poultry manure contains pathogens that may contaminate water. The number of waterborne disease outbreaks that may be associated with zoonotic pathogens from livestock and poultry manure is not understood. This is in part because confirming the source of an outbreak is challenging, and many outbreaks may not even be recognized. Not all persons will seek medical attention, some outbreaks may be too small to be noticed, and reporting to the WBDOSS is voluntary. Furthermore, among recognized outbreaks of acute gastrointestinal illness, the causative agent remains unidentified for a substantial portion (Craun et al. 2006, Hlavsa et al. 2011).

Routes of exposure to waterborne pathogens may involve entry of pathogen-contaminated water into drinking water supplies, either via runoff or infiltration, or into recreational water via runoff. Heavy rainfall in particular has been implicated in a number of outbreaks; the possibility of manure-related contamination may be greater if manure has been recently applied, allowing runoff contaminated with manure to reach recreational waters or drinking water supplies.

Agricultural sources such as runoff containing manure have been suspected in a number of waterborne outbreaks caused by pathogens with zoonotic potential (Table 6-3). It is not generally possible to confirm unequivocally that the source is agricultural as opposed to human, but watershed characteristics, such as nearby livestock and poultry operations and their proximity to recreational or drinking water resources suggest possible zoonotic transmission. Greater surveillance is needed to understand the degree to which manure-related pathogens may be implicated in waterborne disease outbreaks.

6.6. Potential Manure-Related Impacts Summary and Discussion

Livestock production has become increasingly concentrated in the U.S., which in turn has resulted in greater volumes of manure and associated contaminants in local areas (MacDonald and McBride 2009). This chapter reviews some of the potential and documented impacts associated with emerging contaminants, including antimicrobials and hormones. To a lesser extent, this chapter reviews pathogens and indirect effects of nutrients, which have been reviewed in detail elsewhere (e.g. Rogers and Haines 2005, Camargo and Alonso 2006, NITG 2009). The research provided in the preceding chapters indicates both documented and potential ecological and human health impacts associated with livestock and poultry manure, though overall impacts are largely unknown. Importantly, research indicates that manure runoff can contribute to water quality degradation, and the magnitude of manure generated (1.1 billion tons in 2007) may be of concern.

Aquatic communities can be adversely impacted by manure runoff or discharges to surface waters in a number of ways. Nutrient loading is the typical impact discussed, though large manure spills have been implicated in fish kills and degraded water quality (Mulla et al. 1999). Manure can also be a source of hormones, which are known endocrine disruptors. While research is limited, exposure to hormones from livestock and poultry manure has been implicated in adverse impacts on reproduction, fitness, and behavior in fish (Zhao et al. 2008, Iwanowicz and Blazer 2011).

Manure contamination of drinking and recreational water resources can be a human health concern and/or incur increased drinking water treatment costs. Nutrient loadings to surface waters may also contribute to the growth of HABs, which can produce toxins that can be harmful to human and ecological health (Lopez et al. 2008). Waterborne disease outbreaks have been associated with pathogen contributions from manure, though source detection is challenging (Rosen 2000, Guan and Holley 2003). The human health impacts related to potential long-term exposure via drinking water to low levels of hormones and antimicrobials (from all sources) are unknown. Furthermore, little is known about the potential synergistic effects between antimicrobials and hormones, which may be present in drinking water systems (Weinberg et al. 2008).

A topic of increasing interest has been the issue of widespread antimicrobial use in livestock and poultry. Such widespread use may select for antimicrobial-resistant bacteria (Swartz 2002). Many antimicrobials are also used in human clinical medicine (Sapkota et al. 2007). Related to antimicrobial resistance and human health concerns, the USFDA has banned the use of certain types of antimicrobials for livestock and poultry use (Nelson et al. 2007, Gilbert 2012).

Research pertaining to the human health and ecological impacts associated with livestock and poultry manure is relatively limited, particularly in terms of antimicrobials and hormones. However, as reviewed in this chapter, these contaminants have been detected in manure and environments proximal to livestock and poultry operations. A more thorough understanding of livestock and poultry antimicrobial and hormone use and excretion and better source tracking of waterborne disease outbreaks is needed to fully address the ecological and human health impacts associated with manure generation.

7. Drinking Water Treatment Techniques for Agricultural Manure Contaminants

Drinking water resources may be contaminated with livestock and poultry manure through overland runoff, soil infiltration, direct discharges or atmospheric deposition. Key manure contaminants reviewed in this report include pathogens, antimicrobials, hormones, and nutrients, though Table 1-1 provides a more complete list. Because of their acute negative human health impacts, much research and regulatory attention has been given to ensuring the removal and/or inactivation of pathogens and nutrients such as nitrate and nitrite. For example, MCLs and treatment technique requirements have been established under USEPA's Safe Drinking Water Act, focusing on the removal or inactivation of pathogens from drinking water sources (see USEPA's current drinking water regulations website: http://water.epa.gov/lawsregs/rulesregs/sdwa/currentregulations.cfm). While extensive research has been conducted on pathogens, emerging contaminants, such as hormones and antimicrobials, have only recently been studied. This is largely because of recent developments in analytical techniques that allow for the detection of such contaminants at low levels (e.g., ng/L). Research is limited, though hormones and antimicrobials have been detected in drinking water supplies (Stackelberg et al. 2007, Benotti et al. 2009), and understanding how effectively these compounds are removed by drinking water treatment processes is important for preventing potential long-term public health impacts (Snyder et al. 2008, Weinberg et al. 2008). Ingestion of antimicrobials and hormones via drinking water is likely low over the course of a lifetime, though short- and long-term effects related to low-level exposure or synergisms between different compounds are not fully understood (Weinberg et al. 2008).

This chapter provides a brief overview of watershed management techniques and drinking water treatment processes that can help to reduce surface water pollution and remove contaminants. Importantly, this chapter focuses primarily on antimicrobial and hormone removal from drinking water, because our understanding of removal of these contaminants from drinking water is relatively new given recent advancements in analytical techniques allowing for measurement of these compounds. Information on the removal of pathogens and nutrients is covered briefly, but is well established and available from other sources (USEPA's *Alternative Disinfectants and Oxidants Guidance Manual* (1999), AWWA's *Removal of Emerging Waterborne Pathogens* (2001), USEPA's *Effect of Treatment on Nutrient Availability* (2007).

7.1. Source Water Protection

A multi-barrier approach including source water protection efforts in addition to drinking water treatment can help minimize exposure to animal manure contaminants. The first step in this approach is to utilize source water contamination prevention measures related to livestock and poultry manure that can improve water quality and reduce the burden on drinking water treatment utilities. Management strategies include preventing animals and their manure from coming into contact with runoff and water sources; properly applying manure as fertilizer on crop or pastures during growing seasons to match crop nutrient needs (based on well-developed Nutrient Management Plans), and appropriately managing pastures (USEPA 2001).

A variety of intervention practices may be employed to minimize manure contact with precipitation and runoff. Specific practices include lining and maintaining manure storage lagoons, constructing litter storage facilities, diverting precipitation and surface water away from manure, composting, and treating runoff (Armstrong et al. 2010) (see also Chapter 8 for further information). The goal of pasture management is to protect water resources from direct livestock contact and runoff from animal feeding operations. Fencing can be used to keep livestock and poultry from defecating in or near streams or wells. Additionally, providing alternative water sources and hardened stream crossings for use by livestock lessens their impact on water quality (USEPA 2001). For more information on livestock and poultry management strategies designed to protect water resources, refer to the USEPA's *Source Water Protection Practices Bulletin Managing Livestock, Poultry, and Horse Waste to Prevent Contamination of Drinking Water* (2001).

7.2. Drinking Water Treatment Techniques

While source water protection efforts can help to reduce the burden for contaminant removal on drinking water treatment plants, appropriate treatment processes must also be in place. Conventional drinking water treatment facilities typically incorporate: 1) coagulation and flocculation, in which dirt, colloids and other suspended particles in the water column bind to alum or other chemicals that are added to the water to form floc; 2) sedimentation, in which the coagulated particles (floc) settle to the bottom; 3) filtration, in which particles including clays, silt and organic matter are physically removed; and 4) disinfection, in which microorganisms are killed or inactivated (USEPA 2004b). In addition, treatment facilities may utilize advanced treatment options such as nanofiltration and ultrafiltration, reverse osmosis, ion exchange and carbon adsorption to remove contaminants not removed by conventional filtration (USEPA 2004b).

The following subsections provide a brief overview of pathogen and nutrient removal and a more detailed review of recent research findings on antimicrobial and hormone removal.

7.2.1. Pathogen and Antimicrobial-Resistant Bacteria Removal

Coagulation and filtration processes have been demonstrated to remove bacteria, protozoa and viruses. Maximum removal of pathogens is associated with optimized coagulant dosing and production of water with a very low turbidity. Chlorine, the most common disinfectant in the U.S., is an effective bactericide and viricide. Protozoan cyst and oocysts have been found to be more resistant to chlorine disinfection, and high contact time (CT) values are required for their inactivation. *Crypstosporidium parvum* and *Giardia lamblia* are resistant to chlorine disinfection, though UV light has been found to be an appropriate disinfection alternative. For more information on pathogen removal, refer to the USEPA's *Alternative Disinfectants and Oxidants Guidance Manual* (1999) and AWWA's *Removal of Emerging Waterborne Pathogens* (2001).

The process of chlorination during drinking water treatment has been associated with an increase in antimicrobial-resistant bacteria in treated water. During testing of drinking water source, treated, and tap water, Xi et al. (2009) found that during the treatment process, there was a significant increase in the prevalence of bacteria resistant to amoxicillin, and chloramphenicol. Chlorine-induced formation of multidrug-resistant bacteria has also been documented by Armstrong (1981) and (1982). The process by which this occurs, is not entirely known, though one potential explanation is that in the presence of chlorine, the bacteria increase their expression of efflux pumps, which pump toxins and antibiotics outside of the cell (Xi et al. 2009). Further research in this area will help elucidate the impacts of chlorination on the prevalence of antimicrobial-resistant bacteria.

7.2.2. Nutrient Removal

Nutrient removal in drinking water is focused on nitrate and nitrite, related to the human health impacts briefly discussed in Chapter 6. The USEPA has established a drinking water MCL for nitrite of 1 mg/L and for nitrate-nitrogen of 10 mg/L. Ion exchange, reverse osmosis, and electrodialysis have been shown to remove nitrates/nitrite concentrations to below their MCL. For more information on nitrates and nitrites, please refer to USEPA's Basic Information about Nitrate in Drinking Water, available online at http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm. For information on other nutrients, please see USEPA's Effect of Treatment on Nutrient Availability (2007).

7.2.3. Antimicrobial and Hormone Removal

Each step of the drinking water treatment process differs in its efficacy in removing antimicrobials and hormones. Generally, concentrations of antimicrobials and hormones tend to be lower in finished (i.e., treated) water than in source water, either due to degradation or removal (Stackelberg et al. 2007, Snyder et al. 2008). For example, Stackelberg et al. (2007) measured the removal of antimicrobials in a conventional drinking water treatment plant and found that, out of seven antimicrobials detected in source water, only one persisted at detectable concentrations after treatment. In that study, erythromycin, erythromycin-H_2O (an erythromycin degradate), lincomycin, sulfadimethoxine, sulfamethazine, and sulfamethoxazole, all decreased from <0.1 μg/L in source water to non-detectable concentrations in finished, treated water. Sulfathiazole persisted through treatment, though maximum concentrations decreased from 0.08 μg/L in source water to 0.01 μg/L in finished water. Reporting levels for this study ranged from 0.01 μg/L to 0.1 μg/L for the aforementioned antimicrobials.

Importantly, even when treatment appears to remove nearly all of a compound from source water, those compounds are likely still present in the treated effluent, either as degradates or in concentrations below the method detection limit (Snyder et al. 2008, Weinberg et al. 2008). Furthermore, most research has focused on commonly used antimicrobials and naturally produced, rather than synthetic, hormones. Therefore, our knowledge of the amount of antimicrobials and hormones in drinking water is essentially a function of which compounds are analyzed and the analytical methods used. According to Snyder et al. (2008), no water is 'drug free' given the variety of sources of these compounds to the environment. Although some antimicrobials may be degraded during treatment, their degradates may remain biologically active, potentially having long-term public health impacts (Dodd et al. 2005, Weinberg et al. 2008). The following subsections review available research on each treatment process in terms of its effectiveness in removing antimicrobials and hormones from source water.

7.2.3.1. Coagulation and Sedimentation

The effectiveness of coagulation and sedimentation in antimicrobial and hormone removal appears to vary, though the processes are generally considered to be relatively ineffective in overall removal (Westerhoff et al. 2005, Stackelberg et al. 2007). Using ferric chloride as a coagulant, Stackelberg et al. (2007) reported 33% removal of sulfamethoxazole, 47% removal of erythromycin-H_2O, and 60% removal of acetaminophen from source water. However, in a separate study, coagulation using ferric salt or alum did not result in any statistically significant removal of carbadox, trimethoprim, or various types of sulfonamides (Adams et al. 2002). The relative ineffectiveness of coagulation and sedimentation in antimicrobial removal is not surprising because these processes remove hydrophobic compounds, and antimicrobials tend to be hydrophilic (Weinberg et al. 2008, Chee-Sanford et al. 2009).

Coagulation using alum or ferric salt appears to be even less effective in hormone removal (Westerhoff et al. 2005). Using alum, ethynlestradiol, and androstenedione were not removed in measurable amounts, and only approximately 2% of estradiol, 5% of estrone, and 6% of progesterone were removed from source water (Westerhoff et al. 2005). Using ferric salt during coagulation resulted in similar low removals.

7.2.3.2. Filtration and Adsorption

Nanofiltration and reverse osmosis (RO) have been shown to be effective at removing organic compounds (Snyder et al. 2008), while ion exchange is relatively ineffective in antimicrobial removal (Adams et al. 2002). The use of nanofiltration has been shown to remove as much as 80% of chlortetracycline, but only 11% to 20% of sulfonamides (Koyuncu et al. 2008). Removal of the hormones estriol, estradiol, estrone, 17α-ethinylestradiol, and testosterone through nanofiltration range from 22% to 46% (Koyuncu et al. 2008). In a separate study, Nghiem et al. (2004) also reported effective removal of estradiol, estrone, testosterone, and progesterone by nanofiltration.

Using RO, Adams et al. (2002) reported 90% removal of carbadox, trimethoprim, and sulfonamides from Mississippi River water. Currently, limited research on RO in terms of hormone and antimicrobial removal has been conducted, and despite its apparent effectiveness, RO implementation is costly and may not always be economically feasible.

The use of activated carbon appears to be effective in removing organic compounds; however, activated carbon must be regularly replaced or regenerated in order to maintain effectiveness, and the contact time and dose are also important factors in its capacity to remove compounds (Snyder et al. 2006, 2008). As much as 21% of sulfamethoxazole and 65% erythromycin-H_2O may be removed through powdered activated carbon (PAC) adsorption (Westerhoff et al. 2005). The PAC dosage may be an important factor in antimicrobial removal efficacy. Using PAC doses of 10 mg/L, Adams et al. (2002) reported that antimicrobial removal ranged from 49% to 73% in Mississippi River source water, while removal rates ranged from 65% to 100% using a PAC dose of 20 mg/L. The use of PAC also appears to be effective in removing hormones from source water, with as much as 88% of testosterone, 93% of progesterone, and 94% of estradiol removed after four hours of PAC contact time (Westerhoff et al. 2005). PAC is typically only used during certain times of the year, such as during algal blooms in the late spring or summer. The use of granular activated carbon (GAC) is expected to be effective (Adams et al. 2002), though limited research has been conducted on this process in terms of antimicrobial and hormone removal.

7.2.3.3. Disinfection

Research indicates that the disinfection process is instrumental in antimicrobial and hormone removal/degradation during water treatment (Adams et al. 2002, Stackelberg et al. 2007, Snyder et al. 2008, Weinberg et al. 2008). Depending on the treatment facility, disinfection may involve the use of chlorine compounds, ozone, or UV light treatment. Chlorine disinfectants tend to react with antimicrobials such as sulfamethoxazole, trimethoprim, ciprofloxacin, and enrofloxacin, leading to their degradation, but potentially not completely eliminating their biological effect because of the formation of degradation products (Dodd et al. 2005, Weinberg et al. 2008). Disinfection through the use of sodium hypochlorite can significantly decrease the concentration of sulfathiazole in source water (Stackelberg et al. 2007). Regarding hormone removal, Snyder et al. (2008) reported higher removal rates of estrogen than testosterone and progesterone during chlorine treatment; over 20% of testosterone and progesterone were removed, while upwards of 100% of estradiol, estriol, and estrone were removed during bench-scale analyses. Although chlorination provides critical benefits in the disinfection process, it may also lead to the formation of undesirable disinfection byproducts, which can be carcinogenic. The costs and benefits of chlorination in this regard should be further evaluated.

Ozone may be more rapid and effective than chlorine compounds in organic compound removal (Weinberg et al. 2008). Adams et al. (2002) found that concentrations of antimicrobials in Mississippi River water decreased by over 95% through the use of ozone, demonstrating the effectiveness of this disinfection method. Similarly, Snyder et al. (2005) found that sulfamethoxazole concentrations in drinking water decreased from 9.7 ng/L in source water to below the detection limit (<1 ng/L) in treated water after ozonation. Ozone has also been shown to oxidize nearly 100% of testosterone, progesterone, and estrogen hormonal compounds, suggesting that ozonation is more efficient in removing hormones than is chlorination (Snyder et al. 2008). Similar results were observed by Westerhoff et al. (2005) in terms of hormone removal through the use of ozonation.

UV light alone appears to be less effective than chlorination and ozonation in removing hormones and antimicrobials (Snyder et al. 2008). Also, the dose of UV light typically used for disinfection to kill microorganisms is orders of magnitude lower than what would be required to remove micropollutants such as organic compounds (Snyder et al. 2003). However, a combination of UV light and hydrogen peroxide appears to be effective in hormone removal (Rosenfeldt and Linden 2004) and antimicrobial removal (Weinberg et al. 2008, Giri et al. 2011). Certain antimicrobials including tetracycline, chlortetracycline, and oxytetracycline may undergo photodegradation under UV light, the rate of which markedly increases when low concentrations of hydrogen peroxide are added to the disinfection process (López-Peñalver et al. 2010).

7.3. Summary and Discussion

Conventional drinking water treatment processes are effective at removing pathogens, and some treatment plants employ additional processes that effectively remove nutrients. Recent research indicates that conventional drinking water treatment practices are also effective in decreasing the concentrations of hormone and antimicrobials in source water, particularly during disinfection (Adams et al. 2002, Snyder et al. 2008). Filtration using nanofiltration and reverse osmosis is highly effective in antimicrobial and hormone removal (Koyuncu et al. 2008), though these processes are not always used in conventional drinking water treatment facilities, and limited research is available. Antimicrobials and hormones, as with all organic compounds, vary widely in physical and chemical characteristics and may be rapidly removed or unaffected by certain drinking water treatment processes. Therefore, antimicrobial and hormone removal from drinking water may be enhanced through the implementation of multiple treatment and disinfection methods (Snyder et al. 2008). Whereas public water systems are subject to drinking water treatment processes, private drinking water wells are typically not tested or treated for these compounds, so antimicrobials and hormones in private groundwater drinking water systems affected by livestock and poultry production may remain undetected. A stronger understanding of the prevalence and concentrations of antimicrobials and hormones in drinking water, as well as more research on which treatment processes best remove these compounds, will help in planning strategies to minimize their consumption and any potential associated health effects.

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8. Managing Manure to Control Emerging Contaminants

Historically, the focus of manure management has been on utilizing the nutrients in manure for crop production. In recent decades, livestock and poultry producers, land grant universities, and government agencies have worked together to develop practices and systems to minimize the impact of manure production and utilization on air and water quality, including drinking water. Though the practices and systems promoted by these programs typically do not focus specifically on the potential connections between manure, pathogens, emerging contaminants, and water quality, they do address many of the potential pathways described in this report (e.g., erosion, runoff, infiltration). Widespread implementation of appropriate practices and systems will help to reduce agricultural runoff and minimize the potential environmental problems associated with emerging contaminants from livestock and poultry manure.

This chapter provides a brief overview of the standard basic strategies for managing manure and a summary of additional approaches that can provide further benefits, including economic benefits. Many of the existing programs and standards described within this chapter are managed by the USDA Natural Resources Conservation Service (NRCS). Partnerships between federal agencies (including USDA and USEPA), conservation professionals, university extension offices, and local producers have formed to develop programs and technical standards that conserve natural resources, reduce soil erosion, decrease pollutant loading to the nation's surface waters, and improve source water protection. This overview is not intended to be exhaustive; the objective is to highlight information that is most relevant to individuals working to improve water quality. To learn more about tools, policies, technical standards, and programs that may not be listed here and may be more relevant to a specific location, contact your state or local NRCS District Conservationist or your area's Cooperative Extension Service. A sampling of online resources that are available to help planners and producers related to manure management are listed in Appendix 3.

8.1. Land Application of Manure

Manure serves as a nutrient-rich natural fertilizer and is commonly applied to cropland. In some cities, however, facilities that serve as holding pens before slaughter may discharge to wastewater treatment operations instead of land-applying the manure. Variations in the operational characteristics of livestock and poultry facilities (e.g., layout, herd size, access to forage crops and pastures, etc.) make it challenging to identify specific practices that implement widely-accepted principles regarding the timing, location, and rate of manure land application. Thus, NRCS has placed increased emphasis on meeting overarching resource conservation objectives through the development and implementation of nutrient management plans that determine the location and amount of manure applied to meet crop needs and keep manure out of surface and ground water resources. Appropriately managing manure as part of a nutrient management plan should also minimize the loading of other emerging contaminants, though there is relatively little research available that specifically addresses the consequences of manure management on emerging contaminants. In addition, there are many financial incentives to developing and implementing a nutrient management plan, including cost savings within the operation and increased access to federal financial assistance programs.

The NRCS Conservation Practice Standard 590 provides criteria for nutrient management through land application (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046433.pdf). Producers receiving financial support from USDA for nutrient management must follow this standard.

The USEPA also requires nutrient management plans for any operation seeking a permit under the national pollutant discharge elimination system (NPDES) program. (See discussion under 8.5. CAFO Discharge Regulations). Any operation seeking NPDES permit coverage must submit a nutrient management plan as part of its permit application to be covered by an individual permit or a notice of intent to be covered by a general permit (40 CFR 122.23(h) and 122.42(e)(1)). A nutrient management plan is a manure and wastewater management tool that every permitted CAFO must use to properly manage discharges from the production or land application areas through the use of best management practices.

The regulations specify nine minimum requirements that must be included in the nutrient management plan, to the extent that they are applicable (40 CFR 122.42(e)(1)). The NPDES nutrient management practices were developed to be consistent with the content of comprehensive nutrient management plans as defined by USDA in the *Comprehensive Nutrient Management Plan Technical Guidance*. However, there are some differences between the requirements of a nutrient management plan for NPDES permitting and a comprehensive nutrient management plan as defined by USDA. The USEPA describes nutrient management planning requirements in the 2012 Technical Manual for Concentrated Animal Feeding Operations, available at http://cfpub.epa.gov/npdes/afo/info.cfm#guide_docs.

There are many resources available to assist producers with the development of nutrient management plans, including online tools (see Appendix 3) and individual consultation services provided by crop consultants, NRCS, conservation districts, and university extension personnel.

8.2. Manure Storage

Manure storage enables livestock and poultry producers with confined operations to better implement their nutrient management plans and apply their manure to address crop needs. Adequate storage capacity enables operators to store manure during times of the year when no crops are growing and avoid applying manure on frozen or snow-covered ground, immediately before, during, or after precipitation events, or when the land is saturated (Zhao et al. 2008). Storing manure for extended periods of time may also minimize pathogen loads and promote degradation or adsorption of antimicrobials and hormones (Shore et al. 1995, Lee et al. 2007).

Thoughtful design of manure storage infrastructure is critical for ensuring there is adequate capacity to prevent spills and over-topping of an open structure. Operational practices, such as covering open storage lagoons, are also important for preventing the addition of precipitation and managing manure volumes. The NRCS provides additional location-specific information about the design and operation of manure storage structures in their Technical Standards.

Diverting Rainfall. Constructing diversions and gutters around animal lots and buildings are inexpensive and effective ways to minimize the amount of water falling on and washing across manure covered areas. Diverting rainfall from areas with manure is often the first step in reducing the amount of runoff that must be managed to avoid pollution issues. The USEPA requires diversion of clean water, as appropriate, for operations with NPDES permit coverage. Clean water includes, but is not limited to, rain falling on the roofs of facilities and runoff from adjacent land.

Storage Structures. There are many common types of storage structures, including walled enclosures, lagoons, earthen ponds, above-ground tanks and under-floor storage pits. The size and choice of storage structure depends on multiple factors, including the animal production system, precipitation patterns, siting or design limitations, bedding materials, availability of on-site and off-site transportation options, local and state regulations, and costs. Following construction, storage structures should be checked periodically for leaks to prevent contamination of surface water and ground water. Also, insufficient storage capacity increases the risk of runoff from manure piles and spills from lagoons and other containment structures. Furthermore, it increases the possibility that an operation will have to land apply during periods of increased risk to surface water (e.g., during rainfall events).

8.3. Treating Manure

On some farms and in some geographic areas, the amount of manure produced from livestock and poultry operations exceeds what can be safely applied to nearby croplands or pastures to meet nutrient needs. To manage surplus manure, technologies have been developed to treat manure nutrients such that additional options for disposition of nutrients become viable. Recent research indicates that some of these technologies and processes may also promote removal and degradation of pathogens, antimicrobials, and hormones. Although many of these technologies have been proven from an engineering perspective, the costs are generally prohibitive for most producers. Livestock and poultry producers need to analyze the economic viability of any of these technologies for their specific operations. However, potential economically beneficial options do exist such as the sale of electricity generated through the manure-to-energy process. In some cases, nutrients from manure, such as phosphorus byproducts, can be recovered, sold and transported to locations low in phosphorus (Szogi et al. 2010). Given that phosphorus is a nonrenewable resource, it is anticipated that these byproducts could become an increasingly valuable source of income (Chesapeake Bay Commission 2012).

8.3.1. Physical and Chemical Treatments

Physical and chemical treatments are designed to separate the solids and liquids in manure slurry to make the manure easier to utilize, handle, and transport. For example, as recommended in an Ohio State University Extension manure management guide, solids may be reused for livestock bedding material, and liquids can be recycled for washing down hard surfaces (James et al. 2006).

Physical treatment of manure involves separating solids from liquid manure through settling, filtration, screening, or drying. Settling basins are used to separate solids through natural settling so that the solids can be removed (James et al. 2006). Solids may also be separated out in a mechanical centrifuge or through filtering and screening systems that remove solids as the liquid waste passes through. Filtering systems may be constructed with sand drying beds, stationary or vibrating screens, or vacuum filters (James et al. 2006). Manure may also be dried passively (i.e., spread in a manner that allows water to evaporate), though this method is more time consuming and is more likely to result in the emission of foul odors and greenhouse gases unless additional steps are taken to capture the emissions. The effects of physical treatment on emerging contaminants are unknown.

Chemical treatment involves the addition of coagulants, such as lime, alum, and organic polymers to manure (James et al. 2006). Coagulants are effective at separating solids and liquids, but the agents may persist in the manure and may reach surface waters and ground water through runoff and infiltration, if land applied. Some coagulants decrease the presence of pathogens, such as quick lime (CaO) or hydrated lime ($CaOH$), which increase pH and kill most microorganisms (James et al. 2006). Adding lime, however, results in an immediate loss of ammonia from the manure through volatilization (James et al. 2006), reducing its quality as a fertilizer and creating air quality concerns. The effects of chemical treatment on emerging contaminants in manure are largely unknown.

8.3.2. Biological Treatment Techniques

Biological treatment of manure occurs within traditional manure storage structures and other less traditional methods such as composting and anaerobic digestion. These methods remove pathogens and can reduce the total volume of manure. This subsection focuses on less traditional treatments: composting and anaerobic digestion.

8.3.2.1. Composting of Manure

Composting is the process of aerobic biological decomposition of manure in a controlled environment. During composting, microorganisms decompose the manure, increasing the temperature and inactivating pathogens. Numerous factors influence the effectiveness of composting, including nutrient balance (i.e., carbon to nitrogen ratio), water content, oxygen availability, porosity, and temperature (James et al. 2006). Composting manure prior to land application provides some benefits, including reduction of odor and fly problems and weed seeds (USDA 2009j). When composting is properly controlled, most pathogens are inactivated at higher temperatures (i.e., greater than 55° F), with the exception of some viruses and worm eggs (Rosen 2000, Olson 2001, Venglovsky et al. 2009). Also, the quality of the manure as a fertilizer increases when composted, because the nitrogen becomes more stable and nutrients are released more slowly than they are from raw manure (Zhao et al. 2008, USDA 2009j), though nitrogen volatilization during composting reduces the total amount of nitrogen available in the manure. When composting is used as part of a system that includes separation of liquids and solids, the practice can reduce the total amount of dry matter by 50% to 75%, with greater reductions for swine and dairy cow manure, and the total volume of manure can be reduced by as much as 85% (USDA 2007c).

Recent research suggests that composting may promote antimicrobial degradation (Zhao et al. 2008, Ramaswamy et al. 2010), although given the structural diversity of antimicrobials, degradation rates likely vary among compounds. A recent USDA study found that concentrations of extractable oxytetracycline in beef cattle manure mixed with straw and wood chips decreased by over 99% during 35 days of composting (Arikan et al. 2007). Additionally, populations of oxytetracycline-resistant bacteria were ten times lower in the manure after composting. This study suggests that adding straw and wood chips to manure, thereby increasing the temperature during composting, may allow for more rapid antimicrobial and pathogen reduction and/or adsorption. Arikan et al. (2009) documented declines of 99% and 98% in concentrations of extractable chlortetracycline and *epi*-chlortetracycline, respectively, in composted and sterile incubated manure mixtures. In another study, rates of antimicrobial decline in turkey litter extracts were measured during manure stockpiling, managed composting (i.e., routine mixing and managed moisture content), and in-vessel composting (i.e., controlled composting in a rotating steel drum) (Dolliver et al. 2008). In that study, chlortetracycline concentrations rapidly declined during all three treatments, with more than 99% removal within ten days. Concentrations of monensin and tylosin also decreased, but more gradually, with reductions ranging from 54% to 76% during the three treatments. In contrast, concentrations of sulfamethazine remained stable during all three treatments (Dolliver et al. 2008). In combination with recent research indicating that sulfonamides may be the most mobile antimicrobials (Chee-Sanford et al. 2009), the persistence of sulfamethazine (a type of sulfonamide) merits further study of its environmental occurrence and potential effects.

Composting is presumed to be an effective means of reducing hormone concentrations in manure via aerobic digestion (Zhao et al. 2008), though limited research has been conducted. One USDA study found that concentrations of 17β-estradiol and testosterone decreased by 84% and 90%, respectively, in chicken layer manure during composting (Hakk et al. 2005). In that study, testosterone concentrations declined at a faster rate than the 17β-estradiol concentrations. A more recent USDA study reported degradation of 17β-estradiol in poultry litter composted under heated conditions and at room temperature (Hakk et al. 2011). Limited research in this area is available, however, and further research on the degradation and adsorption of both natural and synthetic hormones in manure from various animal types would help elucidate the effectiveness of composting in removing hormones.

8.3.2.2. Anaerobic Digesters/Methane Capture

Anaerobic digesters, or biogas recovery systems, are oxygen-free environments in which bacteria break down manure, generating gases that may be captured for energy use. One of the primary gaseous byproducts of anaerobic digestion, methane, is combustible and may be used to generate electricity needs on the farm (e.g., to warm on-site buildings or heat water), sold to a local electric utility, or converted to compressed natural gas for fueling needs (USEPA 2011b). Liquid effluent from the digester may be spread on fields as fertilizer, since the digester does not reduce the nutrients in the manure. Digested solids may be used as livestock bedding material, or they may be sold for use as a soil amendment or for use in building materials such as particle board (USEPA 2011b).

There are a variety of types of anaerobic digesters; in 2010, the most commonly used types in the U.S. were mixed plug flow digesters (54%), complete mix digesters (42%), and covered lagoons (27%) (USEPA 2011c). A plug flow digester is a long, narrow, covered concrete tank and is used at dairy facilities that collect manure through scraping. A complete mix digester is an enclosed heated tank with a gas mixing system; this type of digester is optimal when manure is diluted with water. A covered lagoon digester is a lagoon with a flexible cover that minimizes atmospheric gas exchange and allows the recovered gas to be piped to a combustion device (USEPA 2011b).

The number of digesters in the U.S. has been steadily increasing since 2000 (USEPA 2011c). In 2010, there were 162 anaerobic digesters in the U.S., generating over 450 million kilowatt hours (kWh) of energy; this is equivalent to the amount of energy used to power 25,000 average American homes for a year. Additionally, the amount of methane emissions avoided due to use of digesters in 2010 was equivalent to reducing annual oil consumption by nearly 2.8 million barrels (USEPA 2011c). The majority of digesters are on dairy farms in the Midwest and Northeast, with 33 states having digesters in 2010 (USEPA 2011c).

Anaerobic Digester Provides Farm a Source of Income and Reduces Environmental Impact:

Brubaker Dairy Farms in Pennsylvania was named the 2011 Innovative Dairy Farmer of the Year by the International Dairy Foods Association for implementing an anaerobic digester powered by solar panels. The farm has over 1,400 cows and also produces 250,000 broilers annually. The digester kills fly larvae and weed seeds, reduces odors by 75% to 90%, and reduces the farm's methane and other greenhouse gas emissions.

All undigested fibers are reused as bedding for the cows or sold to other dairy farmers for bedding or gardening. The digester also generates enough energy in the form of electricity to power 150 to 200 homes per day. The majority of the energy is sold to a local utility, generating more income for the farm. Brubaker Dairy Farms has shown that these systems can work to minimize environmental impact and increase profit margin. (References: Brubaker 2009, IDFA 2011).

The benefits of using anaerobic digesters include reductions in pathogens, reduced greenhouse gas emissions (methane and carbon dioxide), and minimization of odors (USDA 2011c). As reviewed by Sahlström (2003), while time and temperature (among other factors) influence pathogen inactivation, anaerobic digestion has been shown to be effective in reducing 90% of viable counts of microorganisms in hours (120-130°F) to days (86-100°F). Limited available research also suggests that anaerobic digesters may facilitate hormone and antimicrobial degradation. For example, concentrations of 17β-estradiol in dairy manure have been shown to decrease by 40% during anaerobic digestion (Zhao et al. 2008). A separate USDA experiment found that concentrations of oxytetracycline decreased by nearly 60% during 56 days in an anaerobic digester (Arikan et al. 2006). The study also reported that manure laden with 62 μg/g oxytetracycline and diluted 5-fold with water resulted in a 27% decrease in biogas production, indicating potential consequences of antibiotic use on the cost-effectiveness of anaerobic digestion. Levels of chlortetracycline in swine manure and monensin in cattle manure were also reduced by varying degrees after 21 days in anaerobic digesters set at different temperatures (Varel et al. 2012).

8.4. Financial and Technical Assistance Programs

Financial and technical assistance programs are available to help offset the costs of manure management. The table below highlights a few of the key federal programs managed by NRCS that provide financial assistance to producers. In addition to these resources, there are many state and local programs that provide loans and grants for reducing the environmental risks associated with manure.

Table 8-1. Key USDA-NRCS programs that may provide financial assistance to producers.

Program Name	Description	Website
Agricultural Management Assistance (AMA)	Provides financial and technical assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into their farming operations.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ama/
Agricultural Water Enhancement Program (AWEP)	Voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land to conserve surface and ground water and improve water quality.	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/awep/?&cid=nrcs143_008334
Conservation Innovation Grants (CIG)	Voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/cig/?&cid=nrcs143_008205
Environmental Quality Incentives Program (EQIP)	Voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length.	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

Source: NRCS, 2012. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial

8.5. CAFO Regulations

The USGAO (2011b) noted that discharges from CAFOs share many of the traits of a diffuse, nonpoint source but are treated and regulated as a point source. The Clean Water Act specifically includes the term "concentrated animal feeding operation" in the definition of point source (Clean Water Act, Section 502(14)), and the NPDES program regulates discharges of pollutants from point sources. Under the NPDES permitting program, regulations governing CAFOs consist primarily of two different sets. The regulations at 40 CFR 122.23 set the framework for CAFO permitting by establishing criteria that define CAFOs and specifying whether and when a CAFO must have permit coverage. The second set of regulations, which are at 40 CFR Part 412, are the effluent limitations guidelines and standards for CAFOs, which establish discharge limits and certain management practice requirements that must be included in NPDES permits for CAFOs.

Any CAFO seeking NPDES permit coverage must submit a nutrient management plan as part of its permit application to be covered by an individual permit or a notice of intent to be covered by a general permit (40 CFR 122.23(h) and 122.42(e)(1)). A nutrient management plan is a manure and wastewater management tool that every permitted CAFO must use to properly manage discharges from the production or land application areas through the use of best management practices.

For more detailed information on CAFO regulations, refer to USEPA's CAFO rule history website: http://cfpub.epa.gov/npdes/afo/aforule.cfm. For further information on aquaculture NPDES regulations, visit: http://water.epa.gov/scitech/wastetech/guide/aquaculture/index.cfm.

8.6. Additional Technical Resources

A sampling of available on-line resources that are obtainable to help planners and producers related to manure management are listed in Appendix 3.

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Appendix 1. Livestock Animal Unit and Manure Production Calculations

Livestock manure production was estimated using standard methods and conversion factors developed by the USDA's NRCS (see for example Kellogg et al. 2000, Gollehon et al. 2001, and Midwest Planning Service 1985), converting livestock and poultry head counts to animal units (AU). Animal units are a common unit of measure based on animal weight, allowing for the calculation of manure generation and a method for aggregating across animal types and life stages. For this report we used USDA's 2007 Census of Agriculture livestock count data for cattle, swine, chickens (layers and broilers), and turkeys as well as acreage of land in farms for each state. "Land in farms" is defined by the USDA (2009a) as primarily agricultural land used for grazing, pasture, or crops, but it may also include woodland and wasteland that is not under cultivation or used for grazing or pasture, provided it is on the farm operator's operation. For cattle, three categories were used: beef cows, milk cows, and "cattle excluding cows" (e.g., breeding and replacement stock). The total inventory numbers (head of animals) from the end of December, 2007 were used to generate the final numbers of AUs in each state. Similar, but more complex, methods were employed by Kellogg et al. (2000) which used USDA's Census of Agriculture data to calculate livestock and poultry manure generation and manure nutrient contributions, evaluate trends in livestock production, and quantify the extent to which manure nutrient contributions exceed crop assimilative capacity. Additionally, Kellogg et al. (2000) calculated AUs using 16 livestock categories/life stages from more detailed marketing statistics to refine estimates of manure generation and nutrient recovery, and make estimates of confinement operations. (Note: the overall state and national estimates of this report are within a few percentage points of the estimates of these reports for total manure generated).

The AU and manure production conversion factors were then related to the appropriate animals for breeding and marketing for each livestock type (see Table A-1). Following the procedures, three quarters of the "cattle excluding cows" were treated as "Steers, Calves, & Bulls" and the remaining quarter were treated as "Heifers & Dairy Calves," which assumes that roughly half of the animals in this category are adult animals slated for slaughter, and the remaining half is equally split between young females (heifers) and males (steers). Turkey counts were treated as slaughters to provide a more conservative estimate for this animal type (i.e., there are more AUs per slaughter turkey than breeder turkey, therefore providing lower manure generation estimates; see Table A-1).

Table A-1. The number of animal units (AU) and associated manure generation per animal type as defined by USDA's NRCS.

Animal Type	Animals per AU	Manure Generation per AU (tons)
Beef Cattle	1	11.5
Dairy Cows	0.74	15.24
Heifers & Dairy Calves	1.82	12.05
Steers, Calves, & Bulls	1.64	10.59
Swine, Breeders	2.67	6.11
Swine, Market	9.09	14.69
Chickens, Layers	250	11.45
Chickens, Broilers	455	14.97
Turkeys for Slaughter	67	8.18
Turkeys Hens for Breeding	50	8.18

Kellogg et al. 2000, Gollehon et al. 2001.

Converting all the animal types to AUs allows the total number of all AUs to be summed as well as the total estimated manure produced to be summed, so a "total" comparison among the states can be done, as shown in the tables in this appendix. Also, livestock and poultry manure generation was estimated by dividing state manure generation by the sum of land in farms both owned and rented in each state – the most likely land-base for the application of the manure – using data from the USDA's 2007 Census of Agriculture, as discussed in Chapter 2. To illustrate the AU and manure generation calculations, the following example is provided using beef cattle counts in Texas. Calculated data for all states are shown in Tables A-2 to A-9.

$$\text{AUs} = \frac{\text{2007 USDA Census of Agriculture } \mathit{inventory}}{\mathit{Animals\ per\ AU}}$$

$$Texas\ beef\ AUs = \frac{5{,}259{,}843}{1} = 5{,}259{,}843\ AUs$$

$$Percentage\ of\ U.S.\ livestock = \frac{State\ inventory}{Sum\ of\ inventory\ in\ all\ reporting\ states} \times 100$$

$$Texas'\ percentage\ of\ U.S.\ beef\ stock = \frac{5{,}259{,}843}{32{,}834{,}801} \times 100 = 16.02\%$$

$$Tons\ of\ manure\ produced = AUs \times tons\ manure\ produced\ per\ AU$$

$$Texas'\ beef\ manure\ production = 5{,}259{,}843 \times 11.5 = 60{,}488{,}195\ tons$$

$$Total\ AUs = (Beef\ Cow + Milk\ Cow + Cattle\ Excluding\ Cows\ AUs) + (Swine\ Breeder + Swine\ Market\ AUs) + (Layer + Broiler\ AUs) + (Turkey\ AUs)$$

$$Texas'\ AUs = (5{,}259{,}843 + 404{,}399 + 4{,}784{,}377) + (35{,}550 + 116{,}708) + (76{,}467 + 260{,}686) + (29{,}654) = 11{,}109{,}770\ AUs$$

$$\frac{AUs\ or\ tons\ manure}{acre} = \frac{AUs\ or\ tons\ manure}{land\ owned, in\ farms + land, rented, in\ farms}$$

$$\frac{AUs}{acre}\ in\ Texas = \frac{11{,}109{,}770}{75{,}578{,}240 + 54{,}299{,}426} = 0.09\frac{AUs}{acre}$$

Tables A-2 through A-9 present summaries of livestock AUs and estimated total manure generated by those livestock for all 50 states. The states are listed in rank-order in the different categories.

Table A-2. Total animal units and estimated tons of manure produced for beef and dairy cattle in 2007.

National Rank	State	Total Beef Cattle AUs	Percent of Total Beef Cattle AUs	Total Tons Manure	National Rank	State	Total Dairy Cow AUs	Percent of Total Dairy Cow AUs	Total Tons Manure
1	TEXAS	5,259,843	16.02%	60,488,195	1	CALIFORNIA	2,487,473	19.86%	37,909,088
2	MISSOURI	2,089,181	6.36%	24,025,582	2	WISCONSIN	1,688,255	13.48%	25,729,012
3	OKLAHOMA	2,063,613	6.28%	23,731,550	3	NEW YORK	846,561	6.76%	12,901,587
4	NEBRASKA	1,889,842	5.76%	21,733,183	4	PENNSYLVANIA	747,731	5.97%	11,395,422
5	SOUTH DAKOTA	1,649,492	5.02%	18,969,158	5	IDAHO	724,950	5.79%	11,048,238
6	MONTANA	1,522,187	4.64%	17,505,151	6	MINNESOTA	621,286	4.96%	9,468,406
7	KANSAS	1,516,374	4.62%	17,438,301	7	TEXAS	546,485	4.36%	8,328,433
8	TENNESSEE	1,179,102	3.59%	13,559,673	8	MICHIGAN	465,180	3.71%	7,089,339
9	KENTUCKY	1,166,385	3.55%	13,413,428	9	NEW MEXICO	441,081	3.52%	6,722,076
10	ARKANSAS	947,765	2.89%	10,899,298	10	OHIO	367,484	2.93%	5,600,453
11	FLORIDA	942,419	2.87%	10,837,819	11	WASHINGTON	328,557	2.62%	5,007,205
12	NORTH DAKOTA	930,023	2.83%	10,695,265	12	IOWA	291,069	2.32%	4,435,890
13	IOWA	904,100	2.75%	10,397,150	13	ARIZONA	248,303	1.98%	3,784,133
14	COLORADO	735,014	2.24%	8,452,661	14	INDIANA	224,526	1.79%	3,421,771
15	WYOMING	732,141	2.23%	8,419,622	15	VERMONT	188,809	1.51%	2,877,456
16	VIRGINIA	695,061	2.12%	7,993,202	16	COLORADO	171,546	1.37%	2,614,360
17	ALABAMA	678,949	2.07%	7,807,914	17	FLORIDA	161,968	1.29%	2,468,386
18	CALIFORNIA	662,423	2.02%	7,617,865	18	OREGON	157,822	1.26%	2,405,202
19	OREGON	604,069	1.84%	6,946,794	19	KANSAS	156,262	1.25%	2,381,435
20	GEORGIA	554,099	1.69%	6,372,139	20	MISSOURI	149,132	1.19%	2,272,778
21	NEW MEXICO	530,173	1.61%	6,096,990	21	ILLINOIS	134,699	1.08%	2,052,807
22	MISSISSIPPI	521,517	1.59%	5,997,446	22	VIRGINIA	133,672	1.07%	2,037,156
23	LOUISIANA	510,837	1.56%	5,874,626	23	KENTUCKY	122,246	0.98%	1,863,028
24	IDAHO	476,292	1.45%	5,477,358	24	SOUTH DAKOTA	116,545	0.93%	1,776,140
25	ILLINOIS	429,111	1.31%	4,934,777	25	UTAH	115,219	0.92%	1,755,936
26	MINNESOTA	399,768	1.22%	4,597,332	26	GEORGIA	104,315	0.83%	1,589,759
27	NORTH CAROLINA	373,024	1.14%	4,289,776	27	OKLAHOMA	89,220	0.71%	1,359,717
28	UTAH	364,744	1.11%	4,194,556	28	TENNESSEE	82,609	0.66%	1,258,968
29	OHIO	293,757	0.89%	3,378,206	29	MARYLAND	77,259	0.62%	1,177,434
30	WASHINGTON	274,001	0.83%	3,151,012	30	NEBRASKA	73,527	0.59%	1,120,552
31	WISCONSIN	269,820	0.82%	3,102,930	31	NORTH CAROLINA	64,309	0.51%	980,076
32	NEVADA	238,662	0.73%	2,744,613	32	MAINE	43,955	0.35%	669,880
33	INDIANA	235,299	0.72%	2,705,939	33	LOUISIANA	38,295	0.31%	583,610
34	SOUTH CAROLINA	230,419	0.70%	2,649,819	34	NEVADA	37,378	0.30%	569,646
35	WEST VIRGINIA	203,711	0.62%	2,342,677	35	NORTH DAKOTA	35,782	0.29%	545,324
36	ARIZONA	197,060	0.60%	2,266,190	36	MISSISSIPPI	30,486	0.24%	464,614
37	PENNSYLVANIA	158,430	0.48%	1,821,945	37	CONNECTICUT	27,953	0.22%	425,999
38	MICHIGAN	109,500	0.33%	1,259,250	38	SOUTH CAROLINA	24,095	0.19%	367,202
39	NEW YORK	103,620	0.32%	1,191,630	39	MONTANA	23,592	0.19%	359,540
40	HAWAII	86,000	0.26%	989,000	40	ARKANSAS	22,592	0.18%	344,300
41	MARYLAND	44,015	0.13%	506,173	41	MASSACHUSETTS	20,338	0.16%	309,949
42	MAINE	12,114	0.04%	139,311	42	NEW HAMPSHIRE	19,745	0.16%	300,908
43	VERMONT	10,002	0.03%	115,023	43	ALABAMA	17,516	0.14%	266,947
44	NEW JERSEY	9,298	0.03%	106,927	44	WEST VIRGINIA	15,870	0.13%	241,863
45	MASSACHUSETTS	8,646	0.03%	99,429	45	NEW JERSEY	13,230	0.11%	201,621
46	ALASKA	6,468	0.02%	74,382	46	WYOMING	8,978	0.07%	136,830
47	CONNECTICUT	5,982	0.02%	68,793	47	DELAWARE	8,819	0.07%	134,400
48	NEW HAMPSHIRE	4,981	0.02%	57,282	48	HAWAII	3,103	0.02%	47,285
49	DELAWARE	3,668	0.01%	42,182	49	RHODE ISLAND	1,791	0.01%	27,288
50	RHODE ISLAND	1,800	0.01%	20,700	50	ALASKA	780	0.01%	11,883
	U.S. TOTAL	**32,834,801**		**377,600,212**		**U.S. TOTAL**	**12,522,397**		**190,841,335**

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Table A-3. Total animal units and estimated tons of manure produced for cattle other than beef and dairy cattle and for all cattle combined in 2007.

National Rank	State	Other Cattle AUs	Percent of Total Other Cattle AUs	Total Tons Manure	National Rank	State	Total Cattle AUs	Percent of Total Cattle AUs	Total Tons Manure
1	TEXAS	4,784,377	14.83%	52,280,036	1	TEXAS	10,590,705	13.64%	121,096,664
2	KANSAS	2,995,494	9.29%	32,732,479	2	CALIFORNIA	4,930,886	6.35%	64,988,253
3	NEBRASKA	2,754,972	8.54%	30,104,233	3	NEBRASKA	4,718,341	6.08%	52,957,968
4	OKLAHOMA	1,939,667	6.01%	21,195,210	4	KANSAS	4,668,130	6.01%	52,552,215
5	CALIFORNIA	1,780,990	5.52%	19,461,300	5	OKLAHOMA	4,092,501	5.27%	46,286,477
6	IOWA	1,702,481	5.28%	18,603,413	6	MISSOURI	3,483,075	4.49%	39,900,167
7	MISSOURI	1,244,762	3.86%	13,601,808	7	WISCONSIN	3,061,084	3.94%	40,884,779
8	SOUTH DAKOTA	1,160,811	3.60%	12,684,456	8	SOUTH DAKOTA	2,926,847	3.77%	33,429,753
9	COLORADO	1,119,957	3.47%	12,238,042	9	IOWA	2,897,650	3.73%	33,436,453
10	WISCONSIN	1,103,008	3.42%	12,052,836	10	MONTANA	2,170,213	2.80%	24,688,030
11	MINNESOTA	913,248	2.83%	9,979,278	11	COLORADO	2,026,517	2.61%	23,305,063
12	IDAHO	727,526	2.26%	7,949,855	12	KENTUCKY	1,965,738	2.53%	22,675,367
13	KENTUCKY	677,107	2.10%	7,398,911	13	MINNESOTA	1,934,302	2.49%	24,045,016
14	MONTANA	624,434	1.94%	6,823,339	14	IDAHO	1,928,768	2.48%	24,475,451
15	PENNSYLVANIA	533,663	1.65%	5,831,465	15	TENNESSEE	1,786,091	2.30%	20,548,663
16	TENNESSEE	524,380	1.63%	5,730,022	16	FLORIDA	1,490,177	1.92%	17,521,825
17	NORTH DAKOTA	508,464	1.58%	5,556,104	17	NORTH DAKOTA	1,474,269	1.90%	16,796,693
18	ARKANSAS	498,443	1.55%	5,446,603	18	ARKANSAS	1,468,800	1.89%	16,690,201
19	VIRGINIA	459,235	1.42%	5,018,169	19	PENNSYLVANIA	1,439,824	1.86%	19,048,832
20	NEW YORK	424,139	1.31%	4,634,665	20	NEW YORK	1,374,319	1.77%	18,727,881
21	OHIO	420,264	1.30%	4,592,329	21	NEW MEXICO	1,369,334	1.76%	17,168,985
22	ILLINOIS	417,654	1.29%	4,563,802	22	VIRGINIA	1,287,967	1.66%	15,048,526
23	NEW MEXICO	398,080	1.23%	4,349,920	23	OREGON	1,159,334	1.49%	13,694,955
24	OREGON	397,443	1.23%	4,342,960	24	WYOMING	1,081,879	1.39%	12,280,016
25	FLORIDA	385,790	1.20%	4,215,621	25	OHIO	1,081,505	1.39%	13,570,987
26	ARIZONA	368,246	1.14%	4,023,911	26	ALABAMA	990,986	1.28%	11,293,163
27	MICHIGAN	353,521	1.10%	3,863,009	27	ILLINOIS	981,463	1.26%	11,551,386
28	WYOMING	340,760	1.06%	3,723,564	28	GEORGIA	947,306	1.22%	11,118,694
29	WASHINGTON	339,986	1.05%	3,715,110	29	WASHINGTON	942,544	1.21%	11,873,326
30	ALABAMA	294,521	0.91%	3,218,302	30	MICHIGAN	928,201	1.20%	12,211,598
31	GEORGIA	288,892	0.90%	3,156,797	31	MISSISSIPPI	815,604	1.05%	9,342,488
32	INDIANA	281,820	0.87%	3,079,514	32	ARIZONA	813,609	1.05%	10,074,234
33	MISSISSIPPI	263,601	0.82%	2,880,428	33	LOUISIANA	751,019	0.97%	8,664,305
34	NORTH CAROLINA	237,616	0.74%	2,596,482	34	INDIANA	741,645	0.96%	9,207,223
35	UTAH	233,987	0.73%	2,556,837	35	UTAH	713,950	0.92%	8,507,329
36	LOUISIANA	201,887	0.63%	2,206,070	36	NORTH CAROLINA	674,949	0.87%	7,866,334
37	WEST VIRGINIA	116,303	0.36%	1,270,874	37	NEVADA	380,292	0.49%	4,453,441
38	NEVADA	104,252	0.32%	1,139,181	38	SOUTH CAROLINA	345,349	0.44%	4,009,602
39	SOUTH CAROLINA	90,836	0.28%	992,582	39	WEST VIRGINIA	335,885	0.43%	3,855,413
40	VERMONT	68,449	0.21%	747,957	40	VERMONT	267,260	0.34%	3,740,436
41	MARYLAND	53,115	0.16%	580,400	41	MARYLAND	174,389	0.22%	2,264,007
42	HAWAII	37,574	0.12%	410,576	42	HAWAII	126,676	0.16%	1,446,861
43	MAINE	25,898	0.08%	282,997	43	MAINE	81,968	0.11%	1,092,188
44	CONNECTICUT	14,002	0.04%	153,007	44	CONNECTICUT	47,937	0.06%	647,799
45	MASSACHUSETTS	13,770	0.04%	150,472	45	MASSACHUSETTS	42,754	0.06%	559,850
46	NEW JERSEY	11,364	0.04%	124,181	46	NEW HAMPSHIRE	35,006	0.05%	470,530
47	NEW HAMPSHIRE	10,281	0.03%	112,341	47	NEW JERSEY	33,892	0.04%	432,729
48	DELAWARE	6,423	0.02%	70,181	48	DELAWARE	18,909	0.02%	246,763
49	ALASKA	4,625	0.01%	50,543	49	ALASKA	11,873	0.02%	136,808
50	RHODE ISLAND	1,166	0.00%	12,736	50	RHODE ISLAND	4,756	0.01%	60,724
	U.S. TOTAL	**32,259,283**		**352,504,907**		**U.S. TOTAL**	**77,616,481**		**920,946,454**

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Table A-4. Total animal units and estimated tons of manure produced for breeder and market hogs in 2007.

National Rank	State	Total Breeder Hog AUs	Percent of Total Breeder Hog AUs	Total Tons Manure	National Rank	State	Total Market Hog AUs	Percent of Total Market Hog AUs	Total Tons Manure
1	IOWA	406,815	17.77%	2,485,637	1	IOWA	2,003,179	30.25%	29,426,699
2	NORTH CAROLINA	378,608	16.54%	2,313,294	2	NORTH CAROLINA	1,003,644	15.16%	14,743,526
3	MINNESOTA	223,606	9.77%	1,366,235	3	MINNESOTA	776,156	11.72%	11,401,727
4	ILLINOIS	191,057	8.34%	1,167,360	4	ILLINOIS	416,787	6.29%	6,122,600
5	OKLAHOMA	147,216	6.43%	899,488	5	INDIANA	369,134	5.57%	5,422,574
6	NEBRASKA	145,798	6.37%	890,824	6	NEBRASKA	316,751	4.78%	4,653,068
7	MISSOURI	134,134	5.86%	819,557	7	MISSOURI	301,797	4.56%	4,433,394
8	INDIANA	117,465	5.13%	717,712	8	OKLAHOMA	220,606	3.33%	3,240,698
9	KANSAS	69,309	3.03%	423,476	9	KANSAS	187,040	2.82%	2,747,625
10	COLORADO	62,551	2.73%	382,189	10	OHIO	183,864	2.78%	2,700,956
11	SOUTH DAKOTA	61,980	2.71%	378,699	11	SOUTH DAKOTA	145,715	2.20%	2,140,550
12	OHIO	59,837	2.61%	365,602	12	TEXAS	116,708	1.76%	1,714,435
13	PENNSYLVANIA	44,924	1.96%	274,483	13	PENNSYLVANIA	115,237	1.74%	1,692,829
14	MICHIGAN	39,404	1.72%	240,759	14	MICHIGAN	101,963	1.54%	1,497,839
15	TEXAS	35,550	1.55%	217,209	15	COLORADO	78,733	1.19%	1,156,588
16	ARKANSAS	31,477	1.37%	192,325	16	WISCONSIN	42,260	0.64%	620,802
17	WISCONSIN	19,726	0.86%	120,527	17	VIRGINIA	37,293	0.56%	547,827
18	GEORGIA	16,521	0.72%	100,943	18	KENTUCKY	33,627	0.51%	493,980
19	KENTUCKY	15,863	0.69%	96,922	19	SOUTH CAROLINA	29,266	0.44%	429,918
20	NORTH DAKOTA	14,302	0.62%	87,384	20	GEORGIA	24,132	0.36%	354,499
21	VIRGINIA	12,055	0.53%	73,656	21	ARKANSAS	22,585	0.34%	331,774
22	WYOMING	10,416	0.45%	63,642	22	ALABAMA	17,600	0.27%	258,544
23	SOUTH CAROLINA	10,399	0.45%	63,537	23	NORTH DAKOTA	15,786	0.24%	231,894
24	CALIFORNIA	8,001	0.35%	48,889	24	CALIFORNIA	14,590	0.22%	214,320
25	ALABAMA	6,851	0.30%	41,857	25	TENNESSEE	13,778	0.21%	202,396
26	NEW YORK	5,005	0.22%	30,580	26	WYOMING	8,731	0.13%	128,265
27	TENNESSEE	4,857	0.21%	29,674	27	NEW YORK	7,962	0.12%	116,967
28	IDAHO	2,282	0.10%	13,941	28	IDAHO	2,938	0.04%	43,152
29	FLORIDA	2,025	0.09%	12,371	29	WASHINGTON	2,643	0.04%	38,823
30	WASHINGTON	1,694	0.07%	10,348	30	OREGON	1,891	0.03%	27,778
31	MARYLAND	1,619	0.07%	9,895	31	FLORIDA	1,599	0.02%	23,483
32	OREGON	1,474	0.06%	9,007	32	HAWAII	1,217	0.02%	17,870
33	HAWAII	1,451	0.06%	8,868	33	MASSACHUSETTS	1,033	0.02%	15,175
34	DELAWARE	961	0.04%	5,870	34	LOUISIANA	911	0.01%	13,379
35	LOUISIANA	875	0.04%	5,346	35	NEW JERSEY	831	0.01%	12,201
36	MASSACHUSETTS	810	0.04%	4,950	36	WEST VIRGINIA	814	0.01%	11,959
37	WEST VIRGINIA	580	0.03%	3,542	37	DELAWARE	703	0.01%	10,327
38	NEW JERSEY	375	0.02%	2,291	38	MAINE	381	0.01%	5,592
39	CONNECTICUT	354	0.02%	2,160	39	CONNECTICUT	297	0.00%	4,365
40	MAINE	352	0.02%	2,153	40	NEW HAMPSHIRE	242	0.00%	3,557
41	NEVADA	284	0.01%	1,735	41	NEVADA	241	0.00%	3,541
42	NEW HAMPSHIRE	221	0.01%	1,352	42	VERMONT	240	0.00%	3,533
43	NEW MEXICO	219	0.01%	1,339	43	RHODE ISLAND	196	0.00%	2,881
44	RHODE ISLAND	200	0.01%	1,220	44	NEW MEXICO	153	0.00%	2,241
45	VERMONT	193	0.01%	1,179	45	ALASKA	D		
46	ALASKA	D			46	ARIZONA	D		
47	ARIZONA	D			47	MARYLAND	D		
48	MISSISSIPPI	D			48	MISSISSIPPI	D		
49	MONTANA	D			49	MONTANA	D		
50	UTAH	D			50	UTAH	D		
	U.S. TOTAL	**2,289,694**		**13,990,028**		**U.S. TOTAL**	**6,621,249**		**97,266,149**

"D" signifies that the data were not disclosed (because there were too few producers in the category to protect confidentiality). USDA 2009a.

Table A-5. Total animal units and estimated tons of manure produced for swine (breeder and market hogs combined) in 2007.

National Rank	State	Total Swine AUs	Percent of Total Swine AUs	Total Tons Manure
1	IOWA	2,409,994	27.05%	31,912,337
2	NORTH CAROLINA	1,382,252	15.51%	17,056,820
3	MINNESOTA	999,762	11.22%	12,767,962
4	ILLINOIS	607,844	6.82%	7,289,960
5	INDIANA	486,599	5.46%	6,140,286
6	NEBRASKA	462,548	5.19%	5,543,892
7	MISSOURI	435,930	4.89%	5,252,950
8	OKLAHOMA	367,821	4.13%	4,140,186
9	KANSAS	256,349	2.88%	3,171,100
10	OHIO	243,700	2.73%	3,066,558
11	SOUTH DAKOTA	207,695	2.33%	2,519,248
12	PENNSYLVANIA	160,160	1.80%	1,967,313
13	TEXAS	152,257	1.71%	1,931,644
14	MICHIGAN	141,367	1.59%	1,738,598
15	COLORADO	141,284	1.59%	1,538,776
16	WISCONSIN	61,986	0.70%	741,329
17	ARKANSAS	54,062	0.61%	524,100
18	KENTUCKY	49,490	0.56%	590,902
19	VIRGINIA	49,348	0.55%	621,484
20	GEORGIA	40,653	0.46%	455,442
21	SOUTH CAROLINA	39,665	0.45%	493,455
22	NORTH DAKOTA	30,088	0.34%	319,278
23	ALABAMA	24,451	0.27%	300,401
24	CALIFORNIA	22,591	0.25%	263,210
25	WYOMING	19,148	0.21%	191,908
26	TENNESSEE	18,634	0.21%	232,069
27	NEW YORK	12,967	0.15%	147,547
28	IDAHO	5,219	0.06%	57,093
29	WASHINGTON	4,336	0.05%	49,171
30	FLORIDA	3,623	0.04%	35,854
31	OREGON	3,365	0.04%	36,786
32	HAWAII	2,668	0.03%	26,738
33	MASSACHUSETTS	1,843	0.02%	20,125
34	LOUISIANA	1,786	0.02%	18,725
35	DELAWARE	1,664	0.02%	16,196
36	MARYLAND	1,619	0.02%	9,895
37	WEST VIRGINIA	1,394	0.02%	15,501
38	NEW JERSEY	1,205	0.01%	14,492
39	MAINE	733	0.01%	7,745
40	CONNECTICUT	651	0.01%	6,525
41	NEVADA	525	0.01%	5,275
42	NEW HAMPSHIRE	463	0.01%	4,909
43	VERMONT	433	0.00%	4,711
44	RHODE ISLAND	396	0.00%	4,101
45	NEW MEXICO	372	0.00%	3,580
46	ALASKA	D		
47	ARIZONA	D		
48	MISSISSIPPI	D		
49	MONTANA	D		
50	UTAH	D		
	U.S. TOTAL	**8,910,943**		**111,256,177**

"D" signifies that the data were not disclosed (because there were too few producers in the category to protect confidentiality).
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Table A-6. Total animal units and estimated tons of manure produced for broiler and layer chickens in 2007.

National Rank	State	Total Broiler AUs	Percent of Total Broiler AUs	Total Tons Manure	National Rank	State	Total Layer AUs	Percent of Total Layer AUs	Total Tons Manure
1	GEORGIA	517,363	14.69%	7,744,926	1	IOWA	215,175	15.92%	2,463,752
2	ARKANSAS	444,830	12.63%	6,659,104	2	OHIO	108,280	8.01%	1,239,811
3	ALABAMA	391,953	11.13%	5,867,541	3	INDIANA	96,954	7.18%	1,110,124
4	MISSISSIPPI	330,982	9.40%	4,954,799	4	PENNSYLVANIA	87,930	6.51%	1,006,794
5	NORTH CAROLINA	329,498	9.36%	4,932,592	5	CALIFORNIA	84,367	6.24%	965,997
6	TEXAS	260,686	7.40%	3,902,473	6	GEORGIA	77,093	5.71%	882,712
7	MARYLAND	143,964	4.09%	2,155,138	7	TEXAS	76,467	5.66%	875,545
8	DELAWARE	112,291	3.19%	1,680,999	8	ARKANSAS	55,911	4.14%	640,183
9	KENTUCKY	109,399	3.11%	1,637,707	9	NORTH CAROLINA	50,993	3.77%	583,871
10	MISSOURI	102,537	2.91%	1,534,984	10	FLORIDA	47,151	3.49%	539,879
11	SOUTH CAROLINA	100,642	2.86%	1,506,618	11	MINNESOTA	42,386	3.14%	485,323
12	CALIFORNIA	97,548	2.77%	1,460,290	12	NEBRASKA	41,950	3.10%	480,326
13	OKLAHOMA	97,395	2.77%	1,458,000	13	ALABAMA	38,497	2.85%	440,791
14	VIRGINIA	96,142	2.73%	1,439,247	14	MICHIGAN	36,137	2.67%	413,773
15	TENNESSEE	90,198	2.56%	1,350,271	15	MISSOURI	28,998	2.15%	332,023
16	LOUISIANA	79,750	2.26%	1,193,850	16	MISSISSIPPI	24,948	1.85%	285,652
17	PENNSYLVANIA	60,459	1.72%	905,067	17	WASHINGTON	23,143	1.71%	264,983
18	FLORIDA	31,041	0.88%	464,685	18	ILLINOIS	21,142	1.56%	242,080
19	WEST VIRGINIA	28,162	0.80%	421,581	19	WISCONSIN	19,495	1.44%	223,214
20	OHIO	22,026	0.63%	329,733	20	SOUTH CAROLINA	18,857	1.40%	215,917
21	MINNESOTA	19,010	0.54%	284,580	21	KENTUCKY	18,338	1.36%	209,972
22	WISCONSIN	15,517	0.44%	232,292	22	NEW YORK	15,812	1.17%	181,046
23	INDIANA	12,169	0.35%	182,171	23	COLORADO	15,612	1.16%	178,755
24	WASHINGTON	10,214	0.29%	152,899	24	UTAH	14,339	1.06%	164,183
25	OREGON	8,804	0.25%	131,799	25	OKLAHOMA	13,295	0.98%	152,230
26	IOWA	3,964	0.11%	59,335	26	VIRGINIA	12,836	0.95%	146,968
27	NEBRASKA	1,699	0.05%	25,431	27	SOUTH DAKOTA	11,683	0.86%	133,773
28	MICHIGAN	1,500	0.04%	22,448	28	OREGON	10,946	0.81%	125,330
29	NEW YORK	1,031	0.03%	15,429	29	MARYLAND	10,651	0.79%	121,953
30	ILLINOIS	239	0.01%	3,584	30	LOUISIANA	7,968	0.59%	91,231
31	MONTANA	237	0.01%	3,552	31	TENNESSEE	6,854	0.51%	78,473
32	SOUTH DAKOTA	225	0.01%	3,363	32	NEW JERSEY	6,241	0.46%	71,456
33	CONNECTICUT	221	0.01%	3,308	33	WEST VIRGINIA	4,881	0.36%	55,889
34	VERMONT	93	0%	1,398	34	HAWAII	1,473	0.11%	16,865
35	NEW HAMPSHIRE	53	0%	796	35	MONTANA	1,421	0.11%	16,269
36	KANSAS	43	0%	643	36	VERMONT	894	0.07%	10,241
37	NEW JERSEY	39	0%	589	37	NEW HAMPSHIRE	842	0.06%	9,635
38	NORTH DAKOTA	35	0%	520	38	MASSACHUSETTS	559	0.04%	6,401
39	MAINE	33	0%	489	39	NORTH DAKOTA	437	0.03%	5,008
40	NEW MEXICO	25	0%	369	40	RHODE ISLAND	183	0.01%	2,099
41	COLORADO	24	0%	364	41	WYOMING	65	0%	744
42	IDAHO	17	0%	261	42	NEVADA	23	0%	268
43	UTAH	6	0%	84	43	ALASKA	14	0%	166
44	HAWAII	5	0%	70	44	ARIZONA	D		
45	ALASKA	5	0%	69	45	CONNECTICUT	D		
46	ARIZONA	4	0%	66	46	DELAWARE	D		
47	WYOMING	3	0%	50	47	IDAHO	D		
48	NEVADA	1	0%	10	48	KANSAS	D		
49	MASSACHUSETTS	D			49	MAINE	D		
50	RHODE ISLAND	D			50	NEW MEXICO	D		
	U.S. TOTAL	**3,522,083**		**52,725,576**		**U.S. TOTAL**	**1,351,241**		**15,471,706**

"D" signifies that the data were not disclosed (because there were too few producers in the category to protect confidentiality).
USDA 2009a.

Table A-7. Total animal units and estimated tons of manure produced for turkeys, as well as all poultry (broilers, layers, and turkeys combined) in 2007.

National Rank	State	Total Turkey AUs	Percent of Total Turkey AUs	Total Tons Manure	National Rank	State	Total Poultry AUs	Percent of Total Poultry AUs	Total Tons Manure
1	MINNESOTA	273,109	17.41%	2,234,033	1	NORTH CAROLINA	647,147	10.05%	7,697,703
2	NORTH CAROLINA	266,655	17.00%	2,181,239	2	ARKANSAS	641,595	9.96%	8,451,469
3	ARKANSAS	140,853	8.98%	1,152,181	3	GEORGIA	594,486	9.23%	8,627,880
4	MISSOURI	128,421	8.19%	1,050,486	4	ALABAMA	430,581	6.68%	6,309,404
5	CALIFORNIA	100,048	6.38%	818,394	5	TEXAS	366,807	5.69%	5,020,588
6	VIRGINIA	94,492	6.02%	772,944	6	MISSISSIPPI	355,951	5.53%	5,240,622
7	INDIANA	89,128	5.68%	729,064	7	MINNESOTA	334,506	5.19%	3,003,937
8	SOUTH CAROLINA	81,854	5.22%	669,564	8	CALIFORNIA	281,962	4.38%	3,244,681
9	IOWA	59,733	3.81%	488,616	9	IOWA	278,871	4.33%	3,011,703
10	WISCONSIN	55,010	3.51%	449,979	10	MISSOURI	259,956	4.04%	2,917,493
11	PENNSYLVANIA	52,799	3.37%	431,894	11	VIRGINIA	203,470	3.16%	2,359,159
12	SOUTH DAKOTA	33,322	2.12%	272,574	12	SOUTH CAROLINA	201,354	3.13%	2,392,098
13	UTAH	32,676	2.08%	267,293	13	PENNSYLVANIA	201,187	3.12%	2,343,756
14	OHIO	30,966	1.97%	253,305	14	INDIANA	198,251	3.08%	2,021,359
15	TEXAS	29,654	1.89%	242,569	15	OHIO	161,273	2.50%	1,822,849
16	MICHIGAN	29,535	1.88%	241,599	16	MARYLAND	157,947	2.45%	2,304,346
17	WEST VIRGINIA	24,494	1.56%	200,364	17	KENTUCKY	128,197	1.99%	1,851,437
18	ILLINOIS	12,626	0.80%	103,284	18	DELAWARE	112,302	1.74%	1,681,085
19	NEBRASKA	11,362	0.72%	92,938	19	OKLAHOMA	110,690	1.72%	1,610,230
20	KANSAS	8,380	0.53%	68,551	20	TENNESSEE	97,104	1.51%	1,429,169
21	NORTH DAKOTA	6,631	0.42%	54,241	21	WISCONSIN	90,022	1.40%	905,486
22	MARYLAND	3,332	0.21%	27,254	22	LOUISIANA	87,729	1.36%	1,285,179
23	NEW YORK	1,483	0.09%	12,128	23	FLORIDA	78,398	1.22%	1,006,247
24	KENTUCKY	459	0.03%	3,759	24	MICHIGAN	67,172	1.04%	677,820
25	NEW JERSEY	275	0.02%	2,247	25	WEST VIRGINIA	57,537	0.89%	677,834
26	MASSACHUSETTS	261	0.02%	2,137	26	NEBRASKA	55,010	0.85%	598,696
27	MONTANA	243	0.02%	1,990	27	UTAH	47,021	0.73%	431,561
28	FLORIDA	206	0.01%	1,682	28	SOUTH DAKOTA	45,230	0.70%	409,710
29	ALABAMA	131	0.01%	1,073	29	ILLINOIS	34,008	0.53%	348,948
30	NEW MEXICO	92	0.01%	752	30	WASHINGTON	33,413	0.52%	418,344
31	VERMONT	86	0.01%	702	31	OREGON	19,795	0.31%	257,497
32	WASHINGTON	57	0.00%	463	32	NEW YORK	18,325	0.28%	208,603
33	CONNECTICUT	53	0.00%	435	33	COLORADO	15,636	0.24%	179,119
34	TENNESSEE	52	0.00%	425	34	KANSAS	8,423	0.13%	69,194
35	MAINE	46	0.00%	378	35	NORTH DAKOTA	7,103	0.11%	59,769
36	OREGON	45	0.00%	369	36	NEW JERSEY	6,555	0.10%	74,293
37	NEW HAMPSHIRE	38	0.00%	309	37	MONTANA	1,901	0.03%	21,811
38	GEORGIA	30	0.00%	242	38	HAWAII	1,479	0.02%	16,947
39	RHODE ISLAND	29	0.00%	233	39	VERMONT	1,074	0.02%	12,341
40	MISSISSIPPI	21	0.00%	170	40	NEW HAMPSHIRE	933	0.01%	10,741
41	IDAHO	19	0.00%	152	41	MASSACHUSETTS	820	0.01%	8,538
42	ARIZONA	13	0.00%	105	42	CONNECTICUT	274	0.00%	3,743
43	LOUISIANA	12	0.00%	98	43	RHODE ISLAND	212	0.00%	2,332
44	ALASKA	11	0.00%	88	44	NEW MEXICO	117	0.00%	1,121
45	DELAWARE	10	0.00%	86	45	MAINE	79	0.00%	867
46	WYOMING	7	0.00%	54	46	WYOMING	75	0.00%	848
47	NEVADA	2	0.00%	18	47	IDAHO	36	0.00%	412
48	HAWAII	1	0.00%	12	48	ALASKA	30	0.00%	323
49	COLORADO	D			49	NEVADA	26	0.00%	296
50	OKLAHOMA	D			50	ARIZONA	17	0.00%	171
	U.S. TOTAL	**1,568,762**		**12,832,472**		**U.S. TOTAL**	**6,442,085**		**81,029,754**

"D" signifies that the data were not disclosed (because there were too few producers in the category to protect confidentiality).
USDA 2009a.

Table A-8. Livestock (cattle, swine, and poultry) animal units as a total and per acre of farmland in 2007.

Rank Total AUs	State	AUs	Rank AUs/Acre Farmland	State	AUs/Acre Farmland
1	TEXAS	11,109,770	1	NORTH CAROLINA	0.32
2	IOWA	5,586,515	2	DELAWARE	0.26
3	NEBRASKA	5,235,899	3	PENNSYLVANIA	0.23
4	CALIFORNIA	5,235,439	4	VERMONT	0.22
5	KANSAS	4,932,902	5	WISCONSIN	0.21
6	OKLAHOMA	4,571,012	6	CALIFORNIA	0.21
7	MISSOURI	4,178,962	7	NEW YORK	0.20
8	MINNESOTA	3,268,570	8	VIRGINIA	0.19
9	WISCONSIN	3,213,092	9	IOWA	0.18
10	SOUTH DAKOTA	3,179,772	10	TENNESSEE	0.17
11	NORTH CAROLINA	2,704,347	11	FLORIDA	0.17
12	COLORADO	2,183,438	12	IDAHO	0.17
13	MONTANA	2,172,114	13	MARYLAND	0.16
14	ARKANSAS	2,164,456	14	ALABAMA	0.16
15	KENTUCKY	2,143,425	15	ARKANSAS	0.16
16	IDAHO	1,934,024	16	GEORGIA	0.16
17	TENNESSEE	1,901,829	17	KENTUCKY	0.15
18	PENNSYLVANIA	1,801,172	18	MISSOURI	0.14
19	ILLINOIS	1,623,316	19	OKLAHOMA	0.13
20	GEORGIA	1,582,445	20	MINNESOTA	0.12
21	FLORIDA	1,572,198	21	CONNECTICUT	0.12
22	VIRGINIA	1,540,785	22	SOUTH CAROLINA	0.12
23	NORTH DAKOTA	1,511,460	23	HAWAII	0.12
24	OHIO	1,486,479	24	NEBRASKA	0.12
25	ALABAMA	1,446,018	25	MICHIGAN	0.11
26	INDIANA	1,426,494	26	WEST VIRGINIA	0.11
27	NEW YORK	1,405,612	27	OHIO	0.11
28	NEW MEXICO	1,369,823	28	KANSAS	0.11
29	OREGON	1,182,494	29	LOUISIANA	0.10
30	MISSISSIPPI	1,171,555	30	MISSISSIPPI	0.10
31	MICHIGAN	1,136,740	31	INDIANA	0.10
32	WYOMING	1,101,102	32	MASSACHUSETTS	0.09
33	WASHINGTON	980,293	33	TEXAS	0.09
34	LOUISIANA	840,534	34	RHODE ISLAND	0.08
35	ARIZONA	813,626	35	NEW HAMPSHIRE	0.08
36	UTAH	760,972	36	SOUTH DAKOTA	0.07
37	SOUTH CAROLINA	586,368	37	OREGON	0.07
38	WEST VIRGINIA	394,816	38	COLORADO	0.07
39	NEVADA	380,843	39	UTAH	0.07
40	MARYLAND	333,955	40	WASHINGTON	0.07
41	VERMONT	268,767	41	NEVADA	0.06
42	DELAWARE	132,875	42	MAINE	0.06
43	HAWAII	130,823	43	ILLINOIS	0.06
44	MAINE	82,780	44	NEW JERSEY	0.06
45	CONNECTICUT	48,862	45	NORTH DAKOTA	0.04
46	MASSACHUSETTS	45,418	46	WYOMING	0.04
47	NEW JERSEY	41,652	47	MONTANA	0.04
48	NEW HAMPSHIRE	36,402	48	NEW MEXICO	0.03
49	ALASKA	11,903	49	ARIZONA	0.03
50	RHODE ISLAND	5,364	50	ALASKA	0.01
	U.S. TOTAL	**92,969,509**		**U.S. AVERAGE**	**0.12**

USDA 2009a.

Table A-9. Total estimated livestock and poultry (cattle, swine, and poultry) manure and estimated tons of manure per acre of farmland in 2007.

Rank Total Manure	State	Tons Manure	Rank Tons Manure/Acre Farmland	State	Tons Manure/Acre Farmland
1	TEXAS	128,048,896	1	NORTH CAROLINA	3.85
2	CALIFORNIA	68,496,143	2	DELAWARE	3.81
3	IOWA	68,360,493	3	VERMONT	3.05
4	NEBRASKA	59,100,556	4	PENNSYLVANIA	2.99
5	KANSAS	55,792,510	5	WISCONSIN	2.80
6	OKLAHOMA	52,036,892	6	CALIFORNIA	2.70
7	MISSOURI	48,070,611	7	NEW YORK	2.66
8	WISCONSIN	42,531,594	8	MARYLAND	2.23
9	MINNESOTA	39,816,914	9	VIRGINIA	2.22
10	SOUTH DAKOTA	36,358,712	10	IOWA	2.22
11	NORTH CAROLINA	32,620,857	11	IDAHO	2.13
12	ARKANSAS	25,665,769	12	TENNESSEE	2.02
13	KENTUCKY	25,117,706	13	FLORIDA	2.01
14	COLORADO	25,022,958	14	GEORGIA	1.99
15	MONTANA	24,709,841	15	ALABAMA	1.98
16	IDAHO	24,532,956	16	ARKANSAS	1.85
17	PENNSYLVANIA	23,359,900	17	KENTUCKY	1.80
18	TENNESSEE	22,209,901	18	MISSOURI	1.66
19	GEORGIA	20,202,017	19	CONNECTICUT	1.62
20	ILLINOIS	19,190,293	20	OKLAHOMA	1.48
21	NEW YORK	19,084,031	21	MINNESOTA	1.48
22	FLORIDA	18,563,926	22	MICHIGAN	1.46
23	OHIO	18,460,395	23	SOUTH CAROLINA	1.41
24	VIRGINIA	18,029,169	24	HAWAII	1.33
25	ALABAMA	17,902,968	25	OHIO	1.32
26	INDIANA	17,368,868	26	NEBRASKA	1.30
27	NORTH DAKOTA	17,175,740	27	MISSISSIPPI	1.27
28	NEW MEXICO	17,173,686	28	WEST VIRGINIA	1.23
29	MICHIGAN	14,628,016	29	LOUISIANA	1.23
30	MISSISSIPPI	14,583,109	30	KANSAS	1.20
31	OREGON	13,989,238	31	INDIANA	1.18
32	WYOMING	12,472,771	32	MASSACHUSETTS	1.14
33	WASHINGTON	12,340,841	33	NEW HAMPSHIRE	1.03
34	ARIZONA	10,074,405	34	RHODE ISLAND	0.99
35	LOUISIANA	9,968,209	35	TEXAS	0.98
36	UTAH	8,938,890	36	OREGON	0.85
37	SOUTH CAROLINA	6,895,155	37	SOUTH DAKOTA	0.83
38	MARYLAND	4,578,248	38	WASHINGTON	0.82
39	WEST VIRGINIA	4,548,748	39	MAINE	0.82
40	NEVADA	4,459,013	40	UTAH	0.81
41	VERMONT	3,757,488	41	COLORADO	0.79
42	DELAWARE	1,944,044	42	NEVADA	0.76
43	HAWAII	1,490,546	43	ILLINOIS	0.72
44	MAINE	1,100,800	44	NEW JERSEY	0.71
45	CONNECTICUT	658,068	45	NORTH DAKOTA	0.43
46	MASSACHUSETTS	588,513	46	WYOMING	0.41
47	NEW JERSEY	521,513	47	MONTANA	0.40
48	NEW HAMPSHIRE	486,181	48	NEW MEXICO	0.40
49	ALASKA	137,131	49	ARIZONA	0.39
50	RHODE ISLAND	67,158	50	ALASKA	0.16
	U.S. TOTAL	**1,113,232,385**		**U.S. AVERAGE**	**1.50**

USDA 2009a.

Table A-10. Freshwater and saltwater aquaculture farms in the U.S. during 2005.

Geographic Area	Rank Farms	Freshwater Farms	Saltwater Farms	Total Farms
Louisiana	1	738	135	873
Mississippi	2	403	1	403
Florida	3	196	163	359
Alabama	4	213	2	215
Arkansas	5	211	-	211
Washington	6	21	175	194
North Carolina	7	129	57	186
Massachusetts	8	18	140	157
Virginia	9	28	122	147
California	10	96	22	118
Texas	11	79	19	95
New Jersey	12	17	70	87
Maryland	13	11	75	86
South Carolina	14	43	45	85
Wisconsin	15	84	-	84
Georgia	16	78	1	79
Minnesota	17	77	-	77
Kentucky	18	65	-	65
Hawaii	19	33	30	59
Pennsylvania	20	56	-	56
Ohio	21	55	-	55
New York	22	41	13	54
Maine	23	10	40	50
Oregon	24	26	21	47
Illinois	24	47	1	47
Tennessee	26	45	-	45
Missouri	27	35	-	35
Idaho	27	35	-	35
Michigan	29	34	1	34
Connecticut	30	3	27	30
Nebraska	31	26	-	26
Alaska	31	1	25	26
Iowa	33	21	-	21
West Virginia	33	21	-	21
Oklahoma	35	20	-	20
Indiana	36	17	1	18
Colorado	37	15	-	15
Kansas	38	12	-	12
Rhode Island	38	2	11	12
Utah	40	11	-	11
Arizona	40	11	-	11
New Hampshire	42	5	6	10
Vermont	43	9	-	9
Montana	44	8	-	8
South Dakota	45	7	-	7
Wyoming	45	7	-	7
New Mexico	47	3	-	3
Delaware	47	3	-	3
North Dakota	49	1	-	1
Nevada	50	-	-	-
United States		**3,127**	**1,203**	**4,309**

USDA 2006.

Table A-11. Aquaculture in the U.S. presented as total acres and sales.

Geographic Area	Rank Acres	Freshwater Acres	Saltwater Acres	Total Acres	Total Sales (1,000s of $)	Rank $
Louisiana	1	104,645	215,770	320,415	$101,314	4
Mississippi	2	102,898	D	102,898	$249,704	1
Connecticut	3	D	62,959	62,959	$12,902	14
Arkansas	4	61,135	-	61,135	$110,542	2
Minnesota	5	41,023	-	41,023	$8,412	19
Alabama	6	25,351	D	25,351	$102,796	3
Washington	7	209	13,269	13,478	$93,203	5
Virginia	8	143	12,412	12,555	$40,939	8
California	9	3,338	6,002	9,340	$69,607	6
Texas	10	4,651	2,432	7,083	$35,359	10
New Jersey	11	51	4,466	4,517	$3,714	25
North Carolina	12	3,463	707	4,170	$24,725	12
Florida	13	2,292	718	3,010	$57,406	7
Missouri	14	2,689	-	2,689	$7,144	22
Oregon	15	101	2,425	2,526	$12,478	15
South Carolina	16	683	1,531	2,214	$4,773	24
Wisconsin	17	1,977	-	1,977	$7,025	23
Georgia	18	1,914	D	1,914	$7,502	20
Massachusetts	19	60	1,108	1,168	$9,342	16
South Dakota	20	1,066	-	1,066	$484	42
Illinois	21	805	D	805	$3,176	28
Ohio	22	759	-	759	$3,185	27
Tennessee	23	707	-	707	$1,286	35
Pennsylvania	24	626	-	626	$8,951	17
Kentucky	25	624	-	624	$2,341	30
Maine	26	32	585	617	$25,580	11
Iowa	27	594	-	594	$1,469	34
Kansas	28	590	-	590	$342	43
Oklahoma	29	557	-	557	$1,958	31
Nebraska	30	503	-	503	$1,750	33
Indiana	31	443	D	443	D	-
Michigan	32	429	D	429	$2,398	29
Maryland	33	155	238	393	$7,292	21
New York	34	385	D	385	$8,913	18
Hawaii	35	75	254	329	$13,761	13
Idaho	36	151	-	151	$37,685	9
Alaska	37	D	148	148	$826	39
Colorado	38	85	-	85	$3,349	26
New Hampshire	39	10	70	80	$1,054	37
Rhode Island	40	D	51	51	$840	38
West Virginia	41	48	-	48	$1,145	36
Utah	42	38	-	38	$559	41
Wyoming	43	37	-	37	$209	45
Arizona	44	31	-	31	$562	40
Montana	45	13	-	13	$302	44
Vermont	46	11	-	11	$80	46
New Mexico	47	1	-	1	D	-
Delaware	-	D	-	-	$1,870	32
North Dakota	-	D	-	-	D	-
Nevada	-	-	-	-	-	-
United States		**365,566**	**327,487**	**693,053**	**$1,092,386**	

"D" signifies that the data were not disclosed (because there were too few producers in the category to protect confidentiality).
USDA 2006.

Appendix 2. Animal Life Stages

Table A-12. Livestock animal type and life stages definitions.

Animal Type	Term	Definition
Cattle (Beef, Dairy)	Bovine	General term for cattle
	Dairy Cow	A female cow that produces milk for human consumption, or raises replacement heifers
	Heifer	A female cow that has not yet had her first calf. Typically less than three years of age
	Beef Cattle	Cattle raised for meat production
	Steer	A castrated bovine male
	Calf	A male or female bovine under one year of age
	Preweaned Calf	Calves that are nursing from their mother or a dam (i.e., a female parent in pedigree)
	Weaned Heifer	Heifers that are no longer nursing
	Replacement Heifer	Cows raised to replace those currently in the herd
	Lactating	A cow that is producing milk
	Non-Lactating	A cow that is dry (i.e., not secreting milk). Cows are typically provided a dry period between lactations to allow the cow's udders an opportunity to regenerate secretory tissue
	Cow-Calf Operation	A facility that maintains breeding bovine and produces weaned calves
	Growing	A cattle grown to market weight
	Feedlot	Beef cattle in confined, outdoor pens and fed a high-energy ration of grains and other concentrates
Swine	Hog	General term for growing swine
	Sow	A female after she has borne a litter
	Farrow	The life stage between birth and weaning
	Preweaned	Pigs that are still nursing and have not yet been removed from the sow
	Nursery (Weaned)	Pigs that are no longer nursing and have been removed from the sow
	Breeder	Swine that produce offspring
	Grower/Feeder/Finisher/Market	Swine that are fed until they reach market weight and are ready for slaughter
Poultry (Broilers, Layers, and Turkeys)	Broiler	A chicken utilized for meat production
	Layer	A chicken utilized for egg production
	Pullet	A laying hen prior to laying its first egg
	Grower/Finisher	Birds grown to market weight and sent to slaughter
	Breeder	A bird that produces offspring

MacDonald and McBride 2009 and USEPA 2009c.

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Appendix 3. Additional Technical Resources for Manure Management

This appendix includes a sampling of on-line resources that are available to help planners and producers with manure management. It is intended to illustrate the breadth of information available and identify the agencies and organizations that are working actively to provide information to planners and producers.

World Health Organization

- Animal Waste, Water Quality and Human Health- This website provides links to resources published by WHO on water sanitation and health including a book which contains relevant information, in connection with pathogens, on: the scope of domestic animal manure discharged into the environment; the fate and transport of the discharged manure (and the pathogens they may contain); human exposure to the manure; potential health effects associated with those exposures; and interventions that can limit human exposures to livestock manure. It also addresses the monitoring, detection and effectiveness of the best management practices related to these issues.
http://www.who.int/water_sanitation_health/publications/2012/animal_waste/en/

U.S. Department of Agriculture

- USDA's NRCS Technical Standard 590 – Nutrient Management- This website contains the USDA's 590 Nutrient Management Conservation Practice Standard. The standard provides guidance on managing nutrient applications to meet crop needs and minimize nonpoint source pollution. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046433.pdf

- NRCS Manure and Nutrient Management Resources- This site contains many helpful resources, including a guide that provides a complete review of key management practices and methods to minimize waste production, software that may be used by large livestock and poultry facility operators and owners to estimate manure generation and production of process water, and training courses on water quality, waste management, nutrient and pest management, conservation practices and planning, and designing animal waste containment.
http://go.usa.gov/KoB

- USDA's ERS Manure Management Website- This website is an important resource for publications and economic research related to animal and manure production. http://www.ers.usda.gov/Browse/view.aspx?subject=FarmPracticesManagementManureManagement

- USDA's Agricultural Research Service (ARS) Website- The ARS has ongoing efforts designed to enhance current practices and develop new methods for efficiently and effectively managing manure.
http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=214

U.S. Environmental Protection Agency

- The USEPA's Agricultural Center Website- This is the USEPA's primary website for agricultural planning, management, and news.
http://www.epa.gov/agriculture

- Animal Feeding Operations (AFO) Virtual Information Center- The Animal Feeding Operations (AFO) Virtual Information Center is a tool to facilitate quick access to livestock and poultry agricultural information in the U.S. This site is a single point of reference to obtain links to state regulations, web sites, permits and policies, nutrient management information, livestock and trade associations, federal web sites, best management practices and controls, cooperative extension and land grant universities, research, funding, and information on environmental issues. http://cfpub.epa.gov/npdes/afo/virtualcenter.cfm

- National Management Measures to Control Nonpoint Source Pollution from Agriculture- This guidance document contains economically achievable best management practices designed to reduce agricultural pollution to surface and ground water. http://water.epa.gov/polwaste/nps/agriculture/agmm_index.cfm

- The USEPA's Nonpoint Source Pollution Publications & Resources Website- This website provides links and references to nonpoint source materials for both professionals and the public. http://water.epa.gov/polwaste/nps/pubs.cfm

- The USEPA's Source Water Protection Program- This website provides information and resources about protecting surface water and ground water drinking water sources. http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/index.cfm

- Healthy Watersheds Initiative- This website provides information on the concept and benefits of protecting healthy, unimpaired waters from degradation and also provides information on conservation approaches and tools. http://water.epa.gov/polwaste/nps/watershed/index.cfm

- EPA's Nutrient Indicators Dataset- The Dataset consists of a set of nine indicators and associated state-level data to serve as a regional compendium of information pertaining to documented or potential nitrogen and phosphorus pollution, impacts of this pollution, and states' efforts to minimize loadings and adopt numeric criteria. www.epa.gov/nutrientpollution/dataset

Additional State and University Technical Resources

The list of useful resources available from state and university resources is too lengthy to include in this report. In addition to the exceptional resources listed below, please contact applicable university extension services and state agencies responsible for natural resources management and environmental protection for more information.

- eXtension- This website provides objective and research-based information and learning opportunities that help people improve their lives. eXtension is an educational partnership of 74 universities in the U.S. http://www.extension.org/animal_manure_management

- Cornell University's Cornell Dairy Environmental Systems Program - This program provides information to dairy farmers to help manage their businesses in a way that protects the environment. This program also focuses on renewable energy (dairy manure-based anaerobic digestion). http://www.manuremanagement.cornell.edu/

- Ohio State University's Ohio Composting and Manure Management Website- This program researches, develops, and communicates sustainable strategies for management of animal manure and nutrients. Resources provided include workshops and literature on topics such as composting, application of liquid manure, and ammonia emissions and nitrogen conservation. http://www.oardc.ohio-state.edu/ocamm/t01_pageview/Home.htm

- The University of Illinois' Manure Central Website- This website directs the reader to a variety of resources for topics such as composting, manure management plans, a manure exchange program, and manure management for small farms.
http://web.extension.illinois.edu/manurecentral/

- Wisconsin Manure Management Advisory System- This website provides tools that can be used by producers to assist with manure spreading decisions that protect water quality. This is one of many practical tools that incorporate weather forecasts to plan daily hauling activities for specific locations. http://www.manureadvisorysystem.wi.gov/

- Texas A & M University's Texas Animal Manure Management Issues Website- This is an information clearinghouse providing educational materials on regulations and policies and up to date research on animal waste management and air and water quality issues.
http://tammi.tamu.edu/index.html

ATTACHMENT 2:

2001 Proposed CAFO Rule, 66 Fed. Reg. 2960-3145, at 3010 (Jan. 12, 2001)
("Proposed CAFO Rule")

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 122 and 412

[FRL–6921–4]

RIN 2040–AD19

National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: Today the Environmental Protection Agency proposes to revise and update two regulations that address the impacts of manure, wastewater, and other process waters generated by concentrated animal feeding operations (CAFOs) on water quality. These two regulations are the National Pollutant Discharge Elimination System (NPDES) provisions that define which operations are CAFOs and establish permit requirements, and the Effluent Limitations Guidelines for feedlots (beef, deiry, swine and poultry subcategories), which establish the technology-based effluent discharge standards for CAFOs. EPA is proposing revisions to these regulations to address changes that have occurred in the euimal industry sectors over the last 25 years, to clarify and improve implementation of CAFO permit requirements, eud to improve the environmental protection achieved under these rules.

Environmental concerns being addressed by this rnle include both ecological and human health effects. Manure from stockpiles, lagoons, or excessive land application can reach waterways through runoff, erosion, spills, or via groundwater. These discharges can result in excessive nutrients (nitrogen, phosphorus, and potassium), oxygen-depleting substances, and other pollntants in the water. This pollution cau kill fish aud shellfish, cause excess algae growth, harm marine mammals, and contaminete driuking water.

Today's action co-proposes two alternatives for how to structure the revised NPDES program for CAFOs; the alternatives offer comparable environmental benefits but differ in their administrative approacb. EPA also requests comment on two other alternatives that the Agency is considering and may pursue after evaluating the comments.

EPA is also proposing to revise effluent guidelines applicable to beef, dairy, swine, and poultry operations that are defined as CAFOs, pursoant to the NPDES revisions. The proposed effluent guidelines include regulations for both new and existing auimal feeding operations that meet the definition of a CAFO. Today's effluent guidelines revisions do not alter the requirements for horses, ducks, sheep or lambs.

DATES: Comments must be received or postmarked on or before midnight May 2, 2001.

ADDRESSES: Public comments regarding this proposed rule should be submitted by mail to: Concentrated Animal Feeding Operation Proposed Rule, Office of Water, Engineering and Analysis Division (4303), USEPA, 1200 Pennsylvania Avenue, NW., Washington, DC 20460. Hand deliveries (including overnight mail) should be submitted to the Concentrated Animal Feeding Operation Proposed Rule, USEPA, Waterside Mall, West Tower, Room 611, 401 M Street, SW., Washington, DC 20460. You also may submit comments electronically to CAFOS.comments@epa.gov. Please submit any references cited in your comments. Please submit an original and three copies of your written comments and enclosures. For additional information ou how to submit comments, see "**SUPPLEMENTARY INFORMATION**, How May I Submit Comments?"

FOR FURTHER INFORMATION CONTACT: For additional technical infurmation contact Karen Metchis or Jan Goodwin at (202) 564–0766.

SUPPLEMENTARY INFORMATION:

What Entities Are Potentially Regulated by This Action?

This proposed rule would apply to new and existing animal feeding operations that meet the definition of a concentrated animal feeding operation, or which are designated by the permitting authority as such. Concentrated animal feeding operetions are defined by the Clean Water Act as point sources for the purposes of the NPDES program. (33 U.S.C. § 1362).

The following table lists the types of entities that are potentielly subject to this proposed rule. This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regnlated by this action. Other types of eutities not listed in the table could elso be regulated. To determine whether your facility would be regulated by this action, you should carefully examine the epplicebility criteria proposed at § 122.23(a)(2) of the rule. If you have questions regarding the applicability of this action to a particular entity, consult one of the persons listed for technical information in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Category	Examples of regulated entities	North American Industry Code (NAIC)	Standard Industrial Classification Codes
Federal, State and Local Government			
Industry		See below	See below
	Operators of animal production operations that meet the definition of a concentrated animal feeding operation.		
	Beef cattle feedlots	112112	0211
	Hogs	11221	0213
	Sheep and goats	1241, 11242	0214
	General livestock, except dairy and poultry	11299	0219
	Dairy farms	112111, 11212	0241
	Broilers, fryers, and roaster chickens	11232	0251
	Chicken eggs	11231	0252
	Turkey and turkey eggs	11233	0253
	Poultry hatcheries	11234	0254
	Poultry and eggs, NEC	11239	0259
	Ducks	112390	0259
	Horses and other equines	11292	0272

Category	Examples of regulated entities	North American Industry Code (NAIC)	Standard Industrial Classification Codes
	Meat packing or poultry processing companies that may be a potential co-permittee because of substantial operational control over a CAFO.		
	Animal Slaughtering and Processing	3116	02
	Owners or operators of crop production operations that may receive CAFO manure for use as a fertilizer substitute.		
	Crop Production	111	01

How May I Review the Public Record?

The record (including supporting documentation) for this proposed rule is filed under docket number OW–00–27 (proposed rule). The record is available for inspection from 9 a.m. to 4 p.m. on Monday through Friday, excluding legal holidays, at the Water Docket, Room EB 57, USEPA Headquarters, 401 M Street, SW, Washington, DC 20460. For access to docket materials, please call (202) 260–3027 to schedule an appointment during the hours of operation stated above.

How May I Submit Comments?

To ensure that EPA can read, understand, and therefore properly respond to comments, the Agency requests that you cite, where possible, the paragraph(s) or sections in the preamble, rule, or supporting documents to which each comment refers. You should use a separate paragraph for each issue discussed.

If you want EPA to acknowledge receipt of your comments, enclose a self-addressed, stamped envelope. No faxes will be accepted. Comments may also be submitted electronically to CAFOS.comments@epa.gov. Electronic comments must be submitted as an ASCII, WordPerfect 5.1, WP6.1, or WP8 file avoiding the use of special characters and forms of encryption. Electronic comments must be identified by the docket number OW–00–27. EPA will accept comments and data on disks in WordPerfect 5.1, 6.1, or 8 format or in ASCII file format. Electronic comments on this notice may be filed on-line at many Federal depository libraries.

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I. Legal Authority

Today's proposed rule is issued under the authority of sections 301, 304, 306, 307, 308, 402, and 501 of the Clean

Water Act (CWA), 33 U.S.C. 1311, 1314, 1316, 1317, 1318, 1342, and 1361.

II. Purpose and Summary of the Proposed Regulation

Today, the Environmental Protection Agency proposes to revise and update two regulations that address the impacts on water quality from manure, wastewater, and other process waters generated by concentrated animal feeding operations (CAFOs). The National Pollutant Discharge Elimination System (NPDES) provisions in 40 CFR Part 122 define which operations are CAFOs and establish permit requirements for those operation. The Effluent Limitations Guidelines (ELG), or effluent guidelines, for feedlots in 40 CFR Part 412 establish technology-based effluent discharge standards that are applied to CAFOs. Both regulations were originally promulgated in the 1970s. EPA is proposing revisions to these regulations to address changes that have occurred in the animal industry sectors over the last 25 years, to clarify and improve implementation of CAFO permit requirements, and to improve the environmental protection achieved under these rules.

Environmental concerns being addressed by this rule include both ecological and human health effects. Manure from stockpiles, lagoons, or excessive land application rates can reach waterways through runoff, erosion, spills, or via groundwater. These discharges can result in excessive nutrients (nitrogen, phosphorus, and potassium), oxygen-depleting substances, and other pollutants in the water. This pollution can kill fish and shellfish, cause excess algae growth, harm marine mammals, and contaminate drinking water.

On October 30, 1989, Natural Resources Defense Council, Inc., and Public Citizen, Inc., filed an action against EPA in which they alleged, among other things, that EPA had failed to comply with CWA section 304(m). *Natural Resources Defense Council, Inc., et al.* v. *Reilly*, Civ. No. 89–2980 (RCL) (D.D.C.). Plaintiffs and EPA agreed to a settlement of that action in a consent decree entered on January 31, 1992. The consent decree, which has been modified several times, established a schedule by which EPA is to propose and take final action for eleven point source categories identified by name in the decree and for eight other point source categories identified only as new or revised rules, numbered 5 through 12. After completing a preliminary study of the feedlots industry under the decree, EPA selected the swine and poultry portion of the feedlots industry as the subject for New or Revised Rule #8, and the beef and dairy portion of that industry as the subject for New or Revised Rule #9. Under the decree, as modified, the Administrator was required to sign a proposed rule for both portions of the feedlots industry on or before December 15, 2000, and must take final action on that proposal no later than December 15, 2002. As part of EPA's negotiations with the plaintiffs regarding the deadlines for this rulemaking, EPA entered into a settlement agreement dated December 6, 1999, under which EPA agreed, by December 15, 2000, to also propose to revise the existing NPDES permitting regulations under 40 C.F.R. part 122 for CAFOs. EPA also agreed to perform certain evaluations, analyses or assessments and to develop certain preliminary options in connection with the proposed CAFO rules. (The Settlement Agreement expressly provides that nothing in the Agreement requires EPA to select any of these options as the basis for its proposed rule.)

The existing regulation defines facilities with 1,000 animal units ("AU") or more as CAFOs. The regulation also states that facilities with 300–1000 AU are CAFOs if they meet certain conditions. The term AU is a measurement established in the 1970 regulations that attempted to equalize the characteristics of the wastes among different animal types.

Today's proposals presents two alternatives for how to structure the revised NPDES program for CAFOs. The first alternative is a "two-tier structure" that simplifies the definition of CAFOs by establishing a single threshold for each animal sector. This alternative would establish a single threshold at the equivalent of 500 AU above which operations would be defined as CAFOs and below which facilities would become CAFOs only if designated by the permit authority. The 500 AU equivalent for each animal sector would be as follows.

500 cattle excluding mature dairy or veal cattle
500 veal cattle
350 mature dairy cattle (whether milked or dry)
1,250 mature swine weighing over 55 pounds
5,000 immature swine weighing 55 pounds or less
50,000 chickens
27,500 turkeys
2,500 ducks
250 horses
5,000 sheep or lambs

The second proposal would retain the "three-tier structure" of the existing regulation. Under this alternative, all operations with 1,000 AU or more would be defined as CAFOs; those with 300 AU to 1,000 AU would be CAFOs only if they meet certain conditions or if designated by the permit authority; and those with fewer than 300 AU would only be CAFOs if designated by the permit authority. These conditions are detailed in section VII of this preamble and differ from those in the current rule. Facilities with 300 AU to 1,000 AU would certify that they do not meet the conditions for being defined as a CAFO or apply for a permit. The 300 AU and 1,000 AU equivalent number of animals for each sector would be as follows:

Animal type	1,000 AU equivalent (no. of animals)	300 AU equivalent (no. of animals)
Cattle excluding mature dairy or veal cattle	1,000	300
Veal	1,000	300
Mature Dairy Cattle	700	200
Swine weighing more than 55 pounds	2,500	750
Swine weighing 55 pounds or less	10,000	3,000
Chickens	100,000	30,000
Turkeys	55,000	16,500
Ducks	5,000	1,500
Horses	500	150
Sheep or Lambs	10,000	3,000

The Agency is also taking comment on two other alternatives that the Agency is considering and may pursue after evaluating comments.

Today's proposal would also expand the regulatory definition of CAFOs to include all types of poultry operations regardless of the type of manure handling system or watering system they use, and also would include standalone immature swine and heifer operations.

Under the two-tier proposal, EPA is proposing to simplify the criteria for being designated as a CAFO by eliminating two specific criteria that have proven difficult to implement, the "direct contact" criterion and the "man made device" criterion. Under the three-tier proposal, EPA is proposing to retain those criteria for designating operations which have less than 300 AU. Both proposals retain the existing requirement for the permit authority to consider a number of factors to determine whether the facility is a significant contributor of pollution to waters of the U.S., and the requirement for an on-site inspection prior to designation. EPA is also proposing to clarify that EPA has the authority to designate CAFOs both in states where EPA is the permit authority and in States with NPDES authorized programs.

EPA is proposing to eliminate the 25-year, 24-hour storm event permit exclusion and to impose a broader, more explicit duty for all CAFOs to apply for a permit (with one exception as described below). Under the current regulations, facilities are excluded from being defined as, and thus subject to permitting as, CAFOs if they discharge only in the event of a 25-year, 24-hour storm. This exclusion has proven to be problematic in practice, as described below, and ultimately unnecessary. There are many operations that currently may be avoiding permitting by an inappropriate reliance on this exclusion. The Agency believes there is no reason to retain this exclusion from the definition of a CAFO. However, EPA is proposing to retain the 25-year, 24-hour storm standard as a *design standard* in the effluent guidelines for certain sectors (specifically, the beef and dairy sectors). CAFOs in those sectors would need to obtain permits, but the permits would allow certain discharges as long as the facility met the 25-year, 24-hour storm design standard.

In sum, under today's proposal, all operations that meet the definition of a CAFO under either of the two alternative structures (as well as all operations that are designated as CAFOs) would be required to apply for a permit. There would, however, be one exception to this requirement, as described in more detail below: If the operator could demonstrate to the permitting authority that the facility has "no potential to discharge," then a permit application and a permit would not be required.

Under the two-tier structure, the net effect of the revisions for determining which facilities are CAFOs is to require approximately 26,000 operations to apply for a NPDES permit. Under the three-tier structure, EPA estimates that approximately 13,000 operations would be required to apply for a permit, and an additional 26,000 operations could either certify that they are not a CAFO or apply for a permit. Under the existing regulation, EPA estimates that about 12,000 facilities should be permitted but only 2,530 have actually applied for a permit.

Today's proposal would clarify the definition of a CAFO as including both the production areas (animal confinement areas, manure storage areas, raw materials storage areas and waste containment areas) and the land application areas that are under the control of the CAFO owner or operator. As the industry trend is to larger, more specialized feedlots with less cropland needing the manure for fertilizer, EPA is concerned that manure is being land applied in excess of agricultural uses and, therefore, being managed as a waste product, and that this practice is causing runoff or leaching to waters of the U.S. The permit would address practices at the production area as well as the land application area, and would impose record keeping and other requirements with regard to transfer of manure off-site.

EPA is further proposing to clarify that entities that exercise "substantial operational control" over the CAFO are "operators" of the CAFO and thus would need to obtain a permit along with the CAFO owner or operator. The trend toward specialized animal production under contract with processors, packers and other integrators has increasingly resulted in concentrations of excess manure beyond agricultural needs in certain geographic areas. Especially in the poultry and swine sector, the processor provides the animals, feed, medication and/or specifies growing practices. EPA believes that clarifying that both parties are liable for compliance with the terms of the permit as well as responsible for the excess manure generated by CAFOs will lead to better management of manure.

The proposed effluent guidelines revisions would apply only to beef, dairy, swine, poultry and veal operations that are defined or designated as CAFOs under either of the two alternative structures and that are above the threshold for the effluent guideline. For those CAFOs below the threshold for being subject to the effluent guidelines, the permit writer would use best professional judgment (BPJ) to develop the site-specific permit conditions.

Today's proposed effluent guidelines revisions would not alter the existing effluent guideline regulations for horses, ducks, sheep or lambs. In these sectors, only facilities with 1,000 AU or more are subject to the effluent guidelines. Permits for operations in these subcategories with fewer than 1,000 AU would continue to be developed based on the best professional judgement of the permit writer.

The proposed effluent guidelines regulations for beef, dairy, swine, poultry and veal operations will establish the Best Practicable Control Technology (BPT), Best Conventional Pollutant Control Technology (BCT), and the Best Available Technology (BAT) limitations as well as New Source Performance Standards, including specific best management practices which ensure that manure storage and handling systems are inspected and maintained adequately. A description of these requirements is in Section III.

Under the BPT requirements for all of the subcategories, EPA is proposing to require zero discharge from the production area except that an overflow due to catastrophic or chronic storms would be allowed if the CAFO met a certain design standard for its containment structures. If a CAFO uses a liquid manure handling system, the storage structure or lagoon would be required to be designed, constructed and maintained to capture all process wastewater and manure, plus all the storm water runoff from the 25-year, 24-hour storm.

The proposed BPT limitations also include specific requirements on the application of manure and wastewater to land that is owned or under the operational control of the CAFO. EPA is proposing to require that CAFOs apply their manure at a rate calculated to meet the requirements of the crop for either nitrogen or phosphorus (depending on the soil conditions for phosphorus). Livestock manure tends to be phosphorus rich, meaning that if manure is applied to meet the nitrogen requirements of a crop, then phosphorus is being applied at rates higher than needed by the crop. Repeated application of manure on a nitrogen basis may build up phosphorus levels in the soil, and potentially result in saturation, thus contributing to the contamination of surface waters through erosion, snow melt and rainfall events. Therefore, EPA is also proposing that manure must be applied to cropland at rates not to exceed the crop requirements for nutrients and the ability of the soil to absorb any excess phosphorus. BPT establishes specific record keeping requirements associated with ensuring the achievement of the zero discharge limitation for the production area and that the application of manure and wastewater is done in accordance with land application requirements. EPA also proposes to require the CAFO operator to maintain records of any excess manure that is transported off-site.

BAT limitations for the beef and dairy subcategories would include all of the BPT limitations described above and, in addition, would require CAFOs to achieve zero discharge to ground water beneath the production area that has a direct hydrologic connection to surface water. In addition, the proposed BAT requirements for the swine, veal and poultry subcategories would eliminate the provision for overflow in the event of a chronic or catastrophic storm. CAFOs in the swine, veal and poultry subcategories typically house their animals under roof instead of in open areas, thus avoiding or minimizing the runoff of contaminated storm water and the need to contain storm water.

EPA is also proposing to revise New Source Performance Standards (NSPS) based on the same technology requirements as BAT for the beef and dairy subcategories. For the swine, veal and poultry subcategories, EPA proposes revised NSPS based on the same technology as BAT with the additional requirement that there be no discharge of pollutants through ground water beneath the production area that has a direct hydrological connection to surface waters. Both the BAT and NSPS requirements have the same land application and record keeping requirements as proposed for BPT.

Today's proposal would make several other changes to the existing regulation, which would:

- require the CAFO operator to develop a Permit Nutrient Plan for managing manure and wastewater at both the production area and the land application area;
- require certain record keeping, reporting, and monitoring;
- revise the definition of an animal feeding operation (AFO) to more clearly exclude areas such as pastures and rangeland that sustain crops or forage during the entire time that animals are present;
- eliminate the mixed-animal type calculation for determining which AFOs are CAFOs; and
- require permit authorities to include the following conditions in permits to:

(1) require retention of a permit until proper facility closure; (2) establish the method for operators to calculate the allowable manure application rate; (3) specify restrictions on timing and methods of application of manure and wastewater to assure use for an agricultural purpose (e.g., certain applications to frozen, snow covered or saturated land) to prevent impairment of water quality; (4) address risk of contamination via groundwater with a direct hydrological connection to surface water; (5) address the risk of improper manure application off-site by either requiring that the CAFO operator obtain from off-site recipients a certification that they are land applying CAFO manure according to proper agricultural practices or requiring the CAFO to provide information to manure recipients and keep appropriate records of off-site transfers, or both; and (6) establish design standards to account for chronic storm events.

Today's proposal would also:

- clarify EPA's interpretation of the agricultural storm water exemption and its implications for land application of manure both at the CAFO and off-site; and
- clarify application of the CWA to dry weather discharges at AFOs.

EPA is seeking comment on the entire proposal. Throughout the preamble, EPA identifies specific components of the proposed rule on which comment is particularly sought.

III. Background

A. The Clean Water Act

Congress passed the Federal Water Pollution Control Act (1972), also known as the Clean Water Act (CWA), to "restore and maintain the chemical, physical, end biological integrity of the nation's waters." (33 U.S.C. § 1251(a)). The CWA establishes a comprehensive program for protecting our nation's waters. Among its core provisions, the CWA prohibits the discharge of pollutants from a point source to waters of the U.S. except as authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The CWA establishes the NPDES permit program to authorize and regulate the discharges of pollutants to waters of the U.S. EPA has issued comprehensive regulations that implement the NPDES program at 40 CFR Part 122. The CWA also provides for the development of technology-based and water quality-based effluent limitations that are imposed through NPDES permits to control discharges of pollutants.

1. The National Pollutant Discharge Elimination System (NPDES) Permit Program

Under the NPDES permit program, all point sources that directly discharge pollutants to waters of the U.S. must apply for a NPDES permit and may only discharge pollutants in compliance with the terms of that permit. Such permits must include any nationally established, technology based effluent discharge limitations (i.e., effluent guidelines) (discussed below, in subsection III.A.2). In the absence of national effluent limitations, NPDES permit writers must establish technology based limitations and standards on a case-by-case basis, based on their "best professional judgement (BPJ)."

Water quality-based effluent limits also are included in a permit where technology-based limits are not sufficient to ensure compliance with State water quality standards that apply to the receiving water or where required to implement a Total Maximum Daily Load (TMDL). Permits may also include specific best management practices to achieve effluent limitations and standards, typically included as special conditions. In addition, NPDES permits normally include monitoring and reporting requirements, and standard conditions (i.e., conditions that apply to all NPDES permits, such as the duty to properly operate and maintain equipment and treatment systems).

NPDES permits may be issued by EPA or a State, Territory, or Tribe authorized by EPA to implement the NPDES program. Currently, 43 States and the Virgin Islands are authorized to administer the base NPDES program (the base program includes the federal requirements applicable to AFOs and CAFOs). Alaska, Arizona, the District of Columbia, Idaho, Maine, Massachusetts, New Hampshire, and New Mexico are not currently authorized to implement the NPDES program. In addition, Oklahoma, while authorized to administer the NPDES program, does not have CAFO regulatory authority. No tribe is currently authorized.

A NPDES permit may be either an individual permit tailored for a single facility or a general permit applicable to multiple facilities within a specific category. Prior to the issuance of an individual permit, the owner or operator submits a permit application with facility-specific information to the permit authority, who reviews the information and prepares a draft permit. The permit authority prepares a fact sheet explaining the draft permit, and publishes the draft permit and fact sheet for public review and comment. Following consideration of public comments by the permit authority, a final permit is issued. Specific procedural requirements apply to the modification, revocation and reissuance, and termination of a NPDES permit. NPDES permits are subject to a maximum 5-year term.

General NPDES permits are available to address a category of discharges that involve similar operations with similar wastes. General permits are not developed based on facility-specific information. Instead, they are developed based on data that characterize the type of operations being addressed and the pollutants being discharged. Once a general permit is drafted, it is published for public review and comment accompanied by a fact sheet that explains the permit. Following EPA or State permit authority consideration of public comments, a final general permit is issued. The general permit specifies the type or category of facilities that may obtain coverage under the permit. Those facilities that fall within this category then must submit a "notice of intent" (NOI) to be covered under the general permit to gain permit coverage. [Under 40 CFR 122.28(b)(2)(vi), the permit authority also may notify a discharger that it is covered under a general permit even where that discharger has not submitted a notice of intent to be covered by the permit.] EPA anticipates that the Agency and authorized States will use general NPDES permits to a greater extent than individual permits to address CAFOs.

2. Effluent Limitation Guidelines and Standards

Effluent limitation guidelines and standards (which we also refer to today as "effluent guidelines" or "ELG") are national regulations that establish limitations on the discharge of pollutants by industrial category and subcategory. These limitations are subsequently incorporated into NPDES permits. The effluent guidelines are based on the degree of control that can be achieved using various levels of pollution control technology, as outlined below. The effluent guidelines may also include non-numeric effluent limitations in the form of best management practices requirements or directly impose best management practices as appropriate.

a. *Best Practicable Control Technology Currently Available (BPT)—Section 304(b)(1) of the CWA.* In the guidelines for an industry category, EPA defines BPT effluent limits for conventional, toxic, and non-conventional pollutants. In specifying BPT, EPA looks at a number of factors. EPA first considers the cost of achieving effluent reductions in relation to the effluent reduction benefits. The Agency also considers the age of the equipment and facilities, the processes employed and any required process changes, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements), and such other factors as the Agency deems appropriate (CWA 304(b)(1)(B)). Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry of various ages, sizes, processes or other common characteristics. Where existing performance is uniformly inadequate, EPA may require higher levels of control than currently in place in an industrial category if the Agency determines that the technology can be practically applied.

b. *Best Available Technology Economically Achievable (BAT)—Section 304(b)(2) of the CWA.* In general, BAT effluent limitations represent the best existing economically achievable performance of direct discharging plants in the industrial subcategory or category. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the processes employed, engineering aspects of the control technology, potential process changes, non-water quality environmental impacts (including energy requirements), and such factors as the Administrator deems appropriate. The Agency retains considerable discretion in assigning the weight to be accorded to these factors. An additional statutory factor considered in setting BAT is economic achievability. Generally, the achievability is determined on the basis of the total cost to the industrial subcategory and the overall effect of the rule on the industry's financial health. BAT limitations may be based on effluent reductions attainable through changes in a facility's processes and operations. As with BPT, where existing performance is uniformly inadequate, BAT may be based on technology transferred from a different subcategory within an industry or from another industrial category. BAT may be based on process changes or internal controls, even when these technologies are not common industry practice.

c. *Best Conventional Pollutant Control Technology (BCT)—Section 304(b)(4) of the CWA.* The 1977 amendments to the CWA required EPA to identify effluent reduction levels for conventional pollutants associated with BCT technology for discharges from existing industrial point sources. BCT is not an additional limitation, but replaces Best Available Technology (BAT) for control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that EPA establish BCT limitations after consideration of a two part "cost-reasonableness" test. EPA explained its methodology for the development of BCT limitations in July 1986 (51 FR 24974). Section 304(a)(4) designates the following as conventional pollutants: biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501).

d. *New Source Performance Standards (NSPS)—Section 306 of the CWA.* NSPS reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the greatest degree of effluent reduction attainable through the application of the best available demonstrated control technology for all pollutants (i.e., conventional, non-conventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

B. History of EPA Actions to Address CAFOs

EPA's regulation of wastewater and manure from CAFOs dates to the 1970s. The existing NPDES CAFO regulations were issued on March 18, 1976 (41 FR 11458). The existing national effluent limitations guideline and standards for feedlots were issued on February 14, 1974 (39 FR 5704).

By 1992, it became apparent that the regulation and permitting of CAFOs needed review due to changes in the livestock industry, specifically the consolidation of the industry into fewer, but larger operations. In 1992, the Agency established a workgroup composed of representatives of State agencies, EPA regional staff and EPA headquarters staff to address issues related to CAFOs. The workgroup issued The Report of the EPA/State Feedlot Workgroup in 1993. One of the workgroup's recommendations was that the Agency should provide additional guidance on how CAFOs are regulated under the NPDES permit program. The Agency issued such guidance, entitled Guide Manual On NPDES Regulations For Concentrated Animal Feeding Operations, in December 1995.

Massive spills of hog manure (see Section V.B.1.c) and Pfiesteria outbreaks (see Section V.C.1.a.), continued industry consolidation, and increased public awareness of the potential environmental and public health impacts of animal feeding operations resulted in EPA taking more comprehensive actions to improve existing regulatory and voluntary programs. In 1997, dialogues were initiated between EPA and the poultry and pork livestock sectors. On December 12, 1997, the Pork Dialogue participants, including representatives from the National Pork Producers Council (NPPC) and officials from EPA, U.S. Department of Agriculture (USDA), and several States, issued a Comprehensive Environmental Framework for Pork Production Operations. Continued discussions between EPA and the NPPC led to development of a Compliance Audit Program Agreement (CAP Agreement) that is available to any pork producer who participates in NPPC's environmental assessment program. The CAP Agreement for pork producers was issued by the Agency on November 24, 1998. Under the agreement, pork producers that voluntarily have their facilities inspected are eligible for reduced penalties for any CWA violations discovered and corrected. The Poultry Dialogue produced a report in December 1998 that established a voluntary program focused on promoting protection of the environment and water quality through implementation of litter management plans and other actions: Environmental Framework and Implementation Strategy: A Voluntary Program Developed and adopted by the Poultry Industry, Adopted at the December 8–9, 1998 meeting of the Poultry Industry Environmental Dialogue (U.S. Poultry and Egg Association).

President Clinton and Vice President Gore announced the Clean Water Action Plan (CWAP) on February 19, 1998. The CWAP describes the key water quality problems our nation faces today and suggests both a broad plan and specific actions for addressing these problems. The CWAP indicated that polluted runoff is the greatest source of water quality problems in the United States today and that stronger polluted runoff controls are needed. The CWAP goes on to state that one important aspect of such controls is the expansion of CWA permit controls, including those applicable to large facilities such as CAFOs.

The CWAP included two key action items that address animal feeding operations (AFOs). First, it stated that EPA should publish and, upon considering public comments, implement an AFO strategy for important and necessary EPA actions on standards and permits. EPA published a Draft Strategy for Addressing Environmental and Public Health Impacts from Animal Feeding Operations in March 1998 (draft AFO Strategy). In accordance with EPA's draft AFO Strategy, EPA's Office of Enforcement and Compliance Assurance (OECA) also issued the Compliance Assurance Implementation Plan for Animal Feeding Operations in March 1998. This plan describes compliance and enforcement efforts being undertaken to ensure that CAFOs comply with existing CWA regulations. Second, the CWAP stated that EPA and USDA should jointly develop a unified national strategy to minimize the water quality and public health impacts of AFOs. EPA and USDA jointly published a draft Unified National Strategy for Animal Feeding Operations (hereinafter Unified National AFO Strategy) on September 21, 1998 and, after sponsoring and participating in 11 public listening sessions and considering public comments on the draft strategy, published a final Unified National AFO Strategy on March 9, 1999. This joint strategy was generally consistent with and superceded EPA's draft AFO Strategy.

The Unified National AFO Strategy establishes national goals and performance expectations for all AFOs. The general goal is for AFO owners and operators to take actions to minimize water pollution from confinement facilities and land where manure is applied. To accomplish this goal, the AFO Strategy established a national performance expectation that all AFOs should develop and implement technically sound, economically feasible, and site-specific comprehensive nutrient management plans (CNMPs) to minimize impacts on water quality and public health.

The Unified National AFO Strategy identified seven strategic issues that should be addressed to better resolve concerns associated with AFOs. These include: (1) fostering CNMP development and implementation; (2) accelerating voluntary, incentive-based programs; (3) implementing and improving the existing regulatory program; (4) coordinating research, technical innovation, compliance assistance, and technology transfer; (5) encouraging industry leadership; (6) increasing data coordination; and (7) establishing better performance measures and greater accountability. Today's proposed rule primarily addresses strategic issue three: implementing and improving the existing AFO regulatory program.

The Unified National AFO Strategy observed that, for the majority of AFOs (estimated in the AFO Strategy as 95 percent), voluntary efforts founded on locally led conservation, education, and technical and financial assistance would be the principal approach for assisting owners and operators in developing and implementing site-specific CNMPs and reducing water pollution and public health risks. Future regulatory programs would focus permitting and enforcement priorities on high risk operations, which were expected to constitute the remaining 5 percent. EPA estimates that today's proposal would result in permit coverage for approximately 7 percent of AFOs under the two-tier structure, and between 4.5 percent and 8.5 percent of AFOs under the three-tier structure.

Following publication of the Unified National AFO Strategy, EPA issued on August 6, 1999 the Draft Guidance Manual and Example NPDES Permit for CAFOs for a 90-day public comment period. EPA undertook development of this new guidance manual in order to provide permit writers with improved guidance on applying the existing regulations to a changing industry. While the guidance manual has not been finalized, many of the issues discussed in the draft guidance manual are also addresses in today's preamble. EPA expects to issue final, revised permitting guidance to reflect the revised CAFO regulations when they are published in final form.

C. What Requirements Apply to CAFOs?

The discussion below provides an overview of the scope and requirements imposed under the existing NPDES CAFO regulations and feedlot effluent limitations guidelines. It also explains the relationship of these two regulations, and summarizes other federal and State regulations that potentially affect AFOs.

1. What are the Scope and Requirements of the Existing NPDES Regulations for CAFOs?

Under existing 40 CFR 122.23, an operation must be defined as an animal feeding operation (AFO) before it can be defined as a concentrated animal feeding operation (CAFO). The term "animal feeding operation" is defined in EPA regulations as a "lot or facility" where animals "have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period and crops, vegetation[,] forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility." This definition is intended to enable the NPDES authorized permitting authority to regulate facilities where animals are stabled or confined and waste is generated.

Once a facility meets the AFO definition, its size, based upon the total numbers of animals confined, is a key factor in determining whether it is a CAFO. To define these various livestock sectors, EPA established the concept of an "animal unit" (AU), which varies according to animal type. Each livestock type, except poultry, is assigned a multiplication factor to facilitate determining the total number of AU at a facility with more than one animal type. These multiplication factors are as follows: Slaughter and feeder cattle—1.0, Mature dairy cattle—1.4, Swine weighing over 25 kilograms (approximately 55 pounds)—0.4, Sheep—0.1, Horses—2.0. There are currently no animal unit conversions for poultry operations. The regulations, however, define the total number of animals (subject to waste handling technology restrictions) for specific poultry types that make these operations subject to the regulation. (40 CFR Part 122, Appendix B).

Under the existing regulations, an animal feeding operation is a concentrated animal feeding operation if it meets the regulatory CAFO definition or if it is designated as a CAFO. The regulations automatically define an AFO to be a CAFO if either more than 1,000 AU are confined at the facility, or more than 300 AU are confined at the facility and: (1) pollutants are discharged into navigable waters through a manmade ditch, flushing system, or other similar man-made device; or (2) pollutants are discharged directly into waters that originate outside of and pass over, across, or through the facility or come into direct contact with the confined animals. However, no animal feeding operation is defined as a CAFO if it discharges only in the event of a 25-year, 24-hour storm event (although it still may be designated as a CAFO). Although they are not automatically defined as a CAFO, facilities still may be designated as a CAFO even if they discharge only in a 25-year, 24-hour storm event.

An AFO can also become a CAFO through designation. The NPDES permitting authority may, on a case-by-case basis, after conducting an on-site inspection, designate any AFO as a CAFO based on a finding that the facility "is a significant contributor of pollution to the waters of the United States." (40 CFR 122.23(c)). Pursuant to 40 CFR 122.23(c)(1)(i)-(v) the permitting authority shall consider several factors making this determination, including: (1) the size of the operation, and amount of waste reaching waters of the U.S.; (2) the location of the operation relative to waters of the U.S.; (3) the means of conveyance of animal waste and process waste waters into waters of the U.S.; and (4) the slope, vegetation, rainfall and other factors affecting frequency of discharge. A facility with 300 animal units or less, however, may not be designated as a CAFO unless pollutants are discharged into waters of the U.S. through a man-made ditch, flushing system, or other similar man-made device, or are discharged directly into waters of the U.S. which originate outside of the facility and pass over, across or through the facility or otherwise come into direct contact with the animals confined in the operation.

Once defined or designated as a CAFO, the operation is subject to NPDES permitting. As described above, a permit contains the specific technology-based effluent limitations (whether based on the effluent guidelines or BPJ); water quality-based limits if applicable; specific best management practices; monitoring and reporting requirements; and other standard NPDES conditions.

2. What are the Scope and Requirements of the Existing Feedlot Effluent Guidelines?

In 1974, EPA promulgated effluent limitations guidelines applicable to CAFOs (40 CFR Part 412) and established in those regulations the technology-based effluent discharge standards for the facilities covered by the guidelines. The effluent guidelines for the feedlots point source category have two subparts: Subpart B for ducks, and Subpart A for all other feedlot animals. Under the existing regulation, Subpart A covers: beef cattle; dairy cattle; swine; poultry; sheep; and horses. Further, the effluent guidelines apply only to facilities with 1,000 AU or greater. Today's revisions to the effluent guidelines affect only the guidelines for the beef, dairy, swine, poultry and veal subcategories, while the NPDES revisions are applicable to all confined animal types.

The current feedlot effluent guidelines based on BAT prohibit discharges of process wastewater pollutants to waters of the U.S. except when chronic or catastrophic storm events cause an overflow from a facility designed, constructed, and operated to hold process-generated wastewater plus runoff from a 25-year, 24-hours storm event. Animal wastes and other wastewater that must be controlled include: (1) spillage or overflow from animal or poultry watering systems, washing, cleaning, or flushing pens, barns, manure pits, or other feedlot facilities, direct contact swimming, washing, or spray cooling of animals, and dust control; and (2) precipitation (rain or snow) which comes into contact with any manure, litter, or bedding, or any other raw material or intermediate or final material or product used in or resulting from the production of animals or poultry or direct products (e.g., milk or eggs). 40 CFR 412.11.

As described above, in those cases where the feedlot effluent guidelines do not apply to a CAFO (i.e., the operation confines fewer than 1,000 animal units), the permit writer must develop, for inclusion in the NPDES permit, technology-based limitations based on best professional judgement (BPJ).

3. What Requirements May be Imposed on AFOs Under the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA)?

In the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), Congress required States with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. Thirty-three (33) States and Territories currently have federally approved Coastal Zone Management programs. Section 6217(g) of CZARA called for EPA, in consultation with other federal agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. In January 1993, EPA issued its Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters which addresses five major source categories of nonpoint pollution: urban runoff, agriculture runoff, forestry runoff, marinas and recreational boating, and hydromodification.

Within the agriculture runoff nonpoint source category, the EPA guidance specifically included management measures applicable to all new and existing "confined animal facilities." The guidance identifies which facilities constitute large and small confined animal facilities based solely on the number of animals or animal units confined (the manner of discharge is not considered). Under the CZARA guidance: a large beef feedlot contains 300 head or more, a small feedlot between 50–299 head; a large dairy contains 70 head or more, a small dairy between 20–69 head; a large layer or broiler contains 15,000 head or more, a small layer or broiler between 5,000–14,999 head; a large turkey facility contains 13,750 head or more, a small turkey facility between 5,000–13,749 head; and a large swine facility contains 200 head or more, a small swine facility between 100–199 head.

The thresholds in the CZARA guidance for identifying large and small confined animal facilities are lower than those established for defining CAFOs under the current NPDES regulations. Thus, in coastal States the CZARA management measures potentially apply to a greater number of small facilities than the existing CAFO definition. Despite the fact that both the CZARA management measures for confined animal facilities and the NPDES CAFO regulations address similar operations, these programs do not overlap or conflict with each other. Any CAFO facility, defined by 40 CFR Part 122, Appendix B, that has a NPDES CAFO permit is exempt from the CZARA program. If a facility subject to CZARA management measures is later designated a CAFO by a NPDES permitting authority, the facility is no longer subject to CZARA. Thus, an AFO cannot be subject to CZARA and NPDES permit requirements at the same time.

EPA's CZARA guidance provides that new confined animal facilities and existing large confined animal facilities should limit the discharge of facility wastewater and runoff to surface waters by storing such wastewater and runoff during storms up to and including discharge caused by a 25-year, 24-hour frequency storm. Storage structures should have an earthen or plastic lining, be constructed with concrete, or constitute a tank. All existing small facilities should design and implement systems that will collect solids, reduce contaminant concentrations, and reduce runoff to minimize the discharge of contaminants in both facility wastewater and in runoff caused by storms up to and including a 25-year, 24-hour frequency storm. Existing small facilities should substantially reduce pollutant loadings to ground water. Both large and small facilities should also manage accumulated solids in an appropriate waste utilization system. Approved State CZARA programs have management measures in conformity with this guidance and enforceable policies and mechanisms as necessary to assure their implementation.

In addition to the confined animal facility management measures, the CZARA guidance also includes a nutrient management measure that is intended to be applied by States to activities associated with the application of nutrients to agricultural lands (including the application of manure). The goal of this management measure is to minimize edge of field delivery of nutrients and minimize the leaching of nutrients from the root zone.

The nutrient management measures provide for the development, implementation, and periodic updating of a nutrient management plan. Such plans should address: application of nutrients at rates necessary to achieve realistic crop yields; improved timing of nutrient application; and the use of agronomic crop production technology to increase nutrient use efficiency. Under this management measure, nutrient management plans include the following core components: farm and field maps showing acreage, crops, and soils; realistic yield expectations for the crops to be grown; a summary of the nutrient resources available to the producer; an evaluation of field limitations based on environmental hazards or concerns; use of the limiting nutrient concept to establish the mix of nutrient sources and requirements for the crop based on realistic crop expectations; identification of timing and application methods for nutrients; and provisions for proper calibration and operation of nutrient application equipment.

4. How Are CAFOs Regulated By States?

NPDES permits may be issued by EPA or a State authorized by EPA to implement the NPDES program. Currently, 43 States and the Virgin Islands are authorized to administer the NPDES program. Oklahoma, however, has not been authorized to administer the NPDES program for CAFOs.

To become an authorized NPDES state, the State's requirements must, at a minimum, be as stringent as the requirements imposed under the federal NPDES program. States, however, may impose requirements that are broader in scope or more stringent than the requirements imposed at the federal level. In States not authorized to implement the NPDES program, the appropriate EPA Regional office is responsible for implementing the program.

State efforts to control pollution from CAFOs have been inconsistent to date for a variety of reasons. Many States have only recently focused attention on the environmental challenges posed by the emergence of increasing consolidation of CAFOs into larger and larger operations. Others have traditionally viewed AFOs as agriculture, and the reluctance to regulate agriculture has prevented programs from keeping pace with a changing industry. Many states have limited resources for identifying which facilities are CAFOs, or which may be inappropriately claiming the 25-year, 24-hour storm permit exclusion. Some states with a large number of broiler and laying operations do not aggressively try to permit these facilities under NPDES because the technology requirements for these operations in the existing regulation are outdated.

Another reason States may not have issued NPDES permits to CAFOs is the concern over potentially causing operations to lose cost-share money available under EPA's Section 319 Nonpoint Source Program and other assistance under USDA's Environmental Quality Incentive Program (EQIP). Once a facility is considered a point source under NPDES, the operation is not eligible for cost sharing under the Section 319 nonpoint source program. The USDA EQIP program, however, is available to most facilities, and being a permitted CAFO is not a reason for exclusion from the EQIP program. Although EQIP funds may not be used to pay for construction of storage facilities at operations with greater than 1,000 USDA animal units (USDA uses a different definition of animal units than EPA); EQIP is available to these facilities for technical assistance and financial assistance for other practices.

To gather information on State activities concerning AFOs, EPA assembled information into a report entitled, "State Compendium: Programs and Regulatory Activities Related to Animal Feeding Operations, Final Report," dated December 1999, and continues to update information concerning state operations (see "Profile of NPDES Permits and CNMP Permit Requirements for CAFOs," updated periodically). The following discussion draws on information from these reports.

EPA estimates that, under the existing EPA regulations, approximately 9,000 operations with more than 1,000 AU are CAFOs and should be permitted, and approximately 4,000 operations with 300 AU to 1,000 AU shonld be permitted. However, only an estimated 2,520 CAFOs are currently covered under either a general permit or an individual permit. The 43 states authorized to implement the NPDES program for CAFOs have issued coverage for approximately 2,270 facilities, of which about 1,150 facilities are under general permits and about 1,120 facilities are under individual permits. Of these states, 32 states administer their NPDES CAFO program in combination with some other State permit, license, or authorization program. Often, this additional State authorization is a construction or operating permit. Eight of the states regulate CAFOs exclnsively under their State NPDES authority, while three others have chosen to regulate CAFOs solely under State non-NPDES programs. EPA information indicates that, as of December, 1999, seventeen of the 43 states authorized to administer the NPDES program for CAFOs have never issued an NPDES permit to a CAFO.

Of the seven states not anthorized to administer the NPDES program, four rely solely on federal NPDES permits to address CAFOs. As of December 1998, EPA has issued coverage for approximately 250 facilities nnder general NPDES permits.

Virtually all NPDES authorized states use the federal CAFO definition in their State NPDES CAFO program. Most states also use the federal definition for State non-NPDES CAFO programs. Five States, however, have developed unique definitions for their non-NPDES livestock regulatory programs that do not follow the federal definition. These five States typically base their definition on the nnmber of animals confined, weight of animals and design capacity of waste control system, or gross income of agricultural operation. For example, Alabama's new general State NPDES permit covers all operations with at least 250 animal units. Similarly, Minnesota issues State (non-NPDES) feedlot permits to facilities with more than 10 animal units. Minnesota also issues individual NPDES permits to CAFOs as defined under the existing federal regulations.

The regulation of CAFOs is challenging, in part, becanse of the large number of facilities across the country. There are approximately 376,000 AFOs. Regnlating, for example, 5 percent of AFOs would result in some 18,800 permittees. One way of reducing the administrative burden associated with permitting such large numbers of facilities is throngh the use of general permits. NPDES regulations provide that general permits may be issued to cover a category of dischargers that involves similar operations with similar wastes. Operations subject to the same effluent limitations and operating conditions, and requiring similar monitoring are the types of facilities most appropriately regulated under a general permit. EPA and some anthorized States are using general permits to regulate CAFOs, and this trend appears to be increasing.

As mentioned, seventeen of the 43 States authorized to issue NPDES CAFO permits have never issued an NPDES permit to a CAFO, although many regulate CAFOs under non-NPDES programs. Under current regulations, an animal feeding operation that discharges only in the event of a 25-year, 24-hour storm event is not considered to meet the definition of a CAFO (although it may still be designated as a CAFO). EPA believes that many of these facilities have in fact discharged in circumstance other than the 25-year/24-hoor storm and should be required to obtain a permit.

The number of non-NPDES permits issued to AFOs greatly exceeds the number of NPDES permits issued. Although the information may be incomplete on the number of state permits issued, more than 45,000 non-NPDES permits or formal authorizations are known to have been issued through state AFO programs. The non-NPDES State authorizations often are only operating permits or approvals required for construction of waste disposal systems. While some impose terms and conditions on discharges from the CAFO, EPA believes that many would not meet the standards for approval as NPDES permits. Because these are not NPDES permits, none meet the requirement for federal enforceability.

Minnesota alone has issued nearly 25,000 State feedlot permits. Kansas has issued more than 2,400 State permits, of which 1,500 have been to facilities with more than 300 animal nnits. Indiana has issned more than 4,000 letters of approval to AFOs within the State. South Carolina has issued 2,000 construction permits.

With regard to the discharge standards included in permits, 28 NPDES authorized States have adopted the federal feedlot effluent guidelines, while five authorized States use a more stringent limit. These more stringent limits partially or totally prohibit discharges related to storm events. For example, Arkansas regulations prohibit discharges from liquid waste managament systems, including those resulting from periods of precipitatiun greater than the 25-year, 24-hour storm event. In addition, California and North Carolina rules provide for no discharge from new waste control structures even during 100 year storms. Numerons State CAFO permit programs also impose requirements that are broader in scope than the existing federal CAFO regulations.

Twenty-two States have adopted laws that their environmental regulations cannot be more restrictive than the specific requirements in the federal regulations. Should any of tbese states experience environmental problems with CAFOs, they must rely on appropriate state regulations no more stringent than the federal rules.

Thirty-four States explicitly impose at least some requirements that address land application of mannre and wastewater as part of either their NPDES or non-NPDES program. The most common requirements among these States is that CAFO manure and wastewater, when managed through land application, be land applied in accordance with agronomic rates and that the operator develop and use a waste management plan. Although some States do not address how agronomic rates should be determined, many base it on the nitrogen needs of crops, while some require consideration of phosphorus as well. The complexity of waste management plans also varies between statas. Some states have very detailed requirements for content of waste management plans, while others do not. Generally, CAFO operators are asked to address estimates of annual nutrient value of waste, schednles for emptying and applying wastes, rates and locations for applying wastes, provisions for determining agronomic rates, and provisions for conducting required monitoring and reporting.

Although data was not available for all States, State agency staff dedicated to AFOs has increased over the last five years. In general, State staff dedicated to AFOs is relatively small, with average staff nnmbers being below four full-time employees. Several States do not have any staff specifically assigned to manage water quality impacts from AFOs. However, States such as Arkansas, Minnesota, Wisconsin, and Nebraska doubled their staff commitment to AFOs within the last five years. The most notable increases in State staff assigned to address AFOs were in Iowa and North Carolina. Kansas, Minnesota, and North Carolina havo the largest AFO staffs in the country, with each having more than 20 full time employees.

One indication that States have an increasing interest in expanding their efforts to control water quality impacts from AFOs is the promulgation of new

State AFO regulations and program initiatives. At least twelve states have developed new regulations related to AFOs since 1996. (AL, IN, KS, KY, MD, MS, NC, OK, PA, VT, WA, WY). Kansas, Kentucky, North Carolina, and Wyoming passed legislation regarding swine facilities, with Kentucky and North Carolina imposing moratoriums on the expansion of hog AFOs until State management/regulatory plans could be developed. Similarly, Mississippi also has imposed a 2-year moratorium on any new CAFOs. Alabama's recent afforts include developing an NPDES general permitting rule and a Mamorandum of Agreement with EPA outlining State agency responsibilities as they relate to CAFOs. Washington's Dairy Law subjects all dairy farms with more than 300 animal units to permitting and requires each facility to develop nutrient management plans approved by the National Conservation Resource Service. Indiana's Confined Feeding Control Law also requires AFOs to develop waste management plans and receive State approval for operating AFOs.

In conclusion, the implementation of CAFO programs varies from state-to-state, as does the implementation of NPDES programs for CAFOs by NPDES authorized states. As animal production continues to become more industrialized nationwide, a coherent and systematic approach to implementing minimum standards is needed to ensure consistent protection of water quality. Today's proposal will continue to promote a systematic approach to establishing industry standards that are protective of human health and the environment.

D. How Do Today's Proposed Revisions Compare to the Unified National AFO Strategy?

As described in section III.B, on March 9, 1999, EPA and the U.S. Department of Agriculture jointly issued the Unified National Strategy for Animal Feeding Operations (Unified AFO Strategy), which outlined USDA and EPA's plans for achieving better control of pollution from animal agriculture under existing regulations. The following is a comparison chart that illustrates how the proposed rule compares to the Unified AFO Strategy. Table 3–1 compares the proposed CAFO rule requirements with the Unifiad AFO Strategy and identifies whether the proposed requirements are consistent with or not addressed by the Unified AFO Strategy. The table further shows that, overall, the proposed rule meets the intent of the Unified AFO Strategy.

TABLE 3–1.—PROPOSED RULE/UNIFIED NATIONAL AFO STRATEGY COMPARISON

Summary of proposed rule	Consistent with Unified AFO Strategy	Not addressed in Unified AFO Strategy	Comment
Proposed Revisions to NPDES Regulations			
Definition of AFO (122.23(a)(2))—AFO includes land application area; Clarifies crop language.	✓	✓	The Unified AFO Strategy states CNMPs should address land application of manure. (Sec. 3.1 and 3.2) Crop language not explicitly addressed in Unified AFO Strategy.
Definition of CAFO (122.23(a)(3))—Change 1,000 animal unit threshold to 500.	....	✓	Alternative thresholds not explicitly addressed in Unified AFO Strategy, although Strategy does state EPA will explore alternative ways of defining CAFOs. (Sec. 5, Issue 3, Item 2.B.). The Unified AFO Strategy states that regulatory revisions will consider risk, burden, statutory requirements, enforceability, and ease of implementation (i.e., clarity of requirements). (Sec. 5, Issue 3, Item 2). The Unified AFO Strategy states that 5 percent of the AFOs will be subject to the regulatory program, however, this estimate is provided for the *existing* regulatory program (see Figure 2). No specific percentage is specified in the Strategy for the revised regulations.
Definition of CAFO (122.23(a)(3))—Include dry poultry operations.	✓	....	The Unified AFO Strategy states that in revising regulations EPA intends to consider defining ".. large poultry operations, consistent with the size for other animal sectors, as CAFOs, regardless of the type of watering or manure handling system." (Sec. 5, Issue 3, Item 2.B.).
Definition of CAFO (122.23(a)(3))—Include immature animals.	....	✓	Immature animals not explicitly addressed in Unified AFO Strategy.
Definition of CAFO (122.23)—Removes 25 year/24-hour storm provision from definition of CAFO.	✓	....	The Unified AFO Strategy states EPA will consider "requiring CAFOs to have an NPDES permit even if they only discharge during a 25-year, 24-hour or larger storm event." (Sec. 5, Issue 3, Item 2.B.).
Definition of Operation (122.23(a)(5))—Includes a person who exercises substantial operational control over a CAFO.	✓	....	The Unified AFO Strategy states EPA will "explore alternative approaches to ensuring that corporate entities support the efforts of individual CAFOs to comply with permits and develop and implement CNMPs." (Sec. 5, Issue 3, Item 2.B.).
Designation as a CAFO (122.23(b))—In authorized States EPA may designate an AFO as a CAFO. No inspection required a designate facility that was previously defined or designated as a CAFO.	✓	....	The Unified AFO Strategy states EPA will consider "who may designate and the criteria for designating certain AFOs as CAFOs." (Sec. 5, Issue 3, Item 2.B.).
Who must apply for an NPDES permit (122.23(c))—CAFOs must either apply for a permit or seek a determination of no potential to discharge.	✓	....	The Unified AFO Strategy states "the NPDES authority will issue a permit unless it determines that the facility does not have a potential to discharge. (Sec. 4.2).

TABLE 3–1.—PROPOSED RULE/UNIFIED NATIONAL AFO STRATEGY COMPARISON—Continued

Summary of proposed rule	Consistent with Unified AFO Strategy	Not addressed in Unified AFO Strategy	Comment
Co-Permitting (122.23(c)(3))—Operators, including any person who exercises substantial operational control over a CAFO, must either apply for a permit or seek a determination of no potential to discharge.	✓	....	The Unified AFO Strategy states EPA will "explore alternative approaches to ensuring that corporate entities support the efforts of individual CAFOs to comply with permits and develop and implement CNMPs." (Sec. 5, Issue 3, Item 2.B.).
Issuance of permit (122.23(d))—Director must issue permit unless s/he determines no potential to discharge.	✓	....	The Unified AFO Strategy states "the NPDES authority will issue a permit unless it determines that the facility does not have a potential to discharge. (Sec. 4.2.).
No potential to discharge (122.23(e))—Determination must consider discharge from production area, land application area, and via ground waters that have a direct hydrologic connection to surface waters.	✓	....	The Unified AFO Strategy establishes a national performance expectation that all AFOs should develop and implement CNMPs, and that such CNMPs should address land application of manure. (Sec 3.1 and 3.2). The Unified AFO Strategy states "EPA believes that pollution of groundwater may be a concern around CAFOs. EPA has noted in other documents that a discharge via hydrologically connected groundwater to surface waters may be subject to NPDES requirements." (Sec. 4.2.). The Unified AFO Strategy states EPA will consider protecting "sensitive or highly valuable water bodies such as Outstanding Natural Resources, sole source aquifers, wetlands, ground water recharge areas, zones of significant ground/surface water interaction, and other areas." (Sec. 5, Issue 3, Item 2.B.).
AFOs not defined or designated (122.23(g))—AFOs subject to NPDES permitting requirements if they have a discrete conveyance (i.e., point source) discharge from production or land application that is not entirely storm water.	....	✓	The Unified AFO Strategy states EPA will consider "clarifying whether and under what conditions AFOs may be subject to NPDES requirements." (Sec. 5, Issue 3, Item 2.B.).
Non-AFO land application (122.23(h))—Land application inconsistent with practices in 412.31(b) and that result in point source discharge of pollutants to Waters of the US may be designated under 122.26(a)(1)(v).	✓	....	The Unified AFO Strategy states EPA will consider "clarifying requirements for effective management of manure and wastewater from CAFOs whether they are handled on-site or off-site." (Sec. 5, Issue 3, Item 2. B.).
Agricultural Storm Water Exemption—Discharges from land application area if manure is not applied in quantities that exceed the land application rates calculated using one of the methods specified in 40 CFR 412.31(b)(1)(iv).	✓	....	The Unified AFO Strategy states EPA has in the past and will in the future assume that discharges from the majority of agricultural operations are exempt, but that the agricultural storm water exemption would not apply where the discharge is associated with the land disposal of manure or wastewater from a CAFO and the discharge is not the result of proper agricultural practices. (Sec. 4.4).
CAFO permit requirement (122.23(i)(2))—CAFOs subject to effluent guidelines if applicable.	✓	....	The Unified AFO Strategy states the effluent guidelines revisions will be closely coordinated with any charges to the NPDES permitting regulations. (Sec. 5, Issue 3, Item 2. A.).
CAFO permit requirement (122.23(j))—Prohibits land application of manure that would not serve agricultural purpose and would likely result in pollutant discharge te waters of the U.S.	✓	....	The Unified AFO Strategy provides that all AFOs should develop and implement CNMPs, and that such CNMPs should address land application of manure to minimize impacts on water quality and public health. (Sec. 3.1 and 3.2).
CAFO permit requirement (122.23(j)(4))—Permittee must either provide information to recipient or, under one co-proposal option, obtain certification that recipient will land apply per Permit Nutrient Plan (PNP), obtain permit, use for other purpose, or transfer to 3rd party.	....	✓	The Unified AFO Strategy states EPA will consider "clarifying requirements for effective management of manura and wastewater from CAFOs whether they are handled on-site or off-site." (Sec. 5, Issue 3, Item 2. B.).
CAFO permit requirement (122.23(j)(5))—Permit must require specified recordkeeping.	....	✓	The Unified AFO Strategy states EPA will consider "establishing specific monitoring and reporting requirements for permitted facilities." (Sec. 5, Issue 3, Item 2. B.). The Unified AFO Strategy provides records should be kept when manure leaves the CAFO. (Sec.3.3).
Closure (122.23(i)(3))—AFO must maintain permit until it no longer has wastes generated while it was a CAFO.	....	✓	Not explicitly addressed in Unified AFO Strategy.

TABLE 3–1.—PROPOSED RULE/UNIFIED NATIONAL AFO STRATEGY COMPARISON—Continued

Summary of proposed rule	Consistent with Unified AFO Strategy	Not addressed in Unified AFO Strategy	Comment
Public access (122.23(l)—Requires public access to list of NOIs, list of CAFOs that have prepared PNPs, and access to executive summary of PNP upon request.	....	✓	Not explicitly addressed in Unified AFO Strategy.
General Permits (122.28)—Notice of Intent must include topographic map and statement re PNP; additional criteria specified for when individual permits may be required.	✓	✓	NOI requirements not explicitly addressed in Unified AFO Strategy. The Unified AFO Strategy states EPA will consider "requiring individual permits for CAFOs in some situations." (Sec. 5, Issue 3, Item 2. B.).
Proposed Revisions to Feedlot Effluent Guidelines Regulations			
Production Area—Beef/Dairy (412.33(a): No discharge except when designed for 25 year, 24-hour storm, also inspect/ correct/ pump-out, manage mortalities. Swine/Poultry (412.43(a)): No discharge.	✓	✓	The Unified AFO Strategy indicates the existing effluent guidelines is no discharge when designed for 25 year, 24-hour storm. (Sec. 5, Issue 3, Item 2. A). Strategy states that in developing the revised effluent guidelines EPA is to assess different management practices that minimize the discharge of pollutants. (Sec. 5, Issue 3, Item 2. A).
Land Application (412.33(b) and 412.43(b))—Develop and Implement PNP covering the land application areas under the control of the CAFO. Also include Best Management Practices.	✓	....	PNP has been identified as a specific subset of a CNMP applicable to AFOs subject to the regulation. In this manner it is consistent with the Strategy. It also reinforces that the CNMP is applicable to all AFOs (regulatory/voluntary) while the PNP is only applicable to those that fall under the regulatory program. It makes a clear distinction between the regulatory and voluntary programs addressed in the Strategy.
Land Application (412.31(b)(1)(ii))—PNP Approved by Certified Specialist.	✓	....	The PNP is a subset of the CNMP. The Strategy identified that CNMPs "developed to meet the requirements of the NPDES program in general must be developed by a certified specialist, ...". (Sec. 4.6).
New Source Performance Standards (412.35/45): Various additional requirements.	✓	....	Strategy states that in developing the revised effluent guidelines EPA is to evaluate the need for different requirements for new or expanding operations. (Sec. 5, Issue 3, Item 2. A).
Additional Measures (412.37)—Inspect/ correct/ pump-out, manage mortalities; Land application BMPs, sampling, training, recordkeeping.	✓	....	Strategy states that in developing the revised effluent guidelines EPA is to assess different management practices that minimize the discharge of pollutants. (Sec. 5, Issue 3, Item 2. A). Strategy states that the regulatory revision process will include the establishment of specific monitoring and reporting requirements for permitted facilities.

IV. Why is EPA Changing the Effluent Guidelines for Feedlots and the NPDES CAFO Regulations?

A. Main Reasons For Revising the Existing Regulations

Despite more than twenty years of regulation, there are persistent reports of discharge and runoff of manure and manure nutrients from livestock and poultry operations. While this is partly due to inadequate compliance with existing regulations, EPA believes that the regulations themselves also need revision. Today's proposed revisions to the existing effluent guidelines and NPDES regulations for CAFOs are expected to mitigate future water quality impairment and the associated human health and ecological risks by reducing pollutant discharges from the animal production industry.

EPA's proposed revisions also address the changes that have occurred in the animal production industries in the United States since the development of the existing regulations. The continued trend toward fewer but larger operations, coupled with greater emphasis on more intensive production methods and specialization, is concentrating more manure nutrients and other animal waste constituents within some geographic areas. This trend has coincided with increased reports of large-scale discharges from these facilities, and continued runoff that is contributing to the significant increase in nutrients and resulting impairment of many U.S. waterways.

EPA's proposed revisions of the existing regulations will make the regulations more effective for the purpose of protecting or restoring water quality. The revisions will also make the regulations easier to understand and better clarify the conditions under which an AFO is a CAFO and, therefore, subject to the regulatory requirements of today's proposed regulations.

B. Water Quality Impairment Associated with Manure Discharge and Runoff

EPA has made significant progress in implementing CWA programs and in reducing water pollution. Despite such progress, however, serious water quality problems persist throughout the country. Agricultural operations, including CAFOs, are considered a significant source of water pollution in the United States. The recently released National Water Quality Inventory: 1998 Report to Congress was prepared under Section 305(b) of the Clean Water Act. Under this section of the Act, States report their impaired water bodies to EPA, including the suspected sources of those impairments. The most recent report indicates that the agricultural sector (including crop production, pasture and range grazing, concentrated and confined animal feeding operations, and aquaculture) is the leading contributor to identified water quality impairments in the nation's rivers and streams, and also the leading contributor in the nation's lakes, ponds, and reservoirs. Agriculture is also identified as the fifth leading contributor to identified water quality impairments in the nation's estuaries. 1998 National Water Quality Inventory results are illustrated in table 4–1 below.

TABLE 4–1.—FIVE LEADING SOURCES OF WATER QUALITY IMPAIRMENT IN THE UNITED STATES

Rank	Rivers	Lakes	Estuaries
1	Agriculture (59%)	Agriculture (31%)	Municipal Point Sources (28%)
2	Hydro modification (20%)	Hydro modification (15%)	Urban Runoff / Storm Sewers (28%)
3	Urban Runoff / Storm Sewers (11%)	Urban Runoff/Storm Sewers (12%)	Atmospheric Deposition (23%)
4	Municipal Point Sources (10%)	Municipal Point Sources (11%)	Industrial Discharges (15%)
5	Resource Extraction (9%)	Atmospheric Deposition (8%)	Agriculture (15%)

* Source: National Water Quality Inventory: 1998 Report to Congress, USEPA, 2000. Percentage of impairment attributed to each source is shown in parentheses. For example, agriculture is listed as a source of impairment in 59 percent of impaired river miles. The portion of 'agricultural" impairment attributable to animal waste (as compared to crop production, pasture grazing, range grazing, and aquaculture) is not specified in this value. Figure totals exceed 100 percent because water bodies may be impaired by more than one source.

Table 4–2 presents additional summary statistics of the 1998 National Water Quality Inventory. These figures indicate that the agricultural sector contributes to the impairment of at least 170,000 river miles, 2.4 million lake acres, and almost 2,000 estuarine square miles. Twenty-eight states and tribes identified specific agricultural sector activities contributing to water quality impacts on rivers and streams, and 16 states and tribes identified specific agricultural sector activities contributing to water quality impacts on lakes, ponds, and reservoirs. CAFOs are a subset of the agriculture category. For rivers and streams, estimates from these states indicate that 16 percent of the total reported agricultural sector impairment is from the animal feeding operation industry (including feedlots, animal holding areas, and other animal operations), and 17 percent of the agricultural sector impairment is from both range and pasture grazing. For lakes, ponds, and reservoirs, estimates from these states indicate that 4 percent of the total reported agricultural sector impairment is from the animal feeding operation industry, and 39 percent of the agricultural sector impairment is from both range and pasture grazing. Impairment due specifically to land application of manure was not reported.

TABLE 4–2.—SUMMARY OF U.S. WATER QUALITY IMPAIRMENT SURVEY

Total quantity in U.S.	Waters assessed	Quantity impaired by all sources	Quantity impaired by agriculture[a]
Rivers 3,662,255 miles	23% of total 840,402 miles	35% of assessed 291,263 miles	59% of impaired. 170,750 miles.
Lakes, Ponds, and Reservoirs 41.6 million acres	42% of total 17 4 million acres	45% of assessed 7.9 million acres	31% of impaired. 2,417,801 acres.
Estuaries 90,465 square miles	32% of total 28,687 square miles	44% of assessed 12,482 square miles	15% of impaired. 1,827 square miles.

Source: National Water Quality Inventory: 1998 Report to Congress, USEPA, 2000.
[a]CAFOs are a subset of the agriculture category.

Table 4–3 below lists the leading pollutants impairing surface water quality in the United States as identified in the 1998 National Water Quality Inventory. The animal production industry is a potential source of all of these, but is most commonly associated with nutrients, pathogens, oxygen-depleting substances, and solids (siltation). Animal production facilities are also a potential source of the other leading causes of water quality impairment, such as metals and pesticides, and can contribute to the growth of noxious aquatic plants due to the discharge of excess nutrients. Animal production facilities may also contribute loadings of priority toxic organic chemicals and oil and grease, but to a lesser extent than other pollutants.

TABLE 4–3.—FIVE LEADING CAUSES OF WATER QUALITY IMPAIRMENT IN THE UNITED STATES

Rank	Rivers	Lakes	Estuaries
1	Siltation (38%)	Nutrients (44%)	Pathogens (47%)
2	Pathogens (36%)	Metals (27%)	Oxygen-Depleting Substances (42%)
3	Nutrients (29%)	Siltation (15%)	Metals (27%)
4	Oxygen-Depleting Substances (23%)	Oxygen-Depleting Substances (14%)	Nutrients (23%)
5	Metals (21%)	Suspended Solids (10%)	Thermal Modifications (18%)

Source: National Water Quality Inventory: 1998 Report to Congress, USEPA, 2000. Percent impairment attributed to each pollutant is shown in parentheses. For example, siltation is listed as a cause of impairment in 51 percent of impaired river miles. All of these pollutants except thermal modifications are commonly associated with animal feeding operations to varying degrees, though they are also attributable to other sources. Figure totals exceed 100 percent because water bodies may be impaired by more than one source.

Pollutants associated with animal prodnction can also originate from a variety of other sources, such as cropland, municipal and industrial wastewater discharges, urban runoff, and septic systems. The national analyses described in Section V of this preamble are useful in assessing the significance of animal waste as a potential or actual contributor to water quality degradation across the United States. Section V also discusses the environmental impacts and hnman health effects associated with the pollutants found in animal manure.

C. Recent Changes in the Livestock and Poultry Industry

EPA's proposed revisions of the existing effluent guidelines and NPDES regulations take into account the major structnral changes that have occurred in the livestock and poultry industries since the 1970s when the regulatory controls for CAFOs were first instituted. These changes include:

• Increased number of animals produced annually;

• Fewer animal feeding operations and an iucrease in the share of larger operations that concentrate more animals, manure and wastewater iu a single location;

• Geographical shifts iu where animals are produced; and

• Increased coordination between animal feeding operations and processing firms.

1. Increased Livestock and Poultry Production

Since the 1970s, total consumer demand for meat, eggs, milk and dairy products has continned to increase. To meet this demand, U.S. livestock and poultry production have risen sharply, resulting in an increase in the number of animals produced and the amount of manure and wastewater generated annually.

Increased sales from U.S. farms is particularly dramatic in the poultry sectors, as reported in the Census of Agriculture (various years). In 1997, turkey sales totaled 299 million birds. In comparisou, 141 million tnrkeys were sold for slaughter in 1978. Broiler sales totaled 6.4 billion chickens in 1997, up from 2.5 billion chickens sold in 1974. The existing CAFO regulations effectively do not cover broiler operations because they exclude operations that use dry manure management systems. Red meat production also rose during the 1974–1997 period. The number of hogs and pigs sold increased froru 79.9 million hogs in 1974 to 142.6 million hogs in 1997. Sales data for fed cattle (i.e., USDA's data category on "cattle fattened on grain and concentrates") for 1975 show that 20.5 million head were marketed. By 1997, fed cattle marketings totaled 22.8 million head. The total number of egg laying hens rose from 0.3 million birds in 1974 to 0.4 million birds in 1997. The number of dairy cows on U.S. farms, however, dropped from more than 10.7 million cows to 9.1 million cows over the same period.

Not only are more animals produced and sold each year, but the animals are also larger in size. Efficiency gains have raised animal yields in terms of higher average slaughter weight. Likewise, production efficiency gains at egg laying and dairy operations have resulted in higher per-animal yields of eggs and milk. USDA reports that the average number of eggs produced per egg laying hen was 218 eggs per bird in 1970 compared to 255 eggs per bird in 1997. The National Milk Producers Federation reports that average annual milk production rose from under 10,000 pounds per cow in 1970 to more than 16,000 pounds per cow in 1997. In the case of milk production, these efficieocy gains have allowed farmers to maintain or increase production levels with fewer animals. Although animal inventories at dairy farms may be lower, however, this may not necessarily translate to reduced mannre volumes generated because higher yields are largely attributable to improved and often more intensive feeding strategies that may exceed the animal's ability for uptake. This excess is uot always incorporated by the animal and may be excreted.

2. Increasing Share of Larger, More Industrialized Operations

The number of U.S. livestock and poultry operations is declining due to ongoing consolidation in the animal production indnstry. Increasingly, larger, more industrialized, highly specialized operations account for a greater share of all animal production. This has the effect of concentrating more animals, and thus more manure and wastewater, in a single location, and raising the potential for significant environmental damages uuless manure is properly stored and handled.

USDA reports that there were 1.1 million livestock and poultry farms in the United States in 1997, about 40 percent fewer than the 1.7 million farms reported in 1974. Farms are closing, especially smaller operations that cannot compete with large-scale, highly specialized, often lower cost, producers. Consequently, the livestock and poultry industries are increasingly dominated by larger operations. At the same time, cost and efficiency considerations are pushing farms to become more specialized and intensive. Steep gains in production efficiency have allowed farmers to produce more with fewer animals because of higher per-animal yields and quicker turnover of animals between farm production and consumer market. As a result, annual prodnction and sales have increased, even though the numher of animals on farms at any one time has declined (i.e., an increase in the number of marketing cycles over the course of the year allows operators to maintain production levels with fewer animals at any given time, although the total number of animals produced by the facility over the year may be greater).

The increase in animal densities at operations is evident by comparing the average number of animals per operation hetween 1974 and 1997, as derived from Ceusus of Agricnltnre data. In the poultry sectors, the average nnmber of birds across all operations is four to five times greater in 1997 than in 1974. In 1997, the number of broilers per operation averaged 281,700 hirds, up from 73,300 birds in 1974. Over the same period, the average nnmber of egg laying hens per operation rose from 1,100 layers to 5,100 layers per farm, and the average oumber of turkeys per operation rose from 2,100 turkeys to 8,600 turkeys. The average numher of hogs raised per operation rose from under 100 hogs to more than 500 hogs between 1974 and 1997. The average number of fed cattle and dairy cows per operation more than doubled during the period, rising to nearly 250 fed cattle and 80 milking cows by 1997.

This trend toward fewer, larger, and more industrialized operations has contributed to large amounts of manure being produced at a single geographic location. The greatest potential risk is from the largest operations with the most animals given the sheer volume of manure generated at these facilities. Larger, specialized facilities often do not have an adequate land base for manure disposal through land application. A USDA analysis of 1997 Census data shows that animal operations with more than 1,000 AU account for more than 42 percent of all confined animals bnt ouly 3 percent of cropland held by livestock and poultry operations. As a result, large facilities need to store significant volumes of manure and wastewater which have the potential, if not properly handled, to canse significant water qnality impacts. By comparison, smaller operations manage fewer animals aud tend to concentrate less manure at a single farming location. Smaller operations also tend to be more diversified, engaging in both animal and crop production. These operations often have sufficient cropland and fertilizer needs to land apply manure generated by the farm's livestock or poultry business, without exceeding that land's nutrient requirements.

Another recent analysis from USDA confirms that as animal production operations have become larger and more specialized operations, the opportunity to jointly manage animal waste and crop nutrients has decreased. Larger operations typically have inadequate land available for utilizing manure nutrients. USDA estimates that the amount of nitrogen from manure produced by confinement operations increased about 20 percent between 1982 and 1997, while average acreage on livestock and poultry farms declined. Overall, USDA estimates that cropland controlled by operations with confined animals has the assimilative capacity to absorb about 40 percent of the calculated manure nitrogen generated by these operations. EPA expects this excess will need to be transported offsite.

3. Geographic Shifts in Where Animals are Raised

During the 1970s, the majority of farming operations were concentrated in rural, agricultural areas and manure nutrients generated by animal feeding operations were readily incorporated as a fertilizer for crop production. In an effort to reduce transportation costs and streamline distribution between the animal production and food processing sectors, livestock and poultry operations have tended to cluster near slaughtering and manufacturing plants as well as near end-consumer markets. Ongoing structural and technological change in these industries also influences where facilities operate and contributes to locational shifts from the more traditional farm production regions to the more emergent regions.

Operations in more traditional producing states tend to grow both livestock and crops and tend to have adequate cropland for land application of manure. Operations in these regions also tend to be smaller in size. In contrast, confinement operations in more emergent areas, such as hog operations in North Carolina or dairy operations in the Southwest, tend to be larger in size and more intensive types of operations. These operations tend to be more specialized and often do not have adequate land for application of manure nutrients. Production is growing rapidly in these regions due to competitive pressures from more specialized producers who face lower per-unit costs of production. This may be shifting the flow of manure nutrients away from more traditional agricultural areas, often to areas where these nutrients cannot be easily absorbed.

As reported by Census data, shifts in where animals are grown is especially pronounced in the pork sector. Traditionally, Iowa has been the top ranked pork producing state. Between 1982 and 1997, however, the number of hogs raised in that state remained relatively constant with a year-end inventory average of about 14.2 million pigs. In comparison, year-end hog inventories in North Carolina increased from 2.0 million pigs in 1982 to 9.6 million pigs in 1997. This locational shift has coincided with reported nutrient enrichment of the waters of the Pamlico Sound in North Carolina. Growth in hog production also occurred in other emergent areas, including South Dakota, Oklahoma, Wyoming, Colorado, Arizona, and Utah. Meanwhile, production dropped in Illinois, Indiana, Wisconsin, and Ohio.

The dairy industry has seen similar shifts in where milk is produced, moving from the more traditional Midwest and Northeast states to the Pacific and Southwestern states. Between 1982 and 1997, the number of milk cows in Wisconsin dropped from 1.9 million to 1.3 million. Milk cow inventories have also declined in other traditional states, including Illinois, Indiana, Iowa, Minnesota, Missouri, New York, Pennsylvania, Ohio, Connecticut, Maryland, and Vermont. During the same period, milk cow inventories in California rose from 0.9 million in 1982 to 1.4 million in 1997. In 1994, California replaced Wisconsin as the top milk producing state. Milk cow inventories have also increased in Texas, Idaho, Washington, Oregon, Colorado, Arizona, Nevada, and Utah. These locational shifts have coincided with reported nutrient enrichment of waters, including the Puget Sound and Tillamook Bay in the northwest, the Everglades in Florida, and Erath County in Texas, and also elevated salinity levels due to excess manure near milk production areas in southern California's Chino Basin.

4. Increased Linkages between Animal Production Facility and Food Processors

Over the past few decades, closer ties have been forged between growers and various industry middlemen, including packers, processors, and cooperatives. Increased integration and coordination is being driven by the competitive nature of agricultural production and the dynamics of the food marketing system, in general, as well as seasonal fluctuations of production, perishability of farm products, and the inability to store and handle raw farm output. Closer ties between the animal production facility and processing firms—either through contractual agreement or through corporate ownership of CAFOs—raises questions of who is responsible for ensuring proper manure disposal and management at the animal feeding site. This is especially true given the current trend toward larger animal confinement operations and the resultant need for increased animal waste management. As operations become larger and more specialized, they may contract out some phases of the production process.

Farmers and ranchers have long used contracts to market agricultural commodities. However, increased use of production contracts is changing the organizational structure of the individual industries. Under a production contract, a business other than the feedlot where the animals are raised and housed, such as a processing firm, feed mill, or animal feeding operation, may own the animals and may exercise further substantial operational control over the operations of the feedlot. In some cases, the processor may specify in detail the production inputs used, including the genetic material of the animals, the types of feed used, and the production facilities where the animals are raised. The processor may also influence the number of animals produced at a site. In general, these contracts do not deal with management of manure and waste disposal. Recently, however, some processors have become increasingly involved in how manure and waste is managed at the animal production site.

The use of production contracts in the livestock and poultry industries varies by commodity group. Information from USDA indicates that production contracts are widely used in the poultry industry and dominate broiler production. Production contracting is becoming increasingly common in the hog sector, particularly for the finishing stage of production in regions outside the Corn Belt.

Production contracting has played a critical role in the growth of integrators in the poultry sectors. Vertical integration has progressed to the point where large, multifunction producer-packer-processor-distributor firms are the dominant force in poultry and egg production and marketing. Data from USDA on animal ownership at U.S. farms illustrates the use of production contracts in these sectors. In 1997, USDA reported that 97 percent of all broilers raised on U.S. farms were not owned by the farmer. In the turkey and egg laying sectors, use of production contracts is less extensive since 70 percent and 43 percent of all birds in these sectors, respectively, were not owned by the farmer. In the hog sector, data from USDA indicate that production contracting may account for 66 percent of hog production among larger producers in the Southern and Mid-Atlantic states. This differs from the Midwest, where production contracting accounted for 18 percent of hog production in 1997.

By comparison, production contracts are not widely used in the beef and dairy sectors. Data from USDA indicate that less than 4 percent of all beef cattle and 1 percent of all milking cows were not owned by the farmer in 1997. However, production contracts are used in these industries that specialize in a single stage of livestock production, such as to "finish" cattle prior to slaughter or to produce replacement breeding stock. However, this use constitutes a small share of overall production across all producers.

To further examine the linkages between the animal production facility and the food processing firms, and to evaluate the geographical implications of this affiliation, EPA conducted an analysis that shows a relationship between areas of the country with an excess of manure nutrients from animal production operations and areas with a large number of meat packing and poultry slaughtering facilities. This manure—if land applied—would be in excess of crop uptake needs and result in over application and enrichment of nutrients. Across the pork and poultry sectors, this relationship is strongest in northwest Arkansas, where EPA estimates a high concentration of excess manure nutrients and a large number of poultry and hog processing facilities. By sector, EPA's analysis shows that there is excess poultry manure nutrients and a large number of poultry processing plants in the Delmarva Peninsula in the mid-Atlantic, North Carolina, northern Alabama, and also northern Georgia. In the hog sector, the analysis shows excess manure nutrients and a large number of meat packing plants in Iowa, Nebraska and Alabama. The analysis also shows excess manure nutrients from hogs in North Carolina, but relatively fewer meat packing facilities, which is likely explained by continuing processing plant closure and consolidation in that state. More information on this analysis is provided in the rulemaking record.

D. Improve Effectiveness of Regulations

As noted in Section IV.B, reports of continued discharges and runoff from animal production facilities have persisted in spite of regulatory controls that were first instituted in the 1970s. EPA is proposing to revise the effluent guidelines and NPDES regulations to improve their effectiveness by making the regulations simpler and easier to understand and implement. Another change intended to improve the effectiveness of the regulations is clarification of the conditions under which an AFO is a CAFO and is, therefore, subject to the NPDES regulatory requirements. In addition, EPA is revising the existing regulation to remove certain provisions that are no longer appropriate.

The existing regulations were designed to prohibit the release of wastewater from the feedlot site, but did not specifically address discharges that may occur when wastewater or solid manure mixtures are applied to crop, pasture, or hayland. The proposed regulations address the environmental risks associated with manure management. The proposed revisions also are more reflective of current farm production practices and waste management controls.

Today's proposed revised regulations also seek to improve the effectiveness of the existing regulations by focusing on those operations that produce the majority of the animal manure and wastewater generated annually. EPA estimates that the proposed regulations will regulate, as CAFOs, about 7 to 10 percent of all animal confinement operations nationwide, and will capture between 64 percent and 70 percent of the total amount of manure generated at CAFOs annually, depending on the proposed regulatory alternative (discussed in more detail in Section VI.A). Under the existing regulations, few operations have obtained NPDES permits. Presently, EPA and authorized States have issued approximately 2,500 NPDES permits. This is less than 1 percent of the estimated 376,000 animal confinement operations in the United States. EPA's proposed revisions are intended to ensure that all CAFOs, as defined under the proposed regulations, will apply for and obtain a permit.

V. What Environmental and Human Health Impacts Are Potentially Caused by CAFOs?

The 1998 National Water Quality Inventory, prepared under Section 305(b) of the Clean Water Act, presents information on impaired water bodies based on reports from the States. This recent report indicates that the agricultural sector (which includes concentrated and confined animal feeding operations, along with aquaculture, crop production, pasture grazing, and range grazing) is the leading contributor to identified water quality impairments in the nation's rivers and lakes, and the fifth leading contributor in the nation's estuaries. The leading pollutants or stressors of rivers and streams include (in order of rank) siltation, pathogens (bacteria), nutrients, and oxygen depleting substances. For lakes, ponds, and reservoirs, the leading pollutants or stressors include nutrients (ranked first), siltation (ranked third), oxygen depleting substances (ranked fourth), and suspended solids (ranked fifth). For estuaries, the leading pollutants or stressors include pathogens (bacteria) as the leading cause, oxygen depleting substances (ranked second), and nutrients (ranked fourth).

The sections which follow present the pollutants associated with livestock and poultry operators, of which CAFOs are a subset, the pathways by which the pollutants reach surface water, and their impacts on the environment and human health. Detailed information can be found in the Environmental Assessment of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and Effluent Guidelines for Concentrated Animal Feeding Operations. The Environmental Assessment and the supporting references mentioned here are included in Section 8.1 of the Record for this proposal.

A. Which Pollutants Do CAFOs Have the Potential to Discharge and Why Are They of Concern?

The primary pollutants associated with animal waste are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds. Animal waste is also a source of salts and trace elements, and to a lesser extent, antibiotics, pesticides, and hormones. Each of these types of pollutants is discussed in the sections which follow. The actual composition of manure depends on the animal species, size, maturity, and health, as well as on the composition (*e.g.*, protein content) of animal feed.

1. Nutrients (Nitrogen, Phosphorus, and Potassium)

The 1998 National Water Quality Inventory indicates that nutrients are the leading stressor in impaired lakes, ponds, and reservoirs. They are the third most frequent stressor in impaired rivers and streams, and the fourth greatest stressor in impaired estuaries. The three primary nutrients in manure are nitrogen, phosphorus, and potassium. (Potassium also contributes to salinity.)

Nitrogen in fresh manure exists in both organic forms (including urea) and inorganic forms (including ammonium, ammonia, nitrate, and nitrite). In fresh manure, 60 to 90 percent of total nitrogen is present in organic forms. Organic nitrogen is transformed via microbial processes to inorganic forms, which are bioavailable and therefore have fertilizer value. As an example of the quantities of nutrients discharged from AFOs, EPA estimates that hog operations in eastern North Carolina generated 135 million pounds of nitrogen per year as of 1995.

Phosphorus exists in solid and dissolved phases, in both organic and inorganic forms. Over 70 percent of the phosphorus in animal manure is in the organic form. As the waste ages, phosphorus mineralizes to inorganic phosphate compounds which are available to plants. Organic phosphorus compounds are generally water soluble and may leach through soil to groundwater and run off into surface waters. Inorganic phosphorus tends to adhere to soils and is less likely to leach into groundwater. Animal wastes typically have lower nitrogen:phosphorus ratios than crop requirements. The application of manure at a nitrogen-based agronomic rate can, therefore, result in application of phosphorus at several times the agronomic rate. Soil test data in the United States confirm that many soils in areas dominated by animal-based agriculture have elevated levels of phosphorus.

Potassium contributes to the salinity of animal manure which may in turn contribute salinity to surface water polluted by manure. Actual or anticipated levels of potassium in surface water and groundwater are unlikely to pose hazards to human health or aquatic life. However, applications of high salinity manure are likely to decrease the fertility of the soil.

In 1998, USDA studied the amount of manure nitrogen and phosphorus production for confined animals relative to crop uptake potential. USDA evaluated the quantity of nutrients available from recoverable livestock manure relative to crop growth requirements, by county, based on data from the 1997 Census of Agriculture. The analyses were intended to determine the amount of manure that can be recovered and used. The analyses did not consider manure from grazing animals in pasture, excluded manure lost to the environment, and also excluded manure lost in dry storage and treatment. It is not currently possible to completely recover all manure.

Losses to the environment can occur through runoff, erosion, leaching to groundwater, and volatilization (especially for nitrogen in the form of ammonia). These losses can be significant. Considering typical management systems, the 1998 USDA study reported that average manure nitrogen losses range from 31 to 50 percent for poultry, 60 to 70 percent for cattle (including the beef and dairy categories), and 75 percent for swine. The typical phosphorus loss is 15 percent.

The USDA study also looked at the potential for available manure nitrogen and phosphorus generated in a county to meet or exceed plant uptake and removal in each of the 3,141 mainland counties. Based on this analysis of 1992 conditions, available manure nitrogen exceeds crop system needs in 266 counties, and available manure phosphorus exceeds crop system needs in 485 counties. The relative excess of phosphorus compared to nitrogen is not surprising, since manure is typically nitrogen-deficient relative to crop needs. Therefore, when manure is applied to meet a crop's nitrogen requirement, phosphorus is typically over-applied.

USDA's analyses do not evaluate environmental transport of applied manure nutrients. Therefore, an excess of nutrients in a particular county does not necessarily indicate that a water quality problem exists. Likewise, a lack of excess nutrients does not imply the absence of water quality problems. Nevertheless, the analyses provide a general indicator of excess nutrients on a broad basis.

2. Organic Matter

Livestock manures contain many carbon-based, biodegradable compounds. Once these compounds reach surface water, they are decomposed by aquatic bacteria and other microorganisms. During this process dissolved oxygen is consumed, which in turn reduces the amount of oxygen available for aquatic animals. The 1998 National Water Quality Inventory indicates that oxygen-depleting substances are the second leading stressor in estuaries. They are the fourth greatest stressor both in impaired rivers and streams, and in impaired lakes, ponds, and reservoirs. Biochemical oxygen demand (BOD) is an indirect measure of the concentration of biodegradable substances present in an aqueous solution.

3. Solids

The 1998 National Water Quality Inventory indicates that suspended solids are the fifth leading stressor in lakes, ponds, and reservoirs. Solids are measured as total suspended solids, or TSS. (Solids can also be measured as total dissolved solids, or TDS.) Solids from animal manure include the manure itself and any other elements that have been mixed with it. These elements can include spilled feed, bedding and litter materials, hair, feathers, and corpses. In general, the impacts of solids include increasing the turbidity of surface waters, physically hindering the functioning of aquatic plants and animals, and providing a protected environment for pathogens.

4. Pathogens

Pathogens are disease-causing organisms including bacteria, viruses, protozoa, fungi, and algae. The 1998 National Water Quality Inventory indicates that pathogens (specifically bacteria) are the leading stressor in impaired estuaries and the second most prevalent stressor in impaired rivers and streams. Livestock manure contains countless microorganisms, including bacteria, viruses, protozoa, and parasites. Multiple species of pathogens may be transmitted directly from a host animal's manure to surface water, and pathogens already in surface water may increase in number due to loadings of animal manure nutrients and organic matter. In 1998, the Centers for Disease Control and Prevention reported on an Iowa investigation of chemical and microbial contamination near large scale swine operations. The investigation demonstrated the presence of pathogens not only in manure lagoons used to store swine waste before it is land applied, but also in drainage ditches, agricultural drainage wells, tile line inlets and outlets, and an adjacent river.

Over 150 pathogens found in livestock manure are associated with risks to humans. The protozoa *Cryptosporidium parvum* and *Giardia species* are frequently found in animal manure and relatively low doses can cause infection in humans. Bacteria such as *Escherichia coli* O157:H7 and *Salmonella species* are also often found in livestock manure and have also been associated with waterborne disease. A recent study by USDA revealed that about half the cattle at the nation's feedlots carry *E. coli*. The bacteria *Listeria monocytogenes* is ubiquitous in nature, and is commonly found in the intestines of wild and domestic animals without causing illness. *L. monocytogenes* is commonly associated with foodborne disease. The pathogens *C. parvum*, *Giardia*, *E. coli* O157:H7, and *L. monocytogenes* are able to survive and remain infectious in the environment for long periods of time.

Although the pathogen *Pfiesteria piscicida* is not found in manure, researchers have documented stimulation of *Pfiesteria* growth by swine effluent discharges, and have strong field evidence that the same is true for poultry waste. Research has also shown that this organism's growth can be highly stimulated by both inorganic and organic nitrogen and phosphorus enrichments. Discussions of *Pfiesteria* impacts on the environment and on human health are presented later in this section.

5. Salts

The salinity of animal manure is directly related to the presence of dissolved mineral salts. In particular, significant concentrations of soluble salts containing sodium and potassium remain from undigested feed that passes unabsorbed through animals. Other major cations contributing to manure salinity are calcium and magnesium; the major anions are chloride, sulfate, bicarbonate, carbonate, and nitrate. Salinity tends to increase as the volume of manure decreases during decomposition and evaporation. Salt buildup deteriorates soil structure, reduces permeability, contaminates groundwater, and reduces crop yields.

In fresh waters, increasing salinity can disrupt the balance of the ecosystem, making it difficult for resident species to remain. In laboratory settings, drinking water high in salt content has inhibited growth and slowed molting of mallard ducklings. Salts also contribute to degradation of drinking water supplies.

6. Trace Elements

The 1998 National Water Quality Inventory indicates that metals are the fifth leading stressor in impaired rivers, the second leading stressor in impaired lakes, and the third leading stressor in impaired estuaries. Trace elements in manure that are of environmental concern include arsenic, copper, selenium, zinc, cadmium, molybdenum, nickel, lead, iron, manganese, aluminum, and boron. Of these, arsenic, copper, selenium, and zinc are often added to animal feed as growth stimulants or biocides. Trace elements may also end up in manure through use of pesticides, which are applied to livestock to suppress houseflies and other pests. Trace elements have been found in manure lagoons used to store swine waste before it is land applied, and in drainage ditches, agricultural drainage wells, and tile line inlets and outlets. They have also been found in rivers adjacent to hog and cattle operations.

Several of the trace elements in manure are regulated in treated municipal sewage sludge (but not manure) by the Standards for the Use or Disposal of Sewage Sludge, promulgated under the Clean Water Act and published in 40 C.F.R. Part 503. These include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Total concentrations of trace elements in animal manures have been reported as comparable to those in some municipal sludges, with typical values well below the maximum concentrations allowed by Part 503 for land-applied sewage sludge. Based on this information, trace elements in agronomically applied manures should pose little risk to human health and the environment. However, repeated application of manures above agronomic rates could result in exceedances of the cumulative metal loading rates established in Part 503, thereby potentially impacting human health and the environment. There is some evidence that this is happening. For example, in 1995, zinc and copper were found building to potentially harmful levels on the fields of a hog farm in North Carolina.

7. Odorous/Volatile Compounds

Sources of odor and volatile compounds include animal confinement buildings, manure piles, waste lagoons, and land application sites. As animal wastes are degraded by microorganisms, a variety of gases are produced. The four main gases generated are carbon dioxide, methane, hydrogen sulfide, and ammonia. Over 150 other odorous compounds have also been identified with animal manure. Aerobic conditions yield mainly carbon dioxide, while anaerobic conditions generate both methane (60 percent to 70 percent) and carbon dioxide (30 percent). Anaerobic conditions, which dominate in typical, unaerated animal waste lagoons, are also associated with the generation of hydrogen sulfide and about 40 other odorous compounds, including volatile fatty acids, phenols, mercaptans, aromatics, sulfides, and various esters, carbonyls, and amines. Once airborne, these volatile pollutants have the potential to be deposited onto nearby streams, rivers, and lakes.

Up to 50 percent or more of the nitrogen in fresh manure may be in ammonia form or converted to ammonia relatively quickly once manure is excreted. Ammonia is volatile and ammonia losses from animal feeding operations can be considerable. A study of atmospheric nitrogen published in 1998 reported that, in North Carolina, animal agriculture is responsible for over 90 percent of all ammonia emissions. Ammonia from manure comprises more than 40 percent of the total estimated nitrogen emissions from all sources.

8. Antibiotics

Antibiotics are used in animal feeding operations and can be expected to appear in animal wastes. The practice of feeding antibiotics to poultry, swine, and cattle evolved from the 1949 discovery that very low levels usually improved growth. Antibiotics are used both to treat illness and as feed additives to promote growth or to improve feed conversion efficiency. In 1991, an estimated 19 million pounds of antibiotics were used for disease prevention and growth promotion in animals. Between 60 and 80 percent of all livestock and poultry receive antibiotics during their productive lifespan. The primary mechanisms of elimination are in urine and bile. Essentially all of an antibiotic administered is eventually excreted, whether unchanged or in metabolite form. Little information is available regarding the concentrations of antibiotics in animal wastes, or on their fate and transport in the environment.

Of greater concern than the presence of antibiotics in animal manure is the development of antibiotic resistant pathogens. Use of antibiotics in raising animals, especially broad spectrum antibiotics, is increasing. As a result, more strains of antibiotic resistant pathogens are emerging, along with strains that are growing more resistant. Normally, about 2 percent of a bacterial population are resistant to a given antibiotic; however, up to 10 percent of bacterial populations from animals regularly exposed to antibiotics have been found to be resistant. In a study of poultry litter suitable for land application, about 80 to 100 percent of bacterial populations isolated from the litter were found to be resistant to multiple antibiotics. Antibiotic-resistent forms of *Salmonella*, *Campylobacter*, *E. coli*, and *Listeria* are known or suspected to exist. An antibiotic-resistant strain of the bacterie *Clostridium perfringens* was detected in the groundwater below plots of land treated with pig manure, while it was nearly absent beneath unmanured plots.

9. Pesticides and Hormones

Pesticides and hormones are compounds which are used in animal feeding operations and can be expected to appear in animal wastes. Both of these types of pollutants have been linked with endocrine disruption.

Pesticides are applied to livestock to suppress houseflies and other pests. There has been very little research on losses of pesticides in runoff from manured lands. A 1994 study showed that losses of cyromazine (used to control flies in poultry litter) in runoff increased with the rate of poultry manure applied and the intensity of rainfall.

Specific hormones are used to increase productivity in the beef and dairy industries. Several studies have shown hormones are present in animal manures. Poultry manure has been shown to coutain both estrogen and testosterone. Runoff from fields with land-applied manure has been reported to contain estrogens, estradiol, progesterone, and testosterone, as well as their synthetic counterparts. In 1995, an irrigation pond and three streams in the Conestoga River watershed near the Chesapeake Bay had both estrogen and testosterone present. All of these sites were affected by fields receiving poultry litter.

B. How Do These Pollutants Reach Surface Waters?

Pollutants found in animal manures can reach surface water by several mechanisms. These can be categorized as either surface discharges or other discharges. Snrface discharges can occur as the result of runoff, erosion, spills, and dry-weather discharges. In surface discharges, the pollutant travels overland or through drain tiles with surface inlets to a nearby stream, river, or lake. Direct contact between coufined animals and surface waters is another means of surfece discherge. For other types of discharges, the pollutant travels via another environmental medium (groundwater or air) to surfece water.

1. Surface Discharges

a. *Runoff.* Water thet falls on man-made surfaces or soil and fails to be absorbed will flow across the surface and is celled runoff. Surface discharges of manure pollutants can originate from feedlots and from overland runoff at land application sites. Runoff is especially likely at open-air feedlots if rainfall occurs soon after application, or if manure is over-applied, or misapplied. For example, experiments by Edwards and Daniels in the early 1990s show that, for all animal wastes, the application rete had a significant effect on the runoff conceutration. In addition, manure applied to water-saturated or frozen soils is more likely to run off the soil surface. Other factors that promote runoff to surface waters are steep land slope, high rainfall, low soil porosity or permeability, and close proximity to surface waters. Runoff of pollutants dissolved into rainwater is a significant transport mechanism for water soluble pollutants, which includes nitrate, nitrite, and organic forms of phosphorus.

Runoff of manure pollntants has been identified by states, citizen's groups, and the media as a factor in a number of documented impacts from AFOs, including hog, cattle, and chicken operations. For example, in 1994, multiple runoff problems were cited for a hog operation in Minnesota, and in 1996 runoff from manure spread on land was identified at hog and chicken operations in Ohio. In 1997, runoff problems were identified for several cattle operations in numerous counties in Minnesota. More discussion of runoff and its impacts on the environment and human health is provided later in this section.

b. *Erosion.* In addition to runoff, surface discharges can occur by erosion, in which the soil surface is worn away by the actioo of water or wind. Erosion is a significant transport mechanism for land-applied pollutants that are strongly sorbed to soils, of which phosphorus is one example. A 1999 report by the Agricultural Research Service (ARS) noted that phosphorus bound to eroded sediment particles makes up 60 to 90 percent of phosphorus transported in surface runoff from cultivated land. For this reason, most agricultural phosphorus control measures have focused on soil erosion control to limit transport of particulate phosphorus. However, soils do not have infinite adsorption capacity for phosphate or any other adsorbing pollutant, and dissolved pollutants including phosphates can still enter waterways via runoff and leachate even if soil erosion is controlled.

In 1998, the USDA Naturel Resources Conservation Service (NRCS) reviewed the manure production of a watershed in South Carolina. Agricultural activities in the project area are a major influence on the streems and ponds in the watershed, and contribute to nutrient-related water quality problems in the headwaters of Lake Murrey. NRCS found that becteria, nutrients, and sediment from soil erosion are the primary conteminants affecting these resources. The NRCS has calculated thet soil erosion, occurring on over 13,000 acres of cropland in the watershed, ranges from 9.6 to 41.5 tons per acre per year.

c. *Spills and Dry-Weather Discharges.* Surface discharges can occur through spills or other discharges from lagoons. Some causes of spills include malfunctions such as pump failures, manure irrigation gun malfunctions, and pipes or retaining walls breaking. Mauure entering tile drains has a direct route to surface water. (Tile drains are a network of pipes buried in fields below the root zone of plants to remove subsurface drainage water from the root zone to a stream, drainage ditch, or evaporation pond. EPA does not regulate most tile fields.) In 1997, the Ohio Department of Natural Resources documented chicken manure traveling through tile drains into a nearby stream. In addition, spills can occnr as a result of lagoon overflows and washouts from floodwaters when lagoons are sited ou floodplains. There are also indications that discharges from siphoning lagoons occur deliberately as a means to reduce the volume in overfull lagoons. Acute discharges of this kind frequently result in dramatic fish kills. In 1997, an independent review of Indiana Department of Environmental Mauagement records indicated that the most common causes of waste releases in that state were intentional discharge and lack of operator knowledge, rather than spills due to severe rainfall conditions.

Numerous such dry-weather discharges bave been identified. For example, in 1995, two separate discharges of 25 million gallons of manure from hog farms in North Carolina were documented, and both resulted in fish kills. Subsequent discharges of hundreds of thousands of gallons of manure were documented from hog operations in Iowa (1996), Illinois (1997), and Minnesota (1997). Fish kills were also reported as a result of two of these discherges. Discharges of over 8 million gallons of manure from a poultry operation in North Carolina in 1995 likewise resulted in a fish kill. Between 1994 and 1996, half a dozen discharges from poultry operations in Ohio resulted when meuure entered field tiles. In 1998, 125,000 gallons of manure were discharged from a dairy feedlot in Minnesota.

d. *Direct Contact between Confined Animals and Surface Water.* Finally, surface discharges can occur as a result of direct contact between confined animals end the rivers or ponds tbat are located within their reach. Historically, farms were located near waterways for both weter access for animals end discharge of wastes. This practice is now restricted for CAFOs; however, despite this restriction, enforcement actions are the primary means for reducing direct access.

In the more traditional farm production regions of the Midwest and Northeast, dairy barns and feedlots are often in close proximity to streams or other water sources. This close proximity to streams was necessary in order to provide drinking water for the dairy cows, direct access to cool the animals in hot weather, and to cool the milk prior to the wide-spread use of refrigeration. For CAFO-size facilities this practice is now replaced with more efficient means of providing drinking water for the dairy herd. In addition, the use of freestall barns and modern milking centers minimizes the exposure of dairy cows to the environment. For example, in New York direct access is more of a problem for the smaller traditional dairy farms that use older methods of housing animals.

In the arid west, feedlots are typically located near waterbodies to allow for cheap and easy stock watering. Many existing lots were configured to allow the animals direct access to the water. Certain animals, particularly cattle, will wade into the water, linger to drink, and will often urinate and defecate there as well. This direct deposition of manure and urine contributes greatly to water quality problems. Environmental problems associated with allowing farm animals access to waters that are adjacent to the production area are well documented in the literature. EPA Region X staff have documented dramatically elevated levels of Escherichia coli in rivers downstream of AFOs (including CAFOs) with direct access to surface water. Recent enforcement actions against direct access facilities have resulted in the assessment of tens of thousands of dollars in civil penalties.

2. Other Discharges to Surface Waters

a. *Leaching to Groundwater.* Leaching of land-applied pollutants such as nitrate dissolved into rainwater is a significant transport mechanism for water soluble pollutants. In addition, leaking lagoons are a source of manure pollutants to ground water. Although manure solids purportedly "self-seal" lagoons to prevent groundwater contamination, some studies have shown otherwise. A study for the Iowa legislature published in 1999 indicates that leaking is part of design standards for earthen lagoons and that all lagoons should be expected to leak. A 1995 survey of hog and poultry lagoons in the Carolinas found that nearly two-thirds of the 36 lagoons sampled had leaked into the groundwater. Even clay-lined lagoons have the potential to leak, since they can crack or break as they age, and can be susceptible to burrowing worms. In a three-year study (1988–1990) of clay-lined swine lagoons on the Delmarva Peninsula, researchers found that leachate from lagoons located in well-drained loamy sand had a severe impact on groundwater quality.

Pollutant transport to groundwater is also greater in areas with high soil permeability and shallow water tables. Percolating water can transport pollutants to groundwater, as well as to surface waters via interflow. Contaminated groundwater can deliver pollutants to surface waters through hydrologic connections. Nationally, about 40 percent of the average annual stream flow is from groundwater. In the Chesapeake Bay watershed, the U.S. Geological Survey (USGS) estimates that about half of the nitrogen loads from all sources to nontidal streams and rivers originate from groundwater.

b. *Discharge to the Air and Subsequent Deposition.* Discharges to air can occur as a result of volatilization of both pollutants already present in the manure and pollutants generated as the manure decomposes. Ammonia is very volatile, and can have significant impacts on water quality through atmospheric deposition. Other ways that manure pollutants can enter the air is from spray application methods for land applying manure and as particulates wind-borne in dust. Once airborne, these pollutants can find their way into nearby streams, rivers, and lakes. The 1998 National Water Quality Inventory indicates that atmospheric deposition is the third greatest cause of water quality impairment for estuaries, and the fifth greatest cause of water quality impairment for lakes, ponds, and reservoirs.

The degree of volatilization of manure pollutants is dependent on the manure management system. For example, losses are greater when manure remains on the land surface rather than being incorporated into the soil, and are particularly high when spray application is performed. Environmental conditions such as soil acidity and moisture content also affect the extent of volatilization. Losses are reduced by the presence of growing plants. Ammonia also readily volatilizes from lagoons.

Particulate emissions from AFOs may include dried manure, feed, epithelial cells, hair, and feathers. The airborne particles make up an organic dust, which includes endotoxin (the toxic protoplasm liberated when a microorganism dies and disintegrates), adsorbed gases, and possibly steroids. At least 50 percent of dust emissions from swine operations are believed to be respirable (small enough to be inhaled deeply into the lungs).

3. A National Study of Nitrogen Sources to Watersheds

In 1994, the USGS analyzed nitrogen sources to 107 watersheds. Potential sources included manure (both point and nonpoint sources), fertilizers, point sources, and atmospheric deposition. The "manure" source estimates include waste from both confined and unconfined animals. As may be expected, the USGS found that proportions of nitrogen originating from various sources differ according to climate, hydrologic conditions, land use, population, and physical geography. Results of the analysis for selected watersheds for the 1987 base year show that in some instances, manure nitrogen is a large portion of the total nitrogen added to the watershed. The study showed that, for following nine watersheds, more than 25 percent of nitrogen originates from manure: Trinity River, Texas; White River, Arkansas; Apalachicola River, Florida; Altamaha River, Georgia; Potomac River, Washington, D.C.; Susquehanna River, Pennsylvania; Platte River, Nebraska; Snake River, Idaho; and San Joaquin River, California. Of these, California, Texas, Florida, Arkansas, and Idaho have large populations of confined animals.

4. State Level Studies of Feedlot Pollutants Reaching Surface Waters

There are many studies demonstrating surface water impacts from animal feeding operations. These impacts have been documented for at least the past decade. For example, in 1991, the U.S. Fish and Wildlife Service (FWS) reported on suspected impacts from a large number of cattle feedlots on Tierra Blanca Creek, upstream of the Buffalo Lake National Wildlife Refuge in the Texas Panhandle. FWS found elevated aqueous concentrations of ammonia, chemical oxygen demand, coliform bacteria, chloride, nitrogen, and volatile suspended solids; they also found elevated concentrations of the feed additives copper and zinc in the creek sediment.

According to Arkansas' 1996 Water Quality Inventory Report, a publication of the Arkansas Department of Environmental Protection, water in the Grand Neosho basin only partially supports aquatic life. Land uses there, primarily confined animal feeding operations including poultry production and pasture management, are major sources of nutrients and chronic high turbidity. Pathogens sampled in the Muddy Fork Hydrologic Unit Area, in the Arkansas River basin, also exceed acceptable limits for primary contact recreation (swimming). This problem was reported in the 1994 water quality inventory, and it, too, was traced to extensive poultry, swine, and dairy operations in the Moore's Creek basin. Essentially, all parts of the subwatershed are impacted by these activities. Currently, the Muddy Fork Hydrologic Unit Area Project is a USDA agricultural assistance, technology transfer, and demonstration project. A section 319 water quality monitoring operation is also ongoing in the hydrologic unit area.

In 1997, the Hoosier Environmental Council documented the reduction in biodiversity due to AFOs in a study of three Indiana stream systems. That study found that waters downstream of animal feedlots (mainly hog and dairy operations) contained fewer fish and a limited number of species of fish in comparison with reference sites. It also found excessive algal growth, altered oxygen content, and increased levels of ammonia, turbidity, pH, and total dissolved solids.

C. What Are the Potential and Observed Impacts?

Pollutants in animal manures can impair surface waters. Such impairments have resulted in fish kills; eutrophication and algal blooms; contamination of shellfish, and subsequent toxin and pathogen transmission up the food chain; increased turbidity and negative impacts to benthic organisms; and reduced biodiversity when rivers and streams become uninhabitable by resident species. These manure pollutants can also deteriorate soil quality and make it toxic to plants. In addition to these ecological impacts, pollutants in animal manures can present a range of risks to human health when they contaminate drinking water or shellfish, and when they are present in recreational waters.

1. Ecological Impacts

a. *Fish Kills and Other Fishery Impacts.* Fish kills are one of the most dramatic impacts associated with manure reaching surface water. Spills, dry-weather discharges, and runoff can carry pollutants in manure to rivers and streams and can result in serious fish kills. During the years 1987 through 1997, at least 47 incidents of fish kills have been associated with hog manure. Another 8 fish kills were attributed to poultry waste, and 2 with beef/dairy manure. An additional 20 fish kills were associated with animal manure for which one specific animal type was not identified. These incidents were reported by the Iowa Department of Natural Resources, the Maryland Department of the Environment, the Natural Resources Defense Council, several citizen's groups, and numerous newspapers. These incidents are not reflective of all states. In Illinois alone, records indicate that 171 fish kills attributable to manure discharges were investigated by Illinois Environmental Protection Agency personnel between 1979 and 1998. Thousands of fish are typically killed by one of these events.

Ammonia is highly toxic to aquatic life and is a leading cause of fish kills. In a May 1997 incident in Wabasha County, Minnesota, ammonia in a dairy cattle manure discharge killed 16,500 minnows and white suckers. Ammonia and other pollutants in manure exert a direct biochemical oxygen demand (BOD) on the receiving water. As ammonia is oxidized, dissolved oxygen is consumed. Moderate depressions of dissolved oxygen are associated with reduced species diversity, while more severe depressions can produce fish kills.

Nitrites pose additional risks to aquatic life: if sediments are enriched with nutrients, the concentrations of nitrites on the overlying water may be raised enough to cause nitrite poisoning or "brown blood disease" in fish.

Excess nutrients result in eutrophication (see section V.C.1.b, which follows). Eutrophication is associated with blooms of a variety of organisms that are toxic to both fish and humans. This includes the estuarine dinoflagellate Pfiesteria piscicida, which is implicated in several fish kills and fish disease events. Pfiesteria has been implicated as the primary causative agent of many major fish kills and fish disease events in North Carolina estuaries and coastal areas, as well as in Maryland and Virginia tributaries to the Chesapeake Bay. In 1997, hog operations were identified as a potential cause of a Pfiesteria outbreak in North Carolina rivers that resulted in 450,000 fish killed. Also that same year, poultry operations were linked to Pfiesteria outbreaks in the Pokomoke River and Kings Creek (both in Maryland) and in the Chesapeake Bay, in which tens of thousands of fish were killed.

The presence of estrogen and estrogen-like compounds in surface water has caused much concern. These hormones have been found in animal manures and runoff from fields where manure has been applied. The ultimate fate of hormones in the environment is unknown, although early studies indicate that common soil or fecal bacteria cannot metabolize estrogen. When present in high enough concentrations in the environment, hormones and other endocrine disruptors including pesticides are linked to reduced fertility, mutations, and the death of fish. Estrogen hormones have been implicated in widespread reproductive disorders in a variety of wildlife. There is evidence that fish in some streams are experiencing endocrine disruption and that contaminants including pesticides may be the cause, though there is no evidence linking these effects to CAFOs.

b. *Eutrophication and Algal Growth.* Eutrophication is the process in which phosphorus and nitrogen over-enrich water bodies and disrupt the balance of life in that water body. As a result, the excess nutrients cause fast-growing algae blooms. The 1998 National Water Quality Inventory indicates that excess algal growth is the seventh leading stressor in lakes, ponds, and reservoirs. Rapid growth of algae can lower the dissolved oxygen content of a water body to levels insufficient to support fish and invertebrates. Eutrophication can also affect phytoplankton and zooplankton population diversity, abundance, and biomass, and increase the mortality rates of aquatic species. Floating algal mats can reduce the penetration of sunlight in the water column and thereby limit growth of seagrass beds and other submerged vegetation. This in turn reduces fish and shellfish habitat. This reduction in submerged aquatic vegetation adversely affects both fish and shellfish populations.

Increased algal growth can also raise the pH of waterbodies, as algae consume dissolved carbon dioxide to support photosynthesis. This elevated pH can harm the gill epithelium of aquatic organisms. The pH may then drop rapidly at night, when algal photosynthesis stops. In extreme cases, such pH fluctuations can severely stress aquatic organisms.

Eutrophication is also a factor in the growth of toxic microorganisms, such as cyanobacteria (a toxic algae) and Pfiesteria piscicida, which can affect human health as well. Decay of algal blooms and night-time respiration can further depress dissolved oxygen levels, potentially leading to fish kills and reduced biodiversity. In addition, toxic algae such as cyanobacteria release toxins as they die, which can severely impact wildlife as well as humans. Researchers have documented stimulation of Pfiesteria growth by swine effluent discharges, and have shown that the organism's growth can be highly stimulated by both inorganic and organic nitrogen and phosphorus enrichments.

c. *Wildlife Impacts.* As noted earlier, reduction in submerged aquatic vegetation due to algal blooms is the leading cause of biological decline in Chesapeake Bay, adversely affecting both fish and shellfish populations. In marine ecosystems, blooms known as red or brown tides have caused significant mortality in marine mammals. In freshwater, cyanobacterial toxins have caused many incidents of poisoning of wild and domestic animals that have consumed impacted waters.

Even with no visible signs of the algae blooms, shellfish such as oysters, clams and mussels can carry the toxins produced by some types of algae in their tissue. Shellfish are filter feeders which pass large volumes of water over their gills. As a result, they can concentrate a broad range of microorganisms in their tissues. Concentration of toxins in shellfish provides a pathway for pathogen transmission to higher trophic organisms. Information is becoming available to assess the health effects of contaminated shellfish on wildlife receptors. Earlier this year, the death of over 400 California sea lions was linked to ingestion of mussels contaminated by a bloom of toxic algae. Previous incidents associated the deaths of manatees and whales with toxic and harmful algae blooms.

In August 1997, the National Oceanic and Atmospheric Administration (NOAA) released The 1995 National Shellfish Register of Classified Growing Waters. The register characterizes the status of 4,230 shellfish-growing water areas in 21 coastal states, reflecting an assessment of nearly 25 million acres of estuarine and non-estuarine waters. NOAA found that 3,404 shellfish areas had some level of impairment. Of these, 110 (3 percent) were impaired to varying degrees by feedlots, and 280 (8 percent) were impaired by "other agriculture" which could include land where manure is applied.

Avian botulism and avian cholera have killed hundreds of thousands of migratory waterfowl in the past. Although outbreaks of avian botulism have occurred since the beginning of the century, most occurrences have been reported in the past twenty years, which coincides with the trend toward fewer and larger AFOs. The connection between nutrient runoff, fish kills, and subsequent outbreaks of avian botulism was made in 1999 at California's Salton Sea, when almost 8 million fish died in one day. The fish kill was associated with runoff from surrounding farms, which carried nutrients and salts into the Salton Sea. Those nutrients caused algae blooms which in turn lead to large and sudden fish kills. Since the 1999 die off, the number of endangered brown pelicans infected with avian botulism increased to about 35 birds a day. In addition, bottom feeding birds can be quite susceptible to metal toxicity, because they are attracted to shallow feedlot wastewater ponds and waters adjacent to feedlots. Metals can remain in aquatic ecosystems for long periods of time because of adsorption to suspended or bed sediments or uptake by aquatic biota.

Reduction in biodiversity due to AFOs has been documented in a 1997 study of three Indiana stream systems. That study shows that waters downstream of animal feedlots (mainly hog and dairy operations) contained fewer fish and a limited number of species of fish in comparison with reference sites. The study also found excessive algal growth, altered oxygen content, and increased levels of ammonia, turbidity, pH, and total dissolved solids. Multi-generation animal studies have found decreases in birth weight, post-natal growth, and organ weights among mammals prenatally exposed to nitrite. Finally, hormones and pesticides have been implicated in widespread reproductive disorders in a variety of wildlife.

d. *Other Aquatic Ecosystem Imbalances.* Changes to the pH balance of surface water also threaten the survival of the fish and other aquatic organisms. Data from Sampson County, North Carolina show that "ammonia rain" has increased as the hog industry has grown, with ammonia levels in rain more than doubling between 1985 and 1995. In addition, excess nitrogen can contribute to water quality decline by increasing the acidity of surface waters.

In fresh waters, increasing salinity can also disrupt the balance of the ecosystem, making it difficult for resident species to remain. Salts also contribute to the degradation of drinking water supplies.

Trace elements (e.g., arsenic, copper, selenium, and zinc) may also present ecological risks. Antibiotics, pesticides, and hormones may have low-level, long-term ecosystem effects.

2. Drinking Water Impacts

Nitrogen in manure is easily transformed into nitrate form, which can be transported to drinking water sources and present a range of health risks. In 1990, PA found that nitrate is the most widespread agricultural contaminant in drinking water wells, and estimated that 4.5 million people are exposed to elevated nitrate levels from wells. In 1995, several private wells in North Carolina were found to be contaminated with nitrates at levels 10 times higher than the State's health standard; this contamination was linked with a nearby hog operation. The national primary drinking water standard (Maximum Contaminant Level, or MCL) for nitrogen (nitrate, nitrite) is 10 milligrams per liter (mg/L). In 1982, nitrate levels greater than 10 mg/L were found in 32 percent of the wells in Sussex County, Delaware; these levels were associated with local poultry operations. In southeastern Delaware and the Eastern Shore of Maryland, where poultry production is prominent, over 20 percent of wells were found to have nitrate levels exceeding 10 mg/L. Nitrate is not removed by conventional drinking water treatment processes. Its removal requires additional, relatively expensive treatment units.

Algae blooms triggered by nutrient pollution can affect drinking water by clogging treatment plant intakes, producing objectionable tastes and odors, and increasing production of harmful chlorinated byproducts (e.g., trihalomethanes) by reacting with chlorine used to disinfect drinking water. As aquatic bacteria and other microorganisms degrade the organic matter in manure, they consume dissolved oxygen. This can lead to foul odors and reduce the water's value as a source of drinking water. Increased organic matter in drinking water sources can also lead to excessive production of harmful chlorinated byproducts, resulting in higher drinking water treatment costs.

Pathogens can also threaten drinking water sources. Surface waters are typically expected to be more prone than groundwater to contamination by pathogens such as Escherichia coli and Cryptosporidium parvum. However, groundwater in areas of sandy soils, limestone formations, or sinkholes are particularly vulnerable. In a 1997 survey of drinking water standard violations in six states over a four-year period, the U.S. General Accounting Office noted in its 1997 report Drinking Water: Information on the Quality of Water Found at Community Water Systems and Private Wells that bacterial standard violations occurred in up to 6 percent of community water systems each year and in up to 42 percent of private wells. (Private wells are more prone than public wells to contamination, since they tend to be shallower and therefore more susceptible to contaminants leaching from the surface.) In cow pasture areas of Door County, Wisconsin, where a thin topsoil layer is underlain by fractured limestone bedrock, groundwater wells have commonly been shut down due to high bacteria levels.

Each of these impacts can result in increased drinking water treatmeut costs. For example, Califoruia's Chino Basin estimates a cost of over $1 million per year to remove the nitrates from drinkiug water due to loadings from local dairies. Salt load into the Chino Basin from local dairies is over 1,500 tons per year, and the cost to remove that salt by the drinking water treatment system ranges from $320 to $690 for every ton. In Iowa, Des Moines Water Works planned to spend approximately $5 million in the early 1990's to install a treatment system to remove nitrates from their main sources of drinking water, the Raccoon and Des Moines Rivers. Agriculture was cited as a major source of the nitrate contamination, although the portion attributable to animal waste is unknown. In Wisconsin, the City of Oshkosh has spent an extra $30,000 per year on copper sulfate to kill the algae in the water it draws from Lake Winnebago. The thick mats of algae in the lake have been attributed to excess nutrients from manure, commercial fertilizers, and soil. Iu Tulsa, Oklahoma, excessive algal growth in Lake Eucha is associated with poultry farming. The city spends $100,000 per year to address taste and odor problems in the drinking water.

3. Human Health Impacts

Human and animal health impacts are primarily associated with drinking contaminated water, coutact with contaminated water, and consuming contaminated shellfish.

a. *Nutrients*. The main hazard to humau health from uutrients is elevated nitrate levels in driuking water. In particular, infants are at risk from nitrate poisoning (also referred to as methemoglobinemia or "blue baby syndrome"), which results in oxygen starvation and is potentially fatal. Nitrate toxicity is due to its metabolite nitrite, which is formed in the environment, in foods, and in the human digestive system. In addition to blue baby syndromo, low blood oxygen due to methemoglobinemia has also been linked to birth defects, miscarriages, and poor health in humans and auimals. These effects are exacerbated by concurrent exposure to mauy species of bacteria io water.

Studies in Australia compiled in a 1993 review by Bruning-Fann and Kaneene showed an increased risk of congenital malformations with consumption of high-nitrate groundwater. Multi-generation animal studies have found decreases in birth weight and post-natal growth and organ weights associated with nitrite exposure among prenatally exposed mammals. Nitrate-and nitrite-containing componnds also have the ability to cause hypotension or circulatory collapse. Nitrate metabolites such as N-nitroso componnds (especially nitrosamines) have been linked to severe human health effects such as gastric cancer.

Eutrophication can also affect buman health by enhaucing growth of harmful algal blooms that release toxins as they die. In marine ecosystems, harmful algal blooms such as red tides can result in human health impacts via shellfish poisoning and recreational contact. In freshwater, blooms of cyanobacteria (blue-green algae) may pose a serious health hazard to humans via water consumption. When cyanobacterial blooms die or are ingested, they release water-soluble compounds that are toxic to the nervous system and liver. Algal blooms cau also increase production of harmful chlorinated byproducts (e.g., trihalomethanes) by reacting with chlorine used to disinfect drinking water. These substances can result in increased health risks.

b. Pathogens. Livestock manure has been identified as a potential source of pathogens by public health officials. Humans may be exposed to pathogens via consnmption of contaminated drinking water and shellfish, or by contact and incidental ingestion during recreation in contaminated waters. Relatively few microbial agents are responsible for the majority of human disease outbreaks from water-based exposure routes. Intestinal infections are the most common type of waterborne infection, and affect the most people. A May, 2000 outbreak of Escherichia coli O157:H7 in Walkerton, Ontario resulted iu at least seven deaths and 1,000 cases of intestinal problems; public health officials theorize that flood waters washed manure contaminated with E. coli into the town's drinking water well.

A study for the period 1989 to 1996 revealed that infections caused by the protozoa Giardia sp. and Cryptosporidium parvum were the leading cause of infectious water-borne disease outbreaks in which an ageut was identified. C. parvum is particularly associated with cows, and can produce gastrointestinal illness, with symptoms such as severe diarrhea. Healthy people typically recover relatively quickly from gastrointestinal illnesses such as cryptosporidiosis, but such diseases can be fatal in people with weakened immune systems. This subpopulation includes children, the elderly, people with HIV infection, chemotherapy patients, and those taking medications that suppress the immune system. In Milwaukee, Wisconsin in 1993, C. parvum contamination of a public water snpply caused more than 100 deaths and an estimated 403,000 illnesses. The source was not identified, but possible sources include runoff from cow manure application sites.

In 1999, an E. coli outbreak occurred at the Washington County Fair in New York State. This outbreak, possibly the largest waterborne outbreak of E. coli O157:H7 in U.S. history, took the lives of two fair attendees and sent 71 others to the hospital. An investigation identified 781 persons with confirmed or suspected illness related to this outbreak. The outbreak is thought to have been caused by contamination of the Fair's Well 6 by either a dormitory septic system or manure runoff from the nearby Youth Cattle Barn.

Contact with pathogens during recreational activities in surface water can also result in infections of the skin, eye, ear, nose, and throat. In 1989, ear and skin infections and intestinal illnesses were reported in swimmers as a result of discharges from a dairy operation in Wisconsin.

As discussed in the previous section, excess nutrients result in eutrophication, which is associated with the growth of a variety of organisms that are toxic to humans either through ingestion or contact. This includes the estuarine dinoflagellate Pfiesteria piscicida. While Pfiesteria is primarily associated with fish kills and fish disease events, the organism has also been linked with human health impacts through dermal exposure. Researchers working with dilute toxic cultures of Pfiesteria exhibited symptoms such as skin sores, severe headaches, blurred visiou, nansea/vomiting, sustained difficulty breathing, kidney and liver dysfuuction, acnte short-term memory loss, and severe cognitive impairment. People with heavy environmental exposure have exhibited symptoms as well. In a 1998 study, such environmental exposure was defiuitively linked with cognitive impairmeut, and less consistently linked with physical symptoms.

Even with no visible signs of the algae blooms, shellfish such as oysters, clams and mussels can carry the toxins produced by some types of algae in their tissue. These can then affect people who eat the contaminated shellfish. The 1995 National Shellfish Register of Classified Growing Waters published by the National Oceanic and Atmospheric Administration (NOAA) identifies over 100 shellfish bed impairments (shellfish not approved for harvest) due to feedlots.

c. Trace Elements. Some of the trace elements in manure are essential nutrients for humau physiology; however, they can induce toxicity at elavatad concentrations. Thasa elements include the feed additives zinc, arsenic, copper, and selenium. Although thesa elemants are typically present in relatively low concentrations in mauure, they are of concern becausa of their ability to persist in the environment and to bioconcentrate in plant and animal tissues. These elements could pose a hazard if manure is overapplied to land.

Trace elements are associated with a variety of illnesses. For example, arsenic is carcinogenic to humans, based on evidence from human studies; some of these studies have found increased skin cancer and mortality from multiple internal organ cancers in populations who consumed drinking water with high levels of inorganic arsenic. Arsenic is also linked with noncancer effects, including hyperpigmentetion and possible vascular complications. Selenium is associated with liver dysfunction and loss of hair and nails, and zinc can result in changes in copper and iron balances, particularly copper deficiency anemia.

d. Odors. Odor is a significant concern because of its documented effect on moods, such as increased tension, depression, and fatigue. Odor also has the potential for vector attraction, and has been associated with a negative impact on property values. Additionally, many of the odor-causing compounds in manure can cause physical health impacts. For example, hydrogen sulfide is toxic, and ammonia gas is a nasal and respiratory irritant.

4. Recreational Impacts

As discussed above, CAFO pollutants contribute to the increase in turbidity, increase in entrophication and algal blooms, and reduction of aquatic populations in rivers, lakes, and estuaries. Impaired conditions interfere with recreational activities and aesthetic enjoyment of these water bodies. Recreational activities include fishing, swimming, aud boating. Fishing is reduced when fish populations decreasa. Swimming is limited by incraased risk of infection when pathogens are presant. Boating and aesthetic enjoyment decline with the decreased aesthetic appeal caused by loss of water clarity and water surfaces clogged by algae. These impacts are more fully discussed in Section XI of this preamble.

VI. What Are Key Characteristics of the Livestock and Poultry Industries?

A. Introduction and Overview

1. Total Number and Size of Animal Confinement Operations

USDA reports that there were 1.1 million livestock end poultry farms in the United States in 1997. This number includes all operations thet raise beef, dairy, pork, broilers, egg layers, and turkeys, and includes both confinement and non-confinement (grazing and rangefed) production. Only operations that raise animals in confinement will be subject to today's proposed regulations.

For many of the animal sectors, it is not possible to precisely determine what proportion of the total livestock operations are confinement operations and what proportion are grazing operations only. Data on the number of beef and hog operations that raise animals in confinement are available from USDA. Since most large dairies have milking parlors, EPA assumes tbat all dairy operations are potentially confinement operations. In the poultry sectors, there are few small non-confinement operations and EPA assumes that all poultry operations confine animals. EPA's analysis focuses on the largest facilities in these sectors only.

Using available 1997 data from USDA, EPA estimates that there are about 376,000 AFOs that raise or house animals in confinement, as defined by the existing regulations (Tabla 6–1). Table 6–1 presents the estimated number of AFOs and the corresponding animal inventories for 1997 across selact size groupings. Thesc estimates are based on tbe number of "animal units" (AU) as defined in the existing regulations at 40 CFR 122, with the addition of the revisions that are being proposed for immature animals and chickens. Data shown in Table 6–1 aro grouped by operations with more than 1,000 AU and operations with fewer than 300 AU.

As shown in Table 6–1, tbere were an estimated 12,660 AFOs with more that 1,000 AU in 1997 that accounted for about 3 percent of all confinement operation. In most sectors, these larger-sized operations account for the majority of animal productiou. For example, in the beef, turkey and egg laying sectors, operations with more than 1,000 AU accounted for more than 70 percent of all animal inventories in 1997; operations with more than 1,000 AU accounted for more than 50 percent of all hog, broiler, and heifer operations (Table 6–1). In contrast, operations with fewer than 300 AU accounted for 90 percent of all operations, but a relatively smaller share of animal production.

USDA personnel have reviewed the data and assumptions used to derive EPA's estimates of the number of confinement operations. Detailed information on how EPA estimated the number of AFOs that may be subject to today's proposed regulations can be found in the Development Document for the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations (referred to as the "Development Document").

TABLE 6–1.—NUMBER OF AFOs AND ANIMAL ON-SITE, BY SIZE GROUP, 1997

Sector/Size category	Total AFOs	>1000 AU [1]	<300 AU	Total	>1000 AU	<300 AU
	(Number of operations)			(Number of animals, 1000's)		
Cattle	106,080	2,080	102,000	26,840	22,790	2,420
Veal	850	10	640	270	10	210
Heifers	1,250	300	200	850	450	80
Dairy	116,870	1,450	109,740	9,100	2,050	5,000
Hogs: GF [2]	53,620	1,670	48,700	18,000	9,500	2,700
Hogs: FF [2]	64,260	2,420	54,810	38,740	21,460	5,810
Broilers	34,860	3,940	20,720	1,905,070	1,143,040	476,270
Layers: wet [3]	3,110	50	2,750	392,940	275,060	58,940
Layers: dry [3]	72,060	590	70,370	392,940	275,060	58,940
Turkeys	13,720	370	12,020	112,800	95,880	2,260

TABLE 6–1.—NUMBER OF AFOS AND ANIMAL ON-SITE, BY SIZE GROUP, 1997—Continued

Sector/Size category	Total AFOs	>1000 AU [1]	<300 AU	Total	>1000 AU	<300 AU
Total [4]	375,700	12,660	336,590	NA	NA	NA

Source: Derived by USDA from published USDA/NASS data, including 1997 Census of Agriculture. In some cases, available data are used to interpolate data for some AU size categories (see EPA's Development Document). Data for veal and heifer operations are estimated by USDA. Totals may not add due to rounding.

[1] As defined for the proposed CAFO regulations, one AU is equivalent to: one slaughter or feeder cattle, calf or heifer; 0.7 mature dairy cattle; 2.5 hogs (over 55 pounds) or 5 nursery pigs; 55 turkeys; and 100 chickens regardless of the animal waste system used.

[2] "Hogs: FF" are farrow-finish (includes breeder and nursery pigs); "Hogs: GF" are grower-finish only.

[3] "Layers: wet" are operations with liquid manure systems; "Layers: dry" are operations with dry systems.

[4] "Total AFOs" eliminates double counting of operations with mixed animal types. Based on survey level Census data for 1992, operations with mixed animal types account for roughly 25 percent of total AFOs.

2. Total Number of CAFOs Subject to the Proposed Regulations

Table 6–2 presents the estimated number of operations that would be defined as a CAFO under each of the two regulatory alternatives being proposed. The "two-tier structure" would define as CAFOs all animal feeding operations with more than 500 AU. The "three-tier structure" would define as CAFOs all animal feeding operations with more than 1,000 AU and any operation with more than 300 AU, if they meet certain "risk-based" conditions, as defined in Section VII. Table 6–2 presents the estimated number of CAFOs in terms of number of operations with more than 1,000 AU and operations for each co-proposed middle category (operations with between 500 and 1,000 AU and between 300 and 1,000 AU, respectively).

Based on available USDA data for 1997, EPA estimates that both proposed alternative structures would regulate about 12,660 operations with more than 1,000 AU. This estimate adjusts for operations with more than a single animal type. The two alternatives differ in the manner in which operations with less than 1,000 AU would be defined as CAFOs and, therefore, subject to regulation, as described in Section VII. As shown in Table 6–2, in addition to the 12,660 facilities with more than 1,000 AU, the two-tier structure at 500 AU threshold would regulate an additional 12,880 operations with between 500 and 1,000 AU. Including operations with more than 1,000 AU, the two-tier structure regulates a total of 25,540 AFOs that would be subject to the proposed regulations (7 percent of all AFOs).

Under the three-tier structure, an estimated 39,330 operations would be subject to the proposed regulations (10 percent of all AFOs), estimated as the total number of animal confinement operations with more than 300 AU. See Table 6–1. Of these, EPA estimates that a total of 31,930 AFOs would be defined as CAFOs (9 percent of all AFOs) and would need to obtain a permit (Table 6–2), while an estimated 7,400 operations would certify that they do not need to obtain a permit. Among those operations needing a permit, an estimated 19,270 operations have between 300 to 1,000 AU. For more information, see the Economic Analysis.

TABLE 6–2. NUMBER OF POTENTIAL CAFOS BY SELECT REGULATORY ALTERNATIVE, 1997

Sector/Size category	"Two-tier"						"Three-Tier" >300 AU	
	>300 AU	>500 AU	>750 AU	>300 AU	>500 AU	>750AU		
	(#Operations)			(%Total)			(#)	(%Total)
Cattle	4,080	3,080	2,480	4	3	2	3,210	3
Veal	210	90	40	25	10	4	140	16
Heifers	1,050	800	420	84	64	34	980	78
Dairy	7,140	3,760	2,260	6	3	2	6,480	6
Hogs: GF [1]	4,920	2,690	2,300	9	5	4	2,650	5
Hogs: FF [1]	9,450	5,860	3,460	15	9	5	5,700	9
Broilers	14,140	9,780	7,780	41	28	22	13,740	39
Layers: wet [2]	360	360	210	12	12	7	360	12
Layers: dry [2]	1,690	1,280	1,250	2	2	2	1,650	2
Turkeys	2,100	1,280	740	15	9	5	2,060	15
Total [3]	39,320	25,540	19,100	10.5	6.8	5.1	31,930	8.5

Source: See Table 6–1.

[1] FF=farrow-finish (includes breeder and nursery pigs); GF=grower finish.

[2] "Layers: wet" are operations with liquid manure systems. "Layers: dry" are operations with dry systems.

[3] "Total" eliminates double counting of operations with mixed animal types (see Table 6–1).

EPA estimated the number of operations that may be defined as CAFOs under the three-tier structure using available information and compiled data from USDA, State Extension experts, and agricultural professionals. These estimates rely on information about the percentage of operations in each sector that would be impacted by the "risk-based" criteria described in Section VII. In some cases, this information is available on a state or regional basis only and is extrapolated to all operations nationwide. EPA's estimates reflect information from a majority of professional experts in the field. Greater weight is given to information obtained by State Extension agents, since they have broader knowledge of the industry in their state. More detailed information on how EPA estimated the number of operations that may be affected by the proposed regulations under the three-tier structure is available in the rulemaking record and in the Development Document.

EPA is also requesting comment on two additional options for the scope of the rule. One of these is an alternative two-tier structure with a threshold of 750 AU. Under this option, an estimated 19,100 operations, adjusting for operations with more than a single animal type, would be defined as CAFOs. This represents about 5 percent of all CAFOs, and would affect an estimated 2,930 beef, veal, and heifer operations, 2,260 dairies, and 5,750 swine and 9,980 poultry operations (including mixed operations). Under the other alternative, a variation of the three-tier structure being co-proposed today, the same 39,320 operations with 300 AU or greater would potentially be defined as CAFOs. However, the certification conditions for being defined as a CAFO would be different for operations with 300 to 1,000 AU (as described later in Section VII). EPA has not estimated how many operations would be defined as CAFOs under this alternative three-tier approach, although EPA expects that it would be fewer than the 31,930 estimated for the three-tier approach being proposed today. If after considering comments, EPA decides to further explore this approach, it will conduct a full analysis of the number of potentially affected operations.

EPA does not anticipate that many AFOs with less than 500 AU (two-tier structure) or 300 AU (three-tier structure) will be subject to the proposed requirements. In the past 20 years, EPA is aware of very few AFOs that have been designated as CAFOs. Based on available USDA analyses that measure excessive nutrient application on cropland in some production areas and other farm level data by sector, facility size and region, EPA estimates that designation may bring an additional 50 operations under the proposed two-tier structure each year nationwide. EPA assumed this estimate to be cumulative such that over a 10-year period approximately 500 AFOs may become designated as CAFOs and therefore subject to the proposed regulations. EPA expects these operations to consist of beef, dairy, farrow-finish hog, broiler and egg laying operations that are determined to be significant contributors to water quality impairment. Under the three-tier structure, EPA estimates that fewer operations would be designated as CAFOs, with 10 dairy and hog operations may be designated each year, or 100 operations over a 10-year period. Additional information is provided in the Economic Analysis.

EPA expects that today's proposed regulations would mainly affect livestock and poultry operations that confine animals. In addition to CAFOs, however, the proposed regulations would also affect businesses that contract out the raising or finishing production phase to a CAFO but exercise "substantial operational control" over the CAFO (as described in Section VII.C.6).

EPA expects that affected businesses may include packing plants and slaughtering facilities that enter into a production contract with a CAFO. Under a production contract, a contractor (such as a processing firm, feed mill, or other animal feeding operation) may either own the animals and/or may maintain control over the type of production practices used by the CAFO. Processor firms that enter into a marketing contract with a CAFO are not expected to be subject to co-permitting requirements since the mechanism for "substantial operational control" generally do not exist. Given the types of contract arrangements that are common in the hog and poultry industries, EPA expects that packers/slaughterers in these sectors may be subject to the proposed co-permitting requirements.

As discussed later in Sections VI.D.1 and VI.E.1, EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements. Other types of processing firms, such as further processors, food manufacturers, dairy cooperatives, and renderers, are not expected to be affected by the co-permitting requirements since these operations are further up the marketing chain and do not likely contract with CAFOs to raise animals. Fully vertically integrated companies (e.g., where the packer owns the CAFO) are not expected to require a co-permit since the firm as the owner of the CAFO would require only a single permit. EPA solicits comment on these assumptions as part of today's rulemaking proposal. EPA also expects that non-CAFO, crop farmers who receive manure from CAFOs would be affected under one of the two co-proposed options relating to offsite management of manure (see Section VII).

Additional information is provided in the Economic Impact Analysis of Proposed Effluent Limitations Guidelines and National Pollutant Discharge Elimination System for Concentrated Animal Feeding Operations (referred to as "Economic Impact Analysis").

3. Manure and Manure Nutrients Generated Annually at AFOs

USDA's National Resources Conservation Service (NRCS) estimates that 128.2 billion pounds of manure are "available for land application from confined AU" from the major livestock and poultry sectors. EPA believes these estimates equate to the amount of manure that is generated at animal feeding operations since USDA's methodology accounts for all manure generated at confinement facilities. USDA reports that manure nutrients available for land application totaled 2.6 billion pounds of nitrogen and 1.4 billion pounds of phosphorus in 1997 (Table 6–3). USDA's estimates do not include manure generated from other animal agricultural operations, such as sheep and lamb, goats, horses, and other farm animal species.

TABLE 6–3. MANURE AND MANURE NUTRIENTS "AVAILABLE FOR LAND APPLICATION", 1997

Sector	USDA estimates: "available for application" from confined AU" [a]			EPA estimates: Percentage share by facility size group [b]			
	Total manure	Total nitrogen	Total phos-phorus	>1000 AU	>750 AU	>500 AU	>300AU
	(bill. lbs)	(Million pounds)		(Percent of total manure nutrients applied)			
Cattle [c]	32.9	521	362	83	85	86	90
Dairy	45.5	636	244	23	31	37	43
Hogs	16.3	274	277	55	63	69	78
All Poultry	33.5	1,153	554	49	66	77	90

TABLE 6–3. MANURE AND MANURE NUTRIENTS "AVAILABLE FOR LAND APPLICATION", 1997—Continued

Sector	USDA estimates: "available for application" from confined AU" [a]			EPA estimates: Percentage share by facility size group [b]			
	Total manure	Total nitrogen	Total phos-phorus	>1000 AU	>750 AU	>500 AU	>300AU
Total	128.2	2,583	1,437	49	58	64	72

Source:
[a] Manure and nutrients are from USDA/NRCS using 1997 Census of Agriculture and procedures documented developed by USDA. Numbers are "dry state" and reflect the amount of manure nutrient "available for application from confined AU" and are assumed by EPA to coincide with manure generated at confined operations.
[b] Percentage shares are based on the share of animals within each facility size group for each sector (shown in Table 6–1) across three facility size groups.
[c] "Cattle" is the sum of USDA's estimate for livestock operations "with fattened cattle" and "with cattle other than fattened cattle and milk cows."

The contribution of manure and manure nutrients varies by animal type. Table 6–3 shows that the poultry industry was the largest producer of manure nutrients in 1997, accounting for 45 percent (1.2 billion pounds) of all nitrogen and 39 percent (0.6 billion pounds) of all phosphorus available for land application that year. Among the poultry sectors, EPA estimates that approximately 55 percent of all poultry manure was generated by broilers, while layers generated 20 percent and turkeys generated 25 percent. The dairy industry was the second largest producer of manure nutrients, generating 25 percent (0.6 billion pounds) of all nitrogen and 17 percent (0.2 billion pounds) of all phosphorus (Table 6–3). Together, the hog and beef sectors accounted for about one-fourth of all nitrogen and nearly 40 percent of all phosphorus from manure.

Table 6–3 shows EPA's estimate of the relative contribution of manure generated by select major facility size groupings, including coverage for all operations with more than 1,000 AU, all operations with more than 750 AU or 500 AU (two-tier structure), and all operations with more than 300 AU (three-tier structure). EPA estimated these shares based on the share of animals within each facility size group for each sector, as shown in Table 6–1. Given the number of AFOs that may be defined as CAFOs and subject to the proposed regulations (Table 6–1), EPA estimates that the proposed effluent guidelines and NPDES regulations will regulate 5 to 7 percent (two-tier structure) to 10 percent (three-tier structure) percent of AFOs nationwide. Coverage in terms of manure nutrients generated will vary by the proposed regulatory approach. As shown in Table 6–3, under the 500 AU two-tier structure, EPA estimates that the proposed requirements will capture 64 percent of all CAFO manure; under the 750 AU two-tier structure, EPA estimates that the proposed requirements will capture 58 percent of all CAFO manure. Under the three-tier structure, EPA estimates that the proposed requirements will capture 72 percent of all CAFO manure generated annually (Table 6–3). The majority of this coverage (49 percent) is attributable to regulation of operations with more than 1,000 AU.

Additional information on the constituents found in livestock and poultry manure and wastewater is described in Section V. Information on USDA's estimates of nutrients available for land application and on the relative consistency of manure for the main animal types is provided in the Development Document.

B. Beef Subcategory

1. General Industry Characteristics

Cattle feedlots are identified under NAICS 112112 (SIC 0211, beef cattle feedlots) and NAICS 112111, beef cattle ranching and farming (SIC 0212, beef cattle, except feedlots). This sector comprises establishments primarily engaged in feeding cattle and calves for fattening, including beef cattle feedlots and feed yards (except stockyards for transportation).

The beef cattle industry can be divided into four separate producer segments:

- *Feedlot operations* fatten or "finish" feeder cattle prior to slaughter and constitute the final phase of fed cattle production. Calves usually begin the finishing stage after 6 months of age or after reaching at least 400 pounds. Cattle are typically held for 150 to 180 days and weigh between 1,150 to 1,250 pounds (for steers) or 1,050 to 1,150 pounds (for heifers) at slaughter.
- *Veal operations* raise male dairy calves for slaughter. The majority of calves are "special fed" or raised on a low-fiber diet until about 16 to 20 weeks of age, when they weigh about 450 pounds.
- *Stocker or backgrounding operations* coordinate the flow of animals from breeding operations to feedlots by feeding calves after weaning and before they enter a feedlot. Calves are kept between 60 days to 6 months or until they reach a weight of about 400 pounds.
- *Cow-calf producers* typically maintain a herd of mature cows, some replacement heifers, and a few bulls, and breed and raise calves to prepare them for fattening at a feedlot. Calves typically reach maturity on pasture and hay and are usually sold at weaning. Cow-calf operators may also retain the calves and continue to raise them on pasture until they reach 600 to 800 pounds and are ready for the feedlot.

Animal feeding operations in this sector that may be affected by today's proposed regulations include facilities that confine animals. Information on the types of facilities in this sector that may be covered by the proposed regulations is provided in Section VII.

USDA reports that there were more than 106,000 beef feedlots in 1997, with a total inventory of 26.8 million cattle (Table 6.1). Due to ongoing consolidation in the beef sector, the total number of operations has dropped by more than one-half since 1982, when there were 240,000 operations raising fed cattle. EPA also estimates that there were 850 veal operations raising 0.3 million head and 1,250 stand-alone heifer operations raising 0.9 million head in 1997. Only a portion of these operations would be subject to the proposed regulations.

As shown in Table 6–2, under the two-tier structure, EPA estimates that there are 3,080 beef feedlots with more than 500 head (500 AU of beef cattle). EPA also estimates that there are about 90 veal operations and 800 heifer operations that may be subject to the proposed regulations. Under the three-tier structure, EPA estimates that 3,210 beef feedlots, 140 veal and 980 heifer operations with more than 300 head (300 AU) would meet the "risk-based" conditions described in Section VII and thus require a permit.

EPA expects that few operations that confine fewer than 500 AU of beef, veal, or heifers, would be designated by the permit authority. For the purpose of estimating costs, EPA assumes that no beef, veal, or heifer operations would be designated as CAFOs and subject to the proposed regulations under the three-tier structure. Under the two-tier structure, EPA assumes that about four beef feedlots located in the Midwest would be designated annually, or 40 beef feedlots projected over a 10-year period.

The cattle feeding industry is concentrated in the Great Plains and Midwestern states. The majority of feedlots are located in the Midwest. However, the majority of large feedlots (*i.e.*, operations with more than 1,000 head) are located in four Great Plains states—Texas, Kansas, Nebraska, and Colorado—accounting for nearly 80 percent of annual fed cattle marketings. Table 6–1 shows that, although the majority of beef feedlots (over 98 percent) have capacity below 1,000 head, larger feedlots with more than 1,000 head accounted for the majority of animal production. In 1997, feedlots with more than 1,000 head accounted for 85 percent of the nation's fed cattle inventory and sales. Cattle feeding has become increasingly concentrated over the last few decades. Feedlots have decreased in number, but increased in capacity. The decline in the number of operations is mostly among feedlots with less than 1,000 head.

The majority of cattle and calves are sold through private arrangements and spot market agreements. Production contracting is not common in the beef sector. Most beef sector contracts are marketing based where operations agree to sell packers a certain amount of cattle on a predetermined schedule. Production contracts are uncommon, but may be used to specialize in a single stage of livestock production. For example, custom feeding operations provide finish feeding under contract. Backgrounding or stocker operations raise cattle under contract from the time the calves are weaned until they are on a finishing ration in a feedlot. As shown by 1997 USDA data of animal ownership, production contracts account for a relatively small share (4 percent) of beef production. These same data show that production contracts are used to grow replacement breeding stock.

Despite the limited use of contracts for the finishing and raising phase of production, EPA expects that no businesses, other than the CAFO where the animals are raised, will be subject to the proposed co-permitting requirements. Reasons for this assumption are based on data from USDA on the use of production contracts and on animal ownership at operations in this sector. Additional information is provided in Section 2 of the Economic Analysis. EPA is seeking comment on this assumption as part of today's notice.

2. Farm Production and Waste Management Practices

Beef cattle may be kept on unpaved, partly paved, or totally paved lots. The majority of beef feedlots use unpaved open feedlots. In open feedlots, protection from the weather is often limited to a windbreak near the fence in the winter and/or sunshade in the summer; however, treatment facilities for the cattle and the hospital area are usually covered. Confinement feeding barns with concrete floors are also sometimes used at feedlots in cold or high rainfall areas, but account for only 1 to 2 percent of all operations. Smaller beef feedlots with less than 1,000 head, especially in areas with severe winter weather and high rainfall, may use open-front barns, slotted floor housing, or housing with sloped gutters.

Wastes produced from beef operations include manure, bedding, and contaminated runoff. Paved lots generally produce more runoff than unpaved lots. Unroofed confinement areas typically have a system for collecting and confining contaminated runoff. Excessively wet lots result in decreased animal mobility and performance. For this reason, manure is often stacked into mounds for improved drainage and drying, as well as providing dry areas for the animals. If the barn has slotted floors, the manure is collected beneath slotted floors, and is scraped or flushed to the end of the barn where it flows or is pumped to a storage area for later application via irrigation or transported in a tank wagon. Waste may also be collected using flushing systems.

Waste from a beef feedlot may be handled as a solid or liquid. Solid manure storage can range from simply constructed mounds within the pens to large stockpiles. In some areas, beef feedlot operations may use a settling basin to remove bulk solids from the pen runoff, reducing the volume of solids prior to entering a storage pond, therefore increasing storage capacity. A storage pond is typically designed to hold the volume of manure and wastewater accumulated during the storage period, including additional storage volume for normal precipitation, minus evaporation, and storage volume to contain a 25-year, 24-hour storm event. An additional safety volume termed "freeboard" is also typically built into the storage pond design.

Veal are raised almost exclusively in confinement housing, generally using individual stalls or pens. Veal calves are raised on a liquid diet and their manure is highly liquid. Manure is typically removed from housing facilities by scraping or flushing from collection channels and then flushing or pumping into liquid waste storage structures, ponds, or lagoons.

Waste collected from the feedlot may be transported within the site to storage, treatment, and use or disposal areas. Solids and semisolids are typically transported using mechanical conveyance equipment, pushing the waste down alleys, and transporting the waste in solid manure spreaders. Flail-type spreaders, dump trucks, or earth movers may also be used to transport these wastes. Liquids and slurries are transferred through open channels, pipes, or in a portable liquid tank. The most common form of utilization is land application. However, the amount of cropland and pastureland that is available for manure application varies at each operation. Cattle waste may also be used as a bedding for livestock, marketed as compost, or used as an energy source.

Additional information on the types of farm production and waste management practices is provided in the Development Document.

C. Dairy Subcategory

1. General Industry Characteristics

Operations that produce milk are identified under NAICS 11212, dairy cattle and milk production (SIC 0241, dairy farms).

A dairy operation may have several types of animal groups present, including:

- *Calves* (0–5 months);
- *Heifers* (6–24 months);
- *Lactating dairy cows* (*i.e.*, currently producing milk); and;
- *Cows close to calving and dry cows* (*i.e.*, not currently producing milk); and
- *Bulls*.

Animal feeding operations in this sector that may be affected by today's proposed regulations include facilities that confine animals. Information on the types of facilities in this sector that may be covered by the proposed regulations is provided in Section VII.

In 1997, there were 116,900 dairy operations with a year-end inventory of

9.1 million milk cows that produced 156.1 billion pounds of milk (Table 6.1). Only a portion of these operations would be subject to the proposed regulations. As shown in Table 6.2, under the two-tier structure, EPA estimates that there are 3,760 dairy operations that confine more than 350 milk cows (*i.e.*, 500 AU equivalent). Under the three-tier structure, EPA estimates that 6,480 dairy operations with more than 200 head (*i.e.*, 300 AU equivalent) would meet the "risk-based" conditions described in Section VII and thus require a permit.

Table 6–1 shows that dairies with fewer than 200 head account for the majority (95 percent) of milking operations and acconnt for 55 percent of the nation's milk cow herd. EPA expects that under the two-tier structure designation of dairies with fewer than 350 milk cows would be limited to about 22 operations annually, or 220 dairies projected over a 10-year time period. Under the three-tier structure, EPA expects annual designation of dairies with fewer than 200 milk cows would be limited to about 5 operations, or 50 operations over a 10-year period. EPA expects that designated facilities will be located in more traditional farming regions.

More than one-half of all milk produced nationally is concentrated among the top five producing states: California, Wisconsin, New York, Pennsylvania, and Minnesota. Other major producing states include Texas, Michigan, Washington, Idaho, and Ohio. Combined, these ten states acconnted for nearly 70 percent of milk production in 1997. Milk production has been shifting from traditional to nontraditional milk producing states. Operations in the more traditional milk producing regions of the Midwest and Mid-Atlantic tend to be smaller and less industrialized. Milk production at larger operations using newer technologies and production methods is emerging in California, Texas, Arizona, New Mexico, and Idaho. Milk production in these states is among the fastest-growing in the nation, relying on economies of scale and a specialization in milk production to lower per-unit production costs. (Additional data on these trends are provided in Section IV.C).

Over the past few decades, the number of dairy operations and milk cow inventories has dropped, while overall milk production has been increasing. USDA reports that while the number of dairy operations dropped by more than one-half from 277,800 in 1982 to 116,900 in 1997, the amount of milk produced annually at these operations rose from 135.5 billion pounds to 156.1 billion pounds. These figures signal trends toward increased consolidation, large gains in per-cow output, and increases in average herd size per facility. From 1982 to 1997, the average number of dairy cows per facility doubled from 40 cows to 80 cows per facility.

Although milk and dairy food production has become increasingly specialized, it has not experienced vertical integration in the same way as other livestock industries. The use of production contracts is uncommon in milk production. In part, this is attributable to the large role of farmer-owned, farmer-controlled dairy cooperatives, which handle about 80 percent of the milk delivered to plants and dealers. Milk is generally produced under marketing-type contracts through verbal agreement with their buyer or cooperative. Data from USDA indicate that little more than 1 percent of milk was produced under a production contract in 1997. Use of production contracts in the dairy sector is mostly limited to contracts between two animal feeding operations to raise replacement heifers.

Despite the limited use of contracts between operations to raise replacemeut herd, EPA expects that no businesses other than the CAFO where the animals are raised will be subject to the proposed co-permitting requirements. Reasons for this assumption are based on data from USDA on the use of production contracts and on animal ownership at operations in this sector. Additional information is provided in Section 2 of the Economic Analysis. EPA is seeking comment on this assumption as part of today's notice of the proposed rnlemaking.

2. Farm Production and Waste Management Practices

Animals at dairy operations may be confined in free-stalls, drylots, tie-stalls, or loose housiug. Some may be allowed access to exercise yards or open pasture. The holding area confines cows that are ready for milking. Usually, this area is enclosed and is part of the milking center, which in tnrn may be connected to the barn or located in the immediate vicinity of the cow housing. Milking parlors are separate facilities where the cows are milked and are typically cleaned several times each day to remove manure and dirt. Large dairies tend to have automatic flush systems, while smaller dairies simply hose down the area. Larger dairies in the northern states, however, may be more likely to use continuous mechanical scraping of alleys in barns. Cows that are kept in tie-stalls may be milked directly from their stalls.

Waste associated with dairy production inclndes manure, contaminated runoff, milking house waste, bedding, spilled feed and cooling water. Dairies may either scrape or flush manure, depeuding on the solids content in manure and wastewater. Scraping systems utilize mauual, mechanical, or tractor-mounted equipment to collect and transport manure from the production area. Flushing systems use fresh or recycled lagoon water to move manure. Dairy manure as excreted has a solids content of about 12 percent and tends to act as a slurry; however, it can be handled as a semisolid or a solid if bedding is added. Semisolid mannre has a solids content ranging from 10 to 16 percent. Dilution water may be added to the manure to create a slurry with a solids content of 4 to 10 percent. If enough dilution water is added to the manure to reduce the solids content below 4 percent, the waste is considered to be a liquid.

Manure in a solid or semisolid state minimizes the volume of manure that is handled. In a dry system, the manure is collected on a regular basis and covered to prevent exposure to rain and runoff; sources of liquid waste, such as milking center waste, are typically handled separately. In a liquid or slurry system, the manure is typically mixed with flushing system water from lagoons; the milking center efflnent is usually mixed in with the animal manure in the lagoon or in the manure transfer system to ease pumping. Liquid systems are usually favored by large dairies because they have lower labor cost and because the dairies tend to use automatic flushing systems.

Methods used at dairy operations to collect waste include mechanical/tractor scraper, flushing systems, gutter cleaner/gravity gutters, and slotted floors. Manure is typically stored as a slurry or liquid in a waste storage pond or in structural tanks. Milking house waste and contaminated runoff must be stored as liquid in a waste storage pond or structure. One common practice for the treatment of waste at dairies inclndes solids separation. Another common practice for the treatment of liquid waste at dairies includes anaerobic lagoons. The transfer of dairy waste depends on its consistency: liquid and slurry wastes can be transferred through opeu channels, pumps, pipes, or in a portable tank; solid and semi-solid waste can be transferred by mechanical conveyance, solid mannre spreaders, or by being pushed down curbed concrete alleys. The majority of dairy operations dispose of their waste through land application. The amount of crop and pastureland available for land application of manure varies by operation.

Additional information on the types of farm production and waste management practices is provided in the Development Document.

D. Hog Subcategory

1. General Industry Characteristics

Hog operations that raise or feed hogs and pigs either independently or on a contract basis are identified under NAICS 11221, hog and pig farming (SIC 0213, hogs).

Hog operations may be categorized by six facility types based on the life stage of the animal in which they specialize:

- *Farrow-to-wean* operations that breed pigs and ship 10- to 15-pound pigs to nursery operations.
- *Farrowing-nursery* operations that breed pigs and ship 40- to 60-pound "feeder" pigs to growing-finishing operations.
- *Nursery* operations that manage weaned pigs (more than 10 to 15 pounds) and ship 40- to 60-pound "feeder" pigs to growing-finishing operations.
- *Growing-finishing or feeder-to-finish* operations that handle 40- to 60-pound pigs and "finish" these to market weights of about 255 pounds.
- *Farrow-to-finish* operations that handle all stages of production from breeding through finishing.
- *Wean-to-finish* operations that handle all stages of production, except breeding, from weaning (10- to 15-pound pigs) through finishing.

Animal feeding operations in this sector that may be affected by today's proposed regulations include facilities that confine animals. Information on the types of facilities in this sector that may be covered by the proposed regulations is provided in Section VII.

In 1997, USDA reports that there were 117,880 hog operations with 56.7 million market and breeding hogs (Table 6–1). Not all of these operations would be subject to the proposed regulations. As shown in Table 6–2, under the two-tier structure, EPA estimates that there are 5,860 farrow-finish feedlots (including breeder and nursery operations) and 2,690 grower-finish feedlots with more than 1,250 head (*i.e.*, 500 AU equivalent). Under the three-tier structure, EPA estimates that 5,700 farrow-finish feedlots (including breeder and nursery operations) and 2,650 grower-finish feedlots with more than 750 head (*i.e.*, 300 AU equivalent) would meet the "risk-based" conditions described in Section VII and thus require a permit.

Table 6–1 shows that the majority of hog operations (93 percent) have fewer than 1,250 head, accounting for about one-third of overall inventories. Nearly half the inventories are concentrated among the 3 percent of operations with more than 2,500 head. Under the two-tier structure EPA expects that designation of hog operations with fewer than 1,250 head will be limited to about 20 confinement operations annually, or 200 operations over a 10-year time period. Under the three-tier structure, EPA expects that about 5 hog operations with fewer than 750 head would be designated annually, or 50 operations over a 10-year time period. EPA expects that designated facilities will be located in more traditional farming regions.

Hog production is concentrated among the top five producing states, including Iowa, North Carolina, Minnesota, Illinois, and Missouri. Together these states supply 60 percent of annual pork supplies. The majority of operations are located in the Midwest; however, the Southeast has seen rapid growth in hog production in the past decade. Recent growth in this region is due to increased vertical integration, proximity to growing consumer markets, and the mild climate, which offers lower energy costs and improved feed efficiency. (Additional data on these trends are provided in Section IV.C).

The hog sector is undergoing rapid consolidation and becoming increasingly specialized. USDA reports that while the number of hog operations dropped by nearly two-thirds between 1982 and 1997 (from 329,800 to 109,800 operations), the number of feeder pigs sold has risen from 20.0 million to 35.0 million marketed head over the same period. As in other livestock sectors, increasing production from fewer operations is attributable to expansion at remaining operations. Data from USDA indicate that the average number of hogs per facility increased from 170 pigs in 1982 to 560 pigs in 1997. Increasing production is also attributable to substantial gains in production efficiency and more rapid turnover, which has allowed hog farmers to produce as much output with fewer animals.

The hog sector is rapidly evolving from an industry of small, independent firms linked by spot markets to an industry of larger firms that are specialized and vertically coordinated through production contracting. This is particularly true of large-scale hog production in rapidly growing hog production states such as North Carolina. Production contracting is less common in the Midwest where coordination efforts are more diversified.

Information from USDA on animal ownership at U.S. farms provides an indication of the potential degree of processor control in this sector. Data from USDA indicate the use of production contracts accounted for 66 percent of hog production in the Southern and Mid-Atlantic states in 1997, especially among the larger producers. This indicates that a large share of hog production may be under the ownership or control of processing firms that are affiliated with hog operations in this region. This compares to the Midwest, where production contracting accounted for 18 percent of hog production. Production contracting in the hog sector differs from that in the beef and dairy sectors since it is becoming increasingly focused on the finishing stage of production, with the farmer ("grower") entering into an agreement with a meat packing or processing firm ("integrator"). Production contracts are also used between two independent animal feeding operations to raise immature hogs.

Businesses that contract out the growing or finishing phase of production to an AFO may also be affected by the proposed co-permitting requirements. Affected businesses may include other animal feeding operations as well as processing sector firms. By NAICS code, meat packing plants are classified as NAICS 311611, animal slaughtering (SIC 2011, meat packing plants). The Department of Commerce reports that there were a total of 1,393 red meat slaughtering facilities that slaughter hogs as well as other animals, including cattle and calves, sheep, and lamb. Of these, Department of Commerce's 1997 product class specialization identifies 83 establishments that process fresh and frozen pork and 11 establishments that process or cure pork. These data generally account for larger processing facilities that have more than 20 employees. EPA believes that processing firms that may be affected by the proposed co-permitting requirements will mostly be larger facilities that have the administrative and production capacity to take advantage of various contract mechanisms. This assumption is supported by information from USDA that indicates that production contracts in the hog sector are generally associated with the largest producers and processors. Section 2 of the Economic Analysis provides additional information on the basis for EPA's estimate of potential co-permittees. EPA is seeking comment on this assumption as part of today's notice of the proposed rulemaking.

Using these Department of Commerce data, EPA estimates that 94 companies engaged in pork processing may be subject to the proposed co-permitting requirements. This estimate does not include other processors under NAICS 311611, including sausage makers and facilities that "further process" hog hides and other by-products because these operations are considered to be further up the marketing chain and likely do not contract out to CAFOs.

2. Farm Production and Waste Management Practices

Many operations continue to have the traditional full range of pork production phases at one facility, known as farrow-to-finish operations. More frequently at new facilities, operations are specialized and linked into a chain of production and marketing. The evolution in farm structures has resulted in three distinct production systems to create pork products: (1) farrow-to-finish; (2) farrowing, nursery, and grow-finish operations; and (3) farrow-to-wean and wean-finish operations. Most nursery and farrowing operations, as well as practically all large operations of any type, raise pigs in pens or stalls in environmentally controlled confinement housing. These houses commonly use slatted floors to separate manure and wastes from the animal. Open buildings with or without outside access are relatively uncommon at large operations, but can be used in all phases of pork production. Smaller operations, particularly in the Midwest, may utilize open lots or pasture to raise pigs.

Hog waste includes manure and contaminated runoff. Most confinement hog operations use one of three waste handling systems: flush under slats, pit recharge, or deep underhouse pits. Flush housing uses fresh water or recycled lagoon water to remove manure from sloped floor gutters or shallow pits. The flushed manure is stored in lagoons or tanks along with any precipitation or runoff that may come into contact with the manure. Flushing occurs several times a day. Pit recharge systems are shallow pits under slatted floors with 6 to 8 inches of pre-charge water. The liquid manure is pumped or gravity fed to a lagoon approximately once a week. Deep pit systems start with several inches of water, and the manure is stored under the house until it is pumped out for field application on the order of twice a year. Most large operations have 90 to 365 days storage. The deep pit system uses less water, creating a slurry that has higher nutrient concentrations than the liquid manure systems. Slurry systems are more common in the Midwest and the cooler climates.

Dry manure handling systems include those used at open buildings and lots, scraped lots, hoop houses, deep bedded systems, and high rise hog houses. These systems produce a more solid manure material that is readily handled with a tractor or front end loader. The solids are stored in stacks or covered until used as fertilizer. In some cases, solids are composted.

Storage lagoons are used to provide anaerobic bacterial decomposition of organic materials. When only the top liquid is removed for irrigation or some other use, a limited amount of phosphorus-rich sludge accumulates in the lagoon, which requires periodic removal. Vigorous lagoon mixing with an agitator or a chopper prior to irrigation is sometimes done to minimize the sludge accumulation. In certain climates, a settling and evaporation pond is used to remove solids, which are dried in a separate storage area. Some lagoons and tanks are covered with a synthetic material that reduces ammonia volatilization. Covers also prevent rainfall from entering the system and, therefore, reduce disposal costs.

Land application is the most common form of utilization. To mitigate odor problems and volatization of ammonia, liquid waste can be injected below the soil surface. Waste may also be distributed through an irrigation process. Waste management systems for hogs often incorporate odor control measures, where possible.

Additional information on the types of farm production and waste management practices is provided in the Development Document.

E. Poultry Subcategory

1. General Industry Characteristics

Poultry operations can be classified into three individual sectors based on the type of commodity in which they specialize. These sectors include operations that breed and/or raise:

- *Broilers* or young meat chickens that are raised to a live weight of 4 to 4.5 pounds and other meat-type chickens, including roasters that are raised to 8 to 9 pounds. Classification: NAICS 11232, broilers and other meat-type chickens (SIC 0251, broiler, fryer and roaster chickens).
- *Turkeys and turkey hens,* including whole turkey hens that range from 8 to 15 pounds at slaughter, depending on market, and also turkey "canners and cut-ups" that range from 22 to 40 pounds. Classification: NAICS 11233, turkey production (SIC 0253, turkey and turkey eggs).
- *Hens that lay shell eggs,* including eggs that are sold for human consumption and eggs that are produced for hatching purposes. Classification: NAICS 11231, Chicken egg production (SIC 0252, chicken eggs) and NAICS 11234, poultry hatcheries (SIC 0254, poultry hatcheries).

Animal feeding operations in this sector that may be affected by today's proposed regulations include facilities that confine animals. Information on the types of facilities in this sector that may be covered by the proposed regulations is provided in Section VII.

In 1997, the USDA reports that there were 34,860 broiler operations that raised a total of 1.9 billion broilers during the year. There were also 13,720 turkey operations raising a total 112.8 million turkeys. Operations with egg layers and pullets totaled 75,170 with an average annual inventory of 393 million egg layers on-site. (See Table 6–1). Not all of these operations would be subject to the proposed regulations.

Under the two-tier structure, EPA estimates that there are 9,780 broiler operations, 1,280 turkey operations and 1,640 egg laying and pullet operations that have more than 500 AU (i.e., operations with more than 50,000 chickens and more than 27,500 turkeys). Under the three-tier structure, EPA estimates that 13,740 broiler operations, 2,060 turkey operations and 2,010 egg laying operations with more than 300 AU (i.e., operations with more than 30,000 chickens and more than 16,500 turkeys) would meet the "risk-based" conditions described in Section VII and thus require a permit.

EPA expects few, if any, poultry AFOs with fewer than 500 AU will be subject to the revised requirements. As shown in Table 6–1, most poultry operations have fewer than 500 AU. Under the two-tier structure, EPA expects that designation of broiler operations with fewer than 50,000 chickens will be limited to two broiler and two egg operations being designated annually, or a total of 40 poultry operations over a 10-year period. EPA expects that no turkey operations would be designated as CAFOs and subject to the proposed regulations. EPA expects that no confinement poultry operations will be designated as CAFOs under the proposed requirements under the three-tier structure.

Overall, most poultry production is concentrated in the Southeast and in key Midwestern states. As in the pork sector, the Southeast offers advantages such as lower labor, land, and energy costs; proximity to end markets; and milder weather, which contributes to greater feed efficiency. Nearly 60 percent of all broiler production is concentrated among the top five producing states, including Georgia, Arkansas, Alabama, Mississippi, and North Carolina. The top five turkey producing states also account for about 60 percent of all turkeys sold commercially. These include North Carolina, Minnesota, Virginia, Arkansas, and California. Missouri and Texas are also major broiler and turkey producing states. The top five states for egg production account for more than 40 percent of all egg production, including Ohio, California, Pennsylvania, Indiana, and Iowa. Other major egg producing states include Georgia, Texas, Arkansas, and North Carolina.

The number of operations in each of the poultry sectors has been declining while production has continued to rise. USDA reports that while the number of both turkey and broiler operations decreased by about 10,000 operations between 1982 and 1997, the number of animals sold for slaughter rose nearly twofold: the number of broilers sold rose from 3.5 billion to 6.7 billion and the number of turkeys sold rose from 167.5 million to 299.5 million. During the same period, the number of egg operations dropped nearly two-thirds (from 215,800 operations in 1982), while the number of eggs produced annually has increased from 5.8 billion dozen to 6.2 billion dozen. Increased production from fewer operations is due to expanded production from the remaining operations. This is attributable to increases in the average number of animals raised at these operations as well as substantial gains in production efficiency and more rapid turnover, which has allowed operators to produce more with fewer animals. Data from USDA indicate that average inventory size on poultry operations increased twofold on broiler operations and rose threefold at layer and turkey operations between 1982 and 1997. (Additional data on these trends are provided in Section IV.C). As in other sectors, larger operations control most animal inventories and sales.

The poultry industry is characterized by increasing integration and coordination between the animal production facility and the processing sector. Vertical integration has progressed to the point where large multifunction producer-packer-processor-distributor firms are the dominant force in poultry meat and egg production and marketing. Coordination through production contracting now dominates the poultry industry. Today's integrators are subsidiaries of feed companies, independent processors, cooperatives, meat packers, or retailers, or affiliates of conglomerate corporations. These firms may own and/or direct the entire process from the production of hatching eggs to the merchandising of ready-to-eat-sized poultry portions to restaurants.

Production contracting in the poultry sector differs from that in the other livestock sectors since it is dominated by near vertical integration between a farmer ("grower") and a processing firm ("integrator"). Information from USDA on animal ownership at U.S. farms provides an indication of the potential degree of processor control in this sector. Data from USDA indicate production contracting accounted for virtually all (98 percent) of U.S. broiler production in 1997. This indicates that nearly all broiler production may be under the ownership or control of processing firms that are affiliated with broiler operations. Production contracting accounts for a relatively smaller share of turkey and egg production, accounting for 70 percent and 37 percent, respectively.

Businesses that contract out the growing or finishing phase of production to an AFO may also be affected by the proposed co-permitting requirements. Affected businesses may include other animal feeding operations as well as processing sector firms. Poultry processing facilities are classified under NAICS 311615, poultry processing, and NAICS 311999, all other miscellaneous (SIC 2015, poultry slaughtering facilities). The Department of Commerce reports that there were a total of 558 poultry and egg slaughtering and processing facilities in 1997. Of these, Department of Commerce's 1997 product class specialization for poultry identifies 212 establishments that process young chickens, 15 that process hens or fowl, and 39 that process turkeys (rounded to the nearest ten). These data generally account for larger processing facilities that have more than 20 employees. EPA believes that processing firms that may be affected by the proposed co-permitting requirements will mostly be larger facilities that have the administrative and production capacity to take advantage of various contract mechanisms. Section 2 of the Economic Analysis provides additional information on the basis for EPA's estimate of potential co-permittees. EPA is seeking comment on this assumption as part of today's notice of the proposed rulemaking.

Using these Department of Commerce data, EPA estimates that about 270 companies engaged in poultry slaughtering may be subject to the proposed co-permitting requirements. This estimate does not include egg processors under NAICS 311999 because these operations are considered to be further up the marketing chain and likely do not contract out to CAFOs.

2. Farm Production and Waste Management Practices

There are two types of basic poultry confinement facilities—those that are used to raise turkeys and broilers for meat and those that are used to house layers. Broilers and young turkeys are grown on floors on beds of litter shavings, sawdust, or peanut hulls; layers are confined to cages. Broilers are reared in houses where an absorbent bedding material such as wood shavings or peanut hulls are placed on the floor at a depth of several inches. Breeder houses contain additional rows of slats for birds to roost. Broilers may also be provided supplementary heat during the early phases of growth. Turkeys as well as some pullets and layers are produced in a similar fashion. Pullets or chickens that are not yet of egg laying age are raised in houses on litter, or in cages. Most commercial layer facilities employ cages to house the birds, although smaller laying facilities and facilities dedicated to specialty eggs such as brown eggs or free range eggs may use pastures or houses with bedded floors. Layer cages are suspended over a bottom story in a high-rise house, or over a belt or scrape gutter. The gutter may be a shallow sloped pit, in which case water is used to flush the wastes to a lagoon. Flush systems are more likely to be found at smaller facilities in the South.

Poultry waste includes manure, poultry mortalities, littar, spilt water, waste feed, egg wash water, and also flush water at operations with liquid manure systems. Manure from broiler, breeder, some pullet operations, and turkey operations is allowed to accumulate on the floor where it is mixed with the litter. In the chicken houses, litter close to drinking water access forms a cake that is removed between flocks. The rest of the litter pack generally has low moisture content and is removed every 6 months to 2 years, or between flocks to prevent disease. This whole house clean-out may also require storage, depending on the time of year it occurs. The litter is stored in temporary field stacks, in covered piles, or in stacks within a roofed facility to help keep it dry. Commonly, treatment of broiler and turkey litter includes composting which stabilizes the litter into a relatively odorless material and which increases the market value of the litter. Proper composting raises the temperature within the litter such that pathogens are reduced, allowing reuse of the litter in the poultry house.

The majority of egg laying operations also use dry manure handling. Laying hens are kept in cages and the manure drops below the cages in both dry and liquid manure handling systems. Most of the dry manure laying operations are constrncted as high rise houses where the birds are kept on the second floor and the manure drops to the first floor sometimes referred to as the pit. Ventilation flows through the house from the roof down over the hirds and into the pit over the manure before it is forced out through the sides of the honse. The ventilation drys the manure as it piles up into cones. Mauure can be stored in high rise houses for up to a year before requiring removal. In dry layer houses with belts, the manure that drops below the cage collocts on belts and is transported to a separate covered storage area. Layer houses with liquid systems use either a shallow pit or alleyway located beneath tbe cages for flushing. Flnshed wastes are pumped to a lagoon.

Because of the large number of routine mortalities associated with large poultry operations, the disposal of dead birds is occasionally a resource concern. Poultry facilities must have adequate means for disposal of dead birds in a sanitary manner. To prevent the spread of disease, dead birds are usually collected daily. Disposal alternatives inclnde incineration, rendering, composting, and in-ground burial or burial in disposal tanks. Much of the waste from poultry facilities is land applied.

Additional informatioo on the types of farm production and waste management practices is provided in the Development Document.

VII. What Changes to the NPDES CAFO Regulations Are Being Proposed?

A. Summary of Proposed NPDES Regulations

EPA is co-proposing, for public comment, two alternative ways to structnre the NPDES regulation for defining which AFOs are CAFOs. Both structures represent significant improvements to the existing regulation and offer increased environmental protection. The first alternative proposal is a "two-tier structure," and the second is a "three-tier structure." Owners or operators of all facilities that are defined as CAFOs in today's proposal, under either alternative, would be required to apply for an NPDES permit.

In the first co-proposed alternative, EPA is proposing to replace the current three-tier structure in 40 CFR 122.23 with a two-tier structure. See proposed § 122.23(a)(3) for the two-tier structure, included at the end of this preamble. All AFOs with 500 or more animal units would be defined as CAFOs, and those with fewer than 500 animal units would be CAFOs ouly if they are designated as such by EPA or the State NPDES permit authority.

In the second co-proposed alternative, EPA is proposing to retain the current three-tier structure. All AFOs with 1,000 or more animal nnits would be defined as CAFOs, and those with less than 300 animals units would be CAFOs only if they are designated by EPA or the State NPDES permit authority. Those with 300 to 1,000 animal units would be CAFOs if they meet one or more of several specific conditions, and today's proposal would revise the existing conditions. These facilities could also he designated as CAFOs if they are found to be significant contributors of pollutants to waters of the United States. Further, all AFOs between 300 and 1,000 animal units would be required to certify to tho permit authority that they do not meet any of the conditions. Those facilities unable to certify would be required to apply for a permit.

These regulatory alternatives are two of six different approaches that the Agency considered. Two of the approaches are also heing seriously considered, but are not being proposed in today's action because they have not been fully analyzed. However, EPA is soliciting public comment on these two alternatives. One of the alternatives is a two-tier structure, similar to what is being proposed today, bnt would establish a threshold at the equivalent of 750 AU. The other alternative under consideration is a three-tier structnre, with different certification and permitting requirements for facilities in the 300 AU to 1,000 AU tier. These alternatives are described in more detail in Section VII.B.5. After reviewing pnblic comment, EPA may decide to pursue either of these alternatives.

In addition, EPA considered two other alternative approaches that are uot being proposed. One would retaio the existing three-tier structure for determining which AFOs are CAFOs, and would retain the existing conditions for determining which of the middle tier facilities are CAFOs while incorporating all other proposed changes to the CAFO regulations (e.g., the definition of CAFO, the duty to apply, etc.). The sixth approach that was not proposed which is similar to today's second alternative proposal, would retain the three-tiered structure and would revise the conditions for determining which of the middle tier facilities are CAFOs in tbe same manner as today's proposal. In contrast with today's proposal, it would not require all AFOs in the middle tier to certify they are not CAFOs.

EPA is soliciting comment on all six scenarios for structuring how to determine which facilities are CAFOs.

TABLE 7–1.—PROPOSED REVISION TO THE STRUCTURE OF THE CAFO REGULATION

Proposed revision	Section
Historical Record	B.1
Two-Tier Structure	B.2
Three-Tier Structure	B.3
Comparative Analysis	B.4
Alternative Scenarios Considered but not Proposed	B.5

Besides changing the structure of the regulation, under both of today's proposals, EPA is also proposing changes to clarify, simplify, and strengthen the NPDES regulation, including to: clarify the definition of an AFO; discontinue the use of the term "auimal unit" and eliminate the mixed animal type multiplier wben calculating numbers of auimals; eliminate the 25-year, 24-hour storm permit exemption; and impose a clearer and more broad duty to apply for a permit on all operatious defined or designated as a CAFO.

EPA is also proposing several changes that determine whether a facility is an AFO or whether it is a CAFO and therefore must apply for an NPDES permit on that basis. Specifically, EPA is proposing to formally define a CAFO to: include both the animal production area and the land application area; broaden coverage in the poultry sector to include all chicken operations, both wet and dry; add coverage for stand-alone immature swine and heifer operations; lower the NPDES threshold that defines which facilities are CAFOs for other animal sectors, including horses, sheep, lambs and ducks; and require facilities that are no longer active CAFOs to remain permitted until their manure and storage facilities are properly closed and they have no potential to discharge CAFO manure or wastewater. This section also discusses the concept of "direct hydrologic connection" between ground water and surface water and its application to CAFOs. Considerations for providing regulatory relief to small businesses are also discussed.

EPA is also proposing changes that clarify the scope of NPDES regulation of CAFO manure and process wastewater. Today's proposal modifies the criteria for designation of AFOs as CAFOs on a case-by-case basis and explicitly describes EPA's authority to designate facilities as CAFOs in States with approved NPDES programs. EPA is also proposing that the permit authority must require entities that have "substantial operational control" over a CAFO to be co-permitted, and is requesting comment on an option for States to waive this requirement if they provide another means of ensuring that excess manure transported from CAFOs to off-site recipients is properly land applied. EPA also is clarifying Clean Water Act requirements concerning point source discharges at non-CAFOs.

These changes are summarized in Table 7–2 and described in the noted sections.

TABLE 7–2.—PROPOSED REVISIONS FOR DEFINING CAFOS OTHER POINT SOURCES

Proposed revision	Section
Clarify the vegetation language in the definition of an AFO	C.1
Discontinue use of the term animal unit	C.2.a
Eliminate the mixed animal type multiplier	C.2.b
Remove the 25-year, 24-hour storm event exemption from the definition of a CAFO	C.2.c
Clarify the duty to apply, that all CAFOs must apply for an NPDES permit	C.2.d
Definition of a CAFO includes both production area and land application area	C.2.e
Include dry poultry operations	C.2.f
Include stand-alone immature swine and heifer operations	C.2 g
Coverage of other sectors besides beef, dairy, swine and poultry	C.2.h
Require facilities that are no longer CAFOs to remain permitted until proper closure	C.2.i
Applicability of direct hydrological connection to surface water	C.2.j
Regulatory relief for small businesses	C.2.k
Designation criteria	C.3
Designation of CAFOs by EPA in States with NPDES authorized programs	C.4
Co-permitting of entities that exert substantial operational control over a CAFO	C.5
Point source discharges at AFOs that are not CAFOs	C 6

We also extensively discuss matters associated with the land application of CAFO-generated manure and wastewater, including how the agricultural storm water exemption applies to the application of CAFO-generated manure both on land under the control of the CAFO operator and off-site. EPA is proposing to require CAFO owners or operators to land apply manure in accordance with proper agricultural practices, as defined in today's regulation. EPA is also co-proposing two different means of addressing the off-site transfer of CAFO-generated manure. In one proposal, CAFO owners or operators would be allowed to transfer manure off-site only to recipients who certify to land apply according to proper agricultural practices; to maintain records of all off-site transfers; and to provide adequate information to off-site manure recipients to facilitate proper application. Alternately, the certification would not be required, and CAFOs owners or operators would simply be required to maintain records and provide the required information to recipients. See Table 7–3 for references.

TABLE 7–3.—LAND APPLICATION OF CAFO-GENERATED MANURE AND WASTEWATER

Proposed revision	Section
Why is EPA Regulating Land Application of CAFO Waste?	D.1
How is EPA Interpreting the Agricultural Storm Water Exemption with Respect to Land Application of CAFO-generated Manure?	D.2
How is EPA Proposing to Regulate Discharges from Land Application of CAFO-generated Manure by CAFOs?	D.3
How is EPA Proposing to Regulate Land Application of Manure and Wastewater by non-CAFOs?	D.3

EPA is proposing several revisions to requirements contained in CAFO permits. The requirement that CAFO owners or operators develop and implement a "Permit Nutrient Plan," or "PNP," is discussed extensively, including clarifying that a PNP is the EPA-enforceable subset of a Comprehensive Nutrient Management Plan, or "CNMP."

EPA is also proposing to apply revised Effluent Limitation Guidelines and standards (and hereafter referred to as effluent guidelines or ELG) to beef, dairy, swine, poultry and veal operations that are CAFOs by definition in either of the two proposed structures, or that have 300 AU to 1,000 AU in the three-tier structure and are designated. NPDES permits issued to small operations that are CAFOs by designation (those with fewer than 500 AU in the two tier structure, and those with fewer than 300 AU in the three tier structure) would continue to be based on Best Professional Judgment (BPJ) of the permit authority. Similarly, CAFOs in other sectors (i.e., horse, sheep, lambs, and ducks) that have greater than 1,000 AU will continue to be subject to the existing effluent guidelines and standards (as they are in the existing regulation), while those with 1,000 AU or fewer would be issued permits based on BPJ, as today's proposed effluent guidelines does not include revisions to sectors other than beef, dairy, swine, poultry and veal.

Today's NPDES proposal includes monitoring, reporting and record keeping requirements that are consistent with those required by today's proposed effluent guidelines (discussed in section VIII). In addition, EPA is proposing to require all individual permit applicants, as well as new facilities applying for coverage under general NPDES permits, to submit a copy of the cover sheed and Executive Summary of their draft Permit Nutrient Plan (PNP) to the permit authority along with the permit application or Notice of Intent (NOI). EPA is proposing to require all CAFOs to submit a notification to the permit authority, within three months of obtaining permit coverage, that their Permit Nutrient Plans (PNPs) have been developed, along with a fact sheet summarizing the PNP. Further, EPA is proposing to require permittees to submit a notification to the permit authority whenever the PNP has been modified.

EPA is also proposing to require that the permit authority include certain conditions in its general and individual permits that specify: (1) Requirements for land application of manure and wastewater, including methods for developing the allowable manure application rate; (2) restrictions on timing of land application if determined to be necessary, including restrictions with regard to frozen, saturated or snow covered ground; (3) requirements for the facility to be permitted until manure storage facilities are properly closed and therefore the facility has no potential to discharge; (4) conditions for facilities in certain types of topographical regions to prevent discharges to ground water with a direct hydrological connection to surface water; and (5) under one co-proposed option, requirements that the CAFO owner or operator obtain a signed certification from off-site recipients of more than twelve tons annually, that manure will be land applied according to proper agricultural practices (co-proposed with omitting snch a requirement). Comments are also requested on whether EPA should include erosion controls in the NPDES permit, and whether EPA should establish an additional design standard that would address chronic rainfall. Table 7–4 summarizes the proposed revisions that address minimum permit conditions, as well as issues for which comment are being sought.

TABLE 7–4.—PROPOSED REVISIONS FOR PERMIT REQUIREMENTS

Proposed revision	Section
Permit Nutrient Plan	E.1
Effluent Limitations	E.2
Monitoring and reporting	E.3
Record keeping	E.4
Special Conditions and Standard Conditions	E 5
Determining allowable manure application rate	E.5.a
Timing of land application of manure	E.5.b
Maintaining permit until proper closure	E.5.c
Discharge to ground water with a direct hydrological connection to surface water	E.5.d
Obtain certification from off-site recipients of manure of appropriate land application	E.5.e
Erosion control	E.5.f
Solicitation of comment on defining chronic rainfall	E.5.g

Finally, EPA is proposing to amend certain aspects of the general and individual permit process to improve public access and public involvement in permitting CAFOs. While the NPDES regulations already provide a process for public involvement in issuing individual NPDES permits, today EPA is proposing to require the permit authority to issue quarterly public notices of all Notices of Intent (NOIs) received for coverage under general NPDES permits for CAFOs, as well as of notices from CAFOs that their Permit Nutrient Plans have been developed or amended. Today's proposal discusses public availability of NOIs, Permit Nutrient Plans and PNP notifications. EPA is proposing several new criteria for which CAFOs may be ineligible for general permits, and would require the permit authority to conduct a public process for determining, in light of those criteria, when individual permits would be required.

Owners or operators of all facilities that are defined as CAFOs in today's proposed regulation would be required to apply for an NPDES permit. However, EPA also is proposing that they may, iostead, seek to obtain from the permit authority a determination of "no potential to discharge" in lieu of submitting a permit application. (EPA notes that, because of the stringency of demonstrating that a facility has no potential to discharge, EPA expects that few facilities will receive such determinations.) Finally, EPA is proposing to ameud the CAFO individual permit application requirements and corresponding Form 2B. See Table 7–5.

TABLE 7–5.—PROPOSED REVISIONS TO PERMIT PROCESS

Proposed ravision	Section
General Permit and NOI provisions	F.1
Individual permits	F.2
Requests not to have a permit issued by demonstrating "no potential to discharge"	F.3
Amendments to NPDES Permit Application For CAFOs Form 2B	F.4

B. What Size AFOs Would be Considered CAFOs?

EPA is proposing two alternative structures for establishing which AFOs would be regulated as CAFOs. Each proposal reflects the Agency's efforts to balance the goals of ease of implementation and effectively addressing the sources of water quality impairments. The two-tier structure is designed to give both regulators and animal feeding facility operators a clear, straightforward means of determining whether or not an NPDES permit is reqnired for a facility. On the other hand, the three-tier structure, whiln less straightforward in determining which facilities are required to have NPDES permits, may allow the permit authority to focus its permitting resources on facilities which are more likely to be significant sources of water quality impairments. The Agency believes both the two-tier and three-tier approaches are reasonable and is requesting comment on how best to strike a balance between simplicity and flexibility while achieving the goals of the Clean Water Act. EPA may decide to choose either or both alternatives in the final rule, and requests comments on both. EPA is also requesting comment on a variation of the two-tier structure and a variation of the three-tier structure and, after considering public comment, may decide to pursue either or both of these variations for the final rule.

EPA is not proposing to define animal types on the basis of age, size or species in order to avoid complicating the implementation of this proposal. Throughout today's preamble, each of the subcategories, under today's proposed effluent guidelines, is described as follows:

• "Cattle, excluding mature dairy or veal" (referred in today's preamble as the beef sector) includes any age animal confined at a beef operation, including heifers when confined apart from the dairy. This subcategory also includes stand-alone heifer operations, also referred to as heifer operations.

• "Mature dairy cattle" (referred in today's preamble as the dairy sector) indicates that only the mature cows, whether milking or dry, are counted to identify whether the dairy is a CAFO.

• "Veal" is distinguished by the type of operation. Veal cattle are confined and manure is managed differently than beef cattle. EPA is not proposing to define veal by size or age. Note that the current regulation includes veal under the beef subcategory, but in today's proposal a new veal subcategory would be established.

• "Swine weighing over 25 kilograms or 55 pounds" also indicates that only mature swine are counted to determine whether the facility is a CAFO. Once defined as a CAFO, all animals in confinement at the facility wonld be subject to the proposed requirements.

• "Immature Swine weighing less than 25 kilograms or 25 pounds" indicates that immature swine are counted only when confined at a stand-aloce nursery. Today's preamble uses the terms "swine sector" to indicate both mature and immature swiue, but permit provisions are separately applied to them.

• "Chicken" and "Turkeys" are listed as separate subcategories and are counted separately iu order to determine whether the facility is a CAFO. However, they are subject to the same effluent limitations, and are collectively referred to as the "poultry sector."

• "Ducks," "Horses," and "Sheep or Lambs" are separate subcategories under the existiug NPDES aud effluent limitation regulations. Part 412 effluent limitations are not being revised in today's proposal; however, some of the proposed revisions to the NPDES program will affect these subcategories.

1. Historical Record

In 1973, when EPA proposed regulations for CAFOs, the Agency determined the thresholds above which AFOs would be subject to NPDES permitting requirements "on the basis of information and statistics received, pollution potential, and administrative manageability." 38 FR 10961, 10961 (May 3, 1973). In 1975, the Agency, after litigation, again proposed regulations for CAFOs which established a threshold nnmber of animals above which an AFO would be determined to be a CAFO. 40 FR 54182 (Nov. 20, 1975). The Agency noted that it might be possible to establish a precise regulatory formula to determine which AFOs are CAFO point sources based on factors such as the proximity of the operation to surface waters, the numbers and types of animals confiued, the slope of the land, and other factors relative to the likelihood or frequency of discharge of pollutants into navigable waters. 40 FR at 54183.

The Agency decided, however, that even if such a formula could be constructed, it would be so complex that both permitting authorities and feedlot operators would find it difficult to apply. Then, as now, EPA concluded that the clearest and most efficient means of regulating concentrated animal feeding operations was to establish a definitive threshold number of confined animals above which a facility is defined as a CAFO, below which a permitting authority could designate a facility as a CAFO, after consideration of the various relevant factors. The threshold numbers initially established by the Ageucy were based generally on a statement by Senator Muskie when the Clean Water Act was enacted. Senator Muskie, floor manager of the legislation, stated that: "Guidance with respect to the identification of 'point sources' and 'nonpoint sources,' especially with respect to agriculture, will be provided in regulations and guidelines of the Administrator." 2 Legislative History of the Water Pollution Control Act Amendments of 1972 at 1299, 93d Cong, 1st Sess. (Jannary 1973). Senator Muskie then identified the existing policy with respect to identification of agricultural point sources was generally that "runoff from confined livestock and poultry operations are not considered a 'point source' unless the following concentrations of animals are exceeded: 1000 beef cattle; 700 dairy cows; 290,000 broiler chickens; 180,000 laying hens; 55,000 turkeys; 4,500 slaughter hogs; 35,000 feeder pigs; 12,000 sheep or lambs; 145,000 ducks." *Id.* In the final rule, the Agency and commenters agreed thet while Senator Muskie's statement provided useful general guidance, particularly in support of the idea of defining CAFOs based ou specified numbers of animals present, it was not a definitive statement of the criteria for defining a CAFO. 41 FR 11458 (Mar. 18, 1976). The Ageucy, thus, looked to data with respect to both the amouut of manure generated by facilities above the threshold and the number of facilities captured by the regulation.

EPA has again looked to those factors and, with 25 years of regulatory experience, focused particularly on the amount of manure captured by the threshold, ease of implementation for both regulators and the regulated community, as well as on metters of administrative convenieuce and manageability of the permitting program. Based on these considerations, EPA is proposing two alternative structures. EPA notes that the NPDES threshold is generally synchronized with the effluent guidelines applicability threshold, and information on the cost per pound of pollutants removed, and affordability of the various options is available in Section X.

2. Two-Tier Structure

The first alternative that EPA is proposing is a two-tier structure that establishes which operations are defined as CAFOs based on size alone. See proposed § 122.23(a)(3). In this alternative, EPA is proposing that the threshold for defining operations as CAFOs be equivalent to 500 animal units (AU). All operations with 500 or more animal units would be defined as CAFOs (§ 122.23(a)(3)(i)). Operations with fewer than 500 animal units would be CAFOs only if designated by EPA or the State permit authority (§ 122.23(a)(3)(ii)). Table 7–6 describes the number of animals that are equivalent to the proposed 500 AU threshold, as well as three other two-tier thresholds that are discussed in this section.

The proposed two-tier structure would eliminate the 300 AU to 1,000 AU tier of the existing regulation, under which facilities were either defined as a CAFO if they met certain conditions or were subject to designation on a case-by-case basis by the permit authority according to the criteria in the regulations. EPA is proposing to eliminate this middle category primarily because it has resulted in general confusion about which facilities should be covered by an NPDES permit, which, in turn, has led to few facilities being permitted under the existing regulation. The two-tier structure offers simplicity and clarity for the regulated community and enforcement authorities for knowing when a facility is a CAFO and when it is not, thereby improving both compliance and enforcement.

TABLE 7–6.—NUMBER OF ANIMALS COVERED BY ALTERNATIVE TWO-TIER APPROACHES

Animal type	Number of animals equivalent to:			
	300 AU	500 AU	750 AU	1,000 AU
Cattle and Heifers	300	500	750	1,000
Veal	300	500	750	1,000
Mature Dairy Cattle	200	350	525	700
Swine weighing over 25 kilograms—or 55 pounds	750	1,250	1,875	2,500
Immature Swine weighing less than 25 kilograms, or 55 pounds	3,000	5,000	7,500	10,000
Chickens	30,000	50,000	75,000	100,000
Turkeys	16,500	27,500	41,250	55,000
Ducks	1,500	2,500	3,750	5,000
Horses	150	250	375	500
Sheep or Lambs	3,000	5,000	7,500	10,000

Operations with fewer animals than the number listed for the selected threshold in Table 7–6 would only become CAFOs through case-by-case designation.

In order to determine the appropriate threshold for this two-tier approach, EPA analyzed information on numbers of operations, including percent of manure generated, potential to reduce nutrient loadings, and administrative burden. EPA considered current industry trends and production practices, including the trend toward fewer numbers of AFOs, and toward larger facilities that tend to be more specialized and industrialized in practice, as compared to more traditional agricultural operations. EPA also considered other thresholds, including 300 AU, 750 AU, or retaining the existing 1,000 AU threshold. After considering each of these alternatives, EPA is proposing 500 AU as the appropriate threshold for a two-tier structure, but is also requesting comment on a threshold of 750 AU.

EPA is proposing 500 AU as the appropriate threshold for a two-tier structure because it regulates larger operations and exempts more traditional—and oftentimes more sustainable—farm production systems where farm operators grow both livestock and crops and land apply manure nutrients. Consistent with the objectives under the USDA–EPA Unified National Strategy for Animal Feeding Operations (March 9, 1999), the proposed regulations cover more of the largest operations since these pose the greatest potential risk to water quality and public health, given the sheer volume of manure generated at these operations. Larger operations that handle larger herds or flocks often do not have an adequate land base for manure disposal through land application. As a result, large facilities need to store large volumes of manure and wastewater, which have the potential, if not properly handled, to cause significant water quality impacts. By comparison, smaller farms manage fewer animals and tend to concentrate less manure nutrients at a single farming location. Smaller farms tend to be less specialized and are more diversified, engaging in both animal and crop production. These farms often have sufficient cropland and fertilizer needs to appropriately land apply manure nutrients generated at a farm's livestock or poultry business. More information on the characteristics of larger-scale animal production practices is provided in sections IV and VI of this document, as well as noted in the analysis of impacts to small businesses (section X.I).

EPA is proposing the 500 AU threshold because operations of this size account for the majority of all manure and manure nutrients produced annually. The proposed two-tier structure would cover an estimated 25,540 animal production operations, or approximately seven percent of all operations, which account for 64 percent of all AFO manure generated annually. The USDA–EPA Unified National Strategy had a goal of regulating roughly five percent of all operations.

EPA is specifically seeking comment on an alternative threshold of 750 AU, which would encompass five percent of AFOs. There are an estimated 19,100 operations with 750 AU or more (13,000 of which have more than 1,000 AU), and account for 58 percent of all manure and manure nutrients produced annually by AFOs. Regulating five percent of AFOs may be viewed by some as being consistent with the USDA–EPA Unified National Strategy.

A 750 AU threshold has the benefits cited for the 500 AU threshold. The two-tier structure is simple and clear, and it would focus regulation on even larger operations, thereby relieving smaller operations from the burden of being automatically regulated, and moderating the administrative burden to permit authorities. Permit authorities could use state programs to focus on operations below 750 AU, and could use the designation process as needed.

In some sectors, a 750 AU threshold may not be sufficiently protective of the environment. For example, in the Pacific Northwest, dairies tend to be smaller, but also tend to be a significant concern. In the mid-Atlantic, where poultry operations have been shown to be a source of environmental degradation, a 750 AU threshold would exempt many broiler operations from regulatory requirements. EPA is concerned that a 750 AU threshold would disable permit authorities from effectively addressing regional concerns.

EPA also considered adopting the 1,000 AU threshold, which would have regulated three percent of all operations and 49 percent of all manure generated annually. A threshold of 300 AU was also considered, which would have addressed an additional 8 percent of all manure generated annually, but would have brought into regulation 50 percent more operations than the 500 AU threshold (thus regulating a total of 10 percent of all AFOs which account for 72 percent of AFO manure).

Raising the NPDES threshold to 500 AU, 750 AU or 1,000 AU raises a policy question for facilities below the selected threshold but with more than 300 AU. Facilities with 300 to 1,000 AU are currently subject to NPDES regulation under some conditions, though in practice few operations in this size range have actually been permitted to date. To rely entirely on designation for these operations could be viewed by some as deregulatory, because the designation process is a time consuming and resource intensive process that makes it difficult to redress violations. It also results in the inability for permit authorities to take enforcement actions against initial discharges, (unless they are from an independant point source at the facility); instead such discharges could only result in requiring a permit. Unless the designation process can be streamlined in some way to enable permit authorities to more efficiently address those who are significant contributors of pollutants, raising the threshold too high may also not be sufficiently protective of the environment. Please see Section VII.C.3 and VII.C.4 for a discussion of the designation process.

More information on how data for these alternatives were estimated is provided in section VI of this preamble.

EPA is soliciting comment on the two-tier structure, and what the appropriate threshold should be. In addition, EPA is soliciting comment on other measures this rule, when final, might include to ensure that facilities below the regulatory threshold meet environmental requirements, such as by streamlining the designation process or some other means.

3. Three-Tier Structure

The second alternative that EPA is proposing is a three-tier structure that retains the existing tiers but amends the conditions under which AFOs with 300 AU to 1,000 AU, or "middle tier" facilities, would be defined as CAFOs. Further, EPA would require all middle tier AFOs to either apply for an NPDES permit or to certify to the permit authority that they do not meet any of the conditions which would require them to obtain a permit.

EPA is proposing this alternative because it presents a "risk based" approach to determining which operations pose the greatest concern and have the greatest potential to discharge. The particular conditions being proposed would have the effect of ensuring that manure at *all* facilities with 300 AU or more is properly managed, and thus may be more environmentally protective than the two-tier structure. Further, even though this alternative would impose some degree of burden on all AFOs with 300 AU or more, it would provide a way for facilities to avoid being permitted, and could reduce the administrative burden associated with permitting.

The three-tier alternative would affect all 26,665 facilities between 300 AU and 1,000 AU in addition to the 12,660 facilities with greater than 1,000 AU, and thus would affect 10 percent of all AFOs while addressing 72 percent of all AFO manure. However, because owners or operators of middle tier facilities would be able to certify that their operations are not CAFOs, EPA estimates that between 4,000 to 19,000 mid-size facilities would need to apply for and obtain a permit.

Of the approximately 26,000 AFOs with 300 AU to 1,000 AU, EPA estimates that owners or operations of approximately 7,000 facilities would have to, at a minimum, implement a Permit Nutrient Plan (as discussed further below) and would be able to certify to the permit authority that they are not a CAFO based on existing practices. Operators of some 19,000 facilities of these middle tier facilities would be required to adopt certain practices in addition to implementing a PNP, in order to be able to certify they are not a CAFO to avoid being permitted.

See the EPA NPDES CAFO Rulemaking Support Document, included in the Record, for detailed descriptions of the number of facilities affected by this and the other alternative scenarios considered.

EPA is also proposing the three-tier structure because it provides flexibility for State programs. A State with an effective non-NPDES program could succeed in helping many of their middle tier operations avoid permits by ensuring they do not meet any of the conditions that would define them as CAFOs. This important factor would enable States to tailor their programs while minimizing the changes State programs might need to make to accommodate today's proposed rulemaking.

The three-tier structure would affect the facilities shown in Table 7–7.

TABLE 7–7.—NUMBER OF ANIMALS IN THE THREE-TIER APPROACH

[By sector]

Animal Type	>1000 AU equivalent (Number of animals)	300–1000AU equivalent (Number of animals)	<300 AU equivalent (Number of animals)
Cattle, Excluding Mature Dairy and Veal	1,000	300–1,000	<300
Veal	1,000	300–1,000	<300
Mature Dairy Cattle	700	200–700	<200
Swine, weighing over 25 kilograms or 55 pounds	2,500	750–2,500	<750
*Immature Swine, weighing less than 25 kilograms or 55 pounds	10,000	3,000–10,000	<3,000
*Chickens	100,000	30,000–100,000	<30,000
Turkeys	55,000	16,500–55,000	<16,500
Ducks	5,000	1,500–5,000	<1,500
Horses	500	150–500	<150

TABLE 7–7.—NUMBER OF ANIMALS IN THE THREE-TIER APPROACH—Continued
[By sector]

Animal Type	>1000 AU equivalent (Number of animals)	300–1000AU equivalent (Number of animals)	<300 AU equivalent (Number of animals)
Sheep or Lambs	10,000	3,000–10,000	<3,000

*Immature swine, heifers and dry chicken operations are not included in the existing regulation but are included in today's proposed rulemaking.

Revised Conditions. EPA examined the conditions under the existing regulation and determined that the conditions needed to be modified in order to improve its efficacy. Under the existing regulation, an AFO with 300 AU to 1,000 AU is not defined as a CAFO unless it meets one of the two criteria governing the method of discharge: (1) Pollutants are discharged through a man-made ditch, flushing system, or other similar man-made device; or (2) pollutants are discharged directly into waters of the United States that originate outside of the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals. Under the two-tier structure, these conditions would be eliminated because a facility would simply be defined as a CAFO if it had more than 500 AU. Under the three-tier structure, EPA is proposing to eliminate the existing conditions and add several others designed to identify facilities which pose the greatest risk to water quality.

The three-tier proposal would, for the middle tier, eliminate both criteria in the existing regulation because these conditions have proven to be difficult to interpret and implement for AFOs in the 300 AU to 1,000 AU size category, and thus have not facilitated compliance or enforcement, and the scenario does not meet the goal of today's proposal to simplify the NPDES regulation for CAFOs. The two criteria governing method of discharge, e.g., "man-made device" and "stream running through the CAFO," are subject to interpretation, and thus difficult for AFO operators in this size range to determine whether or not the permit authority would consider them to be a CAFO. EPA does not believe it is necessary to retain these criteria because all discharges of pollutants from facilities of this size should be considered point source discharges. By replacing these terms with a list of conditions, EPA intends to clarify that all discharges from CAFOs must be covered by an NPDES permit, whether or not they are from a manmade conveyance. EPA notes that under this proposal, the Agency would not eliminate the two conditions as criteria for designation of AFOs with less than 300 AU as CAFOs. See the discussion of designation in Section VII.C.3.

The revised conditions for the middle tier would require the owner or operator to apply for an NPDES permit if the operation meets any of the following conditions and is therefore a CAFO: (1) There is direct contact of animals with waters of the U.S. at the facility; (2) there is insufficient storage and containment at the production area to prevent discharges from reaching waters of the U.S.; (3) there is evidence of a discharge from the production area in the last five years; (4) the production area is located within 100 feet of waters of the U.S.; (5) the operator does not have, or is not implementing, a Permit Nutrient Plan that meets EPA's minimum requirements; or (6) more than twelve tons of manure is transported off-site to a single recipient annually, unless the recipient has complied with the requirements for off-site shipment of manure.

The EPA NPDES CAFO Rulemaking Support Document, dated September 26, 2000 (available in the rulemaking Record), describes the assumptions used to estimate the number of facilities that would be affected by each condition, which EPA developed in consultation with state regulatory agency personnel, representatives of livestock trade associations, and extension specialists.

Each of these proposed conditions is described further below.

Direct contact of animals with waters of the U.S. The condition for "direct contact of animals with waters of the U.S." covers situations such as dairy or beef cattle walking or standing in a stream or other such water that runs through the production area. This condition ensures that facilities which allow such direct contact have NPDES permits to minimize the water quality problems that such contact can cause.

Insufficient Storage. The condition for "insufficient storage and containment at the production area to prevent discharge to waters of the U.S." is intended to address discharges through any means, including sheet runoff from the production area, whereby rain or other waters might come into contact with manure and other raw materials or wastes and then run off to waters of the U.S. or leach to ground water that has a direct hydrologic connection to waters of the U.S. This is to ensure that all mid-sized facilities prevent discharges from inadequate storage and containment of manure, process wastewater, storm water, and other water coming in contact with manure.

Sufficient storage would be defined as facilities that have been designed and constructed to standards equivalent to today's proposed effluent guidelines. Thus, beef and dairy operations would be designed and constructed to prevent discharge in a 25-year, 24-hour storm event, while swine and poultry would be required to meet a zero discharge standard. See Section VIIIC.6.

Past or Current Discharge. Operations that meet the condition for "evidence of discharge from the production areas within the past five years" would be considered CAFOs under this proposal. A discharge would include *all* discharges from the production area including, for example, a discharge from a facility designed to contain a 25-year, 24-hour storm. Evidence of discharge would include: citation by the permit authority; discharge verified by the permit authority whether cited or not; or other verifiable evidence that the permit authority determines to be adequate to indicate a discharge has occurred.

Under this approach, there would be no allowance in the certification process for facilities in the beef and dairy sectors designed to contain runoff from a 25-year, 24-hour storm that had a discharge anyway during an extreme storm event. Thus, in this respect, the requirements for certification would be more stringent than those that would apply to a permitted facility. EPA is thus proposing that a facility that chooses not to be covered by an NPDES permit would not get the benefits of NPDES coverage such as the 25-year, 24-hour storm standard for beef and dairy operations, and upset and bypass defense. Alternatively, EPA is soliciting comment on the definition of a "past or current discharge," including whether to define it as a discharge from a facility that has not been designed and constructed in accordance with today's proposed effluent guidelines. This would make the certification requirements consistent with those for permitted facilities.

Proximity to Waters of the U.S. Operations with production areas that are located within 100 feet of waters of the U.S. are of particular concern to EPA, since their proximity increases the chance of discharge to waters and is a compelling factor that would indicate the potential to discharge. Research has shown that the amount of pollutants in runoff over land can be mitigated by buffers and setbacks. (See Environmental Impact Assessment; Development of Pollutant Loading Reductions from the Implementation of Nutrient Management and Best Management Practices; both available in the rulemaking Record.) Any operation located at a distance less than the minimum setback poses a particular risk that contaminants will discharge to receiving waters. EPA estimates that approximately 4,000 operations between 300 AU and 1,000 AU in size have production areas that are within 100 feet of waters of the U.S.

Permit Nutrient Plan for Land Application of Manure and Wastewater. For facilities that land apply manure, another condition indicative of risk to water impairment is whether or not the facility has developed and is implementing a Permit Nutrient Plan for manure and/or wastewater that is applied to land that is owned or controlled by the AFO operator. Contamination of water from excessive application of manure and wastewater to fields and cropland presents a substantial risk to the environment and public health because nutrients from agriculture are one of the leading sources of water contamination in the United States. While CAFOs are not the only source of contamination, they are a significant source, and CAFO operators should apply manure properly to minimize environmental impacts. Thus, EPA would require any facility with 300 AU to 1,000 AU that does not have a PNP that conforms to today's proposed effluent guidelines for land application to apply for an NPDES permit. (As described in Section VII.E.1, the PNP is the effluent guideline subset of elements in a CNMP. Section VIII.C.6 of today's proposal describes the effluent guideline requirements in a PNP.)

Certification for Off-site Transfer of CAFO-generated Manure. The final condition for avoiding a permit concerns the transfer of CAFO-generated manure and wastewater to off-site recipients. EPA is co-proposing two ways to address manure transferred off-site, which are discussed in detail in Section VII.D.2, as well as in VII.e.5.e. In this condition, a facility would be considered a CAFO if more than 12 tons of manure is transported off-site to a single recipient annually, unless the AFO owner or operator is complying with the requirements for off-site transfer of manure, or is complying with the requirements of a State program that are equivalent to the requirements of 40 CFR part 412.

Under one co-proposed option, the AFO owner or operator would be required to obtain certifications from recipients that the manure will be properly managed; to maintain records of the recipients and the quantities transferred; and to provide information to the recipient on proper manure management and test results on nutrient content of the manure. Under the alternative option, CAFOs would not be required to obtain certifications, but would still maintain the records of transfers and provide the information to the recipients.

Under the first option, the CAFO owner or operator would obtain a certification from recipients (other than waste haulers that do not land apply the waste) that the manure: (1) Will be land applied in accordance with proper agricultural practices as defined in today's proposal; (2) will be applied in accordance with an NPDES permit; or (3) will be used for alternative uses, such as for pelletizing or distribution to other markets. If transferring manure and wastewater to a waste hauler, the CAFO owner or operator would be required to obtain the name and location of the recipients of the waste, if known, and provide the hauler with an analysis of the content of the manure and a brochure describing responsibilities for appropriate manure management, which would be provided, in turn, to the recipient. These provisions are discussed in more detail in Sections VII.D.4 and VII.E.4.

Excess Manure Alternative Considered. As an alternative to the two conditions addressing land application of CAFO-generated manure, EPA also considered a condition that would simply require the CAFO operator to determine whether it generates more manure than the land under his or her control could accommodate at allowable manure application rates, and if so, it would be a CAFO, required to land apply according to a PNP. Further, this condition would create a voluntary option for off-site transfer of CAFO-generated manure whereby, if the manure was transferred to someone certifying they had a certified CNMP and were implementing it, the facility would not be a CAFO on the basis of having excess manure.

EPA considered this criterion to identify which CAFOs were likely to pose a risk of discharge and impacts to human health and the environment based on generation of excess manure (*e.g.*, more manure than can be properly applied to land under his or her operational control). Requiring such CAFOs to apply for an NPDES permit would allow EPA to require these operations to maintain records documenting the fate of the manure (*e.g.*, whether it was land applied on-site or transferred to a third party). EPA is interested in monitoring the fate of the large quantities of manure generated by CAFOs, and in educating recipients regarding proper agricultural practices. CAFO operators able to certify there is sufficient cropland under their operational control to accommodate the proper application of manure generated at their facility would not be defined as CAFOs and thus would not need to apply for an NPDES permit on that basis.

To identify facilities that generate excess manure, EPA considered a screening tool originally developed by USDA, known as Manure Master. The tool allows AFO operators to compare the nutrient content in the animal manure produced by an AFO with the quantity of nutrients used and removed from the field on which that manure is applied. This tool would help assess the relative potential for the nutrients contained in the animal manure to meet or exceed the crop uptake and utilization requirements for those crops that receive applications of manure. The screening tool calculates a balance between the nitrogen, phosphorus, and potassium content in the manure and the quantity of these nutrients used by particular crops. This balance can be calculated based upon recommended fertilizer application rates, when known, or upon estimated plant nutrient content, when recommended fertilizer application rates are not known. For nitrogen, the balance is calculated taking into account expected losses from leaching, denitrification, and volatilization.

The manure screening tool would be available as either an Internet-based program or as a computer software program that allows for direct input of data and generation of reports. AFO operators would enter the average number of confined animals by animal type, the number of acres for each crop, and the expected yield for each crop for which the operator expects to apply manure. The operator would also specify whether the manure is incorporated into the soil or surface applied. The software also allows, but does not reqnire, entry of soil test or other crop nutrient recommendations. The screening tool produces a report that includes the balance (i.e., pounds needed or pounds excess, per acre) for nitrogen, phosphorus, and potassium for an AFO operator's fields. The balance will advise the operator whether the quantity of nutrients in his or her animal manure exceeds the quantity removed in harvested plants or the quantity of nutrients recommended.

There are many assumptions in this screening tool that make it too general to use for detailed nutrient management planning, although it would be useful as a rough means of determining whether a facility is generating manure in excess of crop needs. The factors used to calculate manure nutrient content are developed from estimates that account for nutrient losses due to collection, storage, treatment, and handling. When manure is not incorporated, an additional nitrogen loss is included for volatilization. When the nutrients exceed nutrient ntilization, there is increased potential for nutrients to leach or runoff from fields and become pollntants of gronnd or surface water. This software is intended to be used as a decision support screening tool to allow AFO operators to make a quick evaluation as to whether the quantity of nntrients applied to the land on which manure is spread exceeds the quantity of nutrients used by crops. EPA believes it could be a valuable tool to determine, at a screening level, whether available nutrients exceed crop needs and, thus, whether a facility has a greater likelihood for generating the runoff of nutrients that could impact water quality. EPA is not proposing this option as there are concerns that simply having enough land may not provide assurance that the manure would be applied in ways that avoided impairing water quality. However, EPA is requesting comment below on an alternative three-tier approach that would include such a screening tool as one of the criteria for certifying that an AFO in the 300 to 1,000 AU size category is not a CAFO.

Certifying That a Middle Tier AFO is not a CAFO. Under the three-tier structure, EPA is proposing to allow AFOs with between 300 AU and 1,000 AU to certify to the permit authority that they do not meet any of the risk-based conditions and thus are not CAFOs. The certification would be a check-off form that would also request some basic information about the facility, including name and address of the owner and operators; facility name and address and contact person; physical location and longitude and latitude information for the production area; type and number of animals at the AFO; and signature of owner, operator or authorized representative. The draft sample certification form is included here for public comment.

Form for Certifying Out of the Concentrated Animal Feeding Operation Provisions of the National Pollutant Discharge Elimination System

This checklist is to assist you in determining whether your animal feeding operation (AFO) is, or is not, a concentrated animal feeding operation (CAFO) subject to certain regulatory provisions. For clarification, please see the attached fact sheet.

Section 1. First Determine Whether or not Your Facility Is an AFO

A facility that houses animals is an animal feeding operation if:

• Animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period.

• Animals are not considered to be stabled or confined when they are in areas such as pastures or rangeland that sustain crops or forage growth during the entire time that animals are present.

Yes, my facility is an AFO. PROCEED TO SECTION 2.

No, my facility is *not* an AFO. STOP. YOU DO NOT NEED TO SUBMIT THIS FORM

Section 2. Determine the Size Range of Your AFO

If your facility is an AFO, and the number of animals is in the size range for any animal type listed below, then you may potentially be a concentrated animal feeding operation.

200–700 mature dairy cattle (whether milked or dry)
300–1000 head of cattle other than mature dairy cattle
750–2,500 swine each weighing over 25 kilograms (55 pounds)
3,000–10,000 swine each weighing under 25 kilograms (55 pounds)
30,000–100,000 chickens
16,500–55,000 turkeys
150–500 horses
3,000–10,000 sheep or lambs
1,500–5,000 ducks

My AFO is within this size range. PROCEED TO SECTION 3.

My AFO has fewer than the lower threshold number for any animal type so I am not a CAFO under this description. STOP.

My AFO has more than the upper threshold number of animals for any animal type. STOP. PLEASE CONTACT YOUR PERMIT AUTHORITY FOR INFORMATION ON HOW TO APPLY FOR AN NPDES PERMIT.

Section 3. Minimum Requirements

Check all boxes that apply to your operation. If *all* of the following boxes are checked, PROCEED TO SECTION 4.

My production area is not located within 100 feet of waters of the U.S.

There is no direct contact of animals with waters of the U.S. in the production area.

I am currently maintaining properly engineered manure and wastewater storage and containment structures designed to prevent discharge in either a 25-year, 24-hour storm (for beef and dairy facilities) or all circumstances (for all other facilities), in accordance with the effluent guidelines (40 CFR Part 412).

There are no discharges from the production area and there have been no discharges in the past 5 years.

I have not been notified by my State permit authority or EPA that my facility needs an NPDES permit

If any box in this section is *not* checked, you may not use this certification and you must apply for an NPDES permit. STOP. PLEASE CONTACT YOUR PERMIT AUTHORITY FOR MORE INFORMATION.

Section 4. Land Application

A. If all of the boxes in Section 3 are checked, you may be able to certify that you are not a CAFO on the basis of ensuring proper agricultural practices for land application of CAFO manure:

I either do not land apply mannre or, if land applying mannre, I have, and am implementing, a certified Permit Nutrient Plan (PNP). I maintain a copy of my PNP at my facility, including records of implementation and monitoring; and

B. Check One:

My State has a program for excess manure in which I participate. OR

[Alternative 1: I do not transfer more than 12 tons of manure to any off-site recipients nnless they have signed a certification form assuring me that they are either 1) applying manure according to proper agricultural practices; 2) obtaining an NPDES permit for discharges; or 3) transferring manure to other non-land application uses; and] [For Alternative 2, this box is not needed]

I maintain records of recipients, receiving greater than 12 tons of manure annually, and the quantity and dates transferred, and I provide recipients an analysis of the content of the manure as well as information describing the recipients responsibilities for appropriate manure management. If I transfer manure or wastewater to a manure hauler, I also obtain the name and location of the recipients of the manure, if known;

If a box is checked in both subsection A and subsection B above, you may certify that you are not a CAFO. PROCEED TO SECTION 5.

If a box is not checked in both subsection A and subsection B above, you may not use this certification form. STOP. YOU MUST APPLY FOR AN NPDES PERMIT.

Section 5. Certification

I certify that I own or operate the animal feeding operation described herein, and have legal authority to make management decisions about said operation. I certify that the information provided is true and correct to the best of my knowledge.

I understand that in the event of a discharge to waters of the U.S. from my AFO, I must report the discharge to the Permit Authority and apply for a permit. I will report the discharge by phone within 24 hours, submit a written report within 7 calendar days, and make arrangements to correct the conditions that caused the discharge.

In the event any of these conditions can no longer be met, I understand that my facility is a CAFO and I must immediately apply for a permit. I also understand that I am liable for any unpermitted discharges. This certification must be renewed every 5 years.

I certify under penalty of law that this document either was prepared by me or was prepared under my direction or supervision. Based on my inquiry of the person or persons who gathered the information, the information provided is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Facility Name □□□□□□□□□□□□□□□
Name of Certifier □□□□□□□□□□□□□□
Signature □□□□□□□□□□□□□□□□
Date□□□□□□□□□□□

Check one: □ owner □ operator

Name & Address of other entity that exercises substantial operational control of this CAFO: □□□□□□□□□□□□□□□□□□□□□□

Address of animal feeding operation:
County:
State:
Latitude/Longitude:
Phone:
Email:
Name of Closest Waters of the U.S.:
Distance to Waters:
Description of closest waters: (e.g. intermittent stream, perennial stream; ground water aquifer): □□□□□□□□□□□□□□□□□□ □□□□□□□□□□□□□□□□□□□□□□□

Where an operation in the 300–1000 AU size range has certified that it meets all of the required conditions to be excluded from the CAFO definition, if at any future point the operation fails to meet one or more of these conditions, it would immediately become defined as a CAFO. Any discharges from the operation at that point would be illegal until the operation obtains a permit. For example, if an operation has certified that it meets all of the conditions for being excluded from the CAFO definition, but then has an actual discharge to the waters (which would be inconsistent with the certification that there is no "current discharge"), that discharge would be considered to be an unpermitted discharge from a CAFO. Similarly, if an operation at any point no longer has sufficient storage and containment to prevent discharges, it would immediately become a CAFO and be required to apply for a permit (regardless of whether it had any actual discharges).

Constructing the regulations in this way would do two things. First, it would make clear that there is no shield from liability for any operation that falsely certified that it met the conditions to be excluded from regulation. Second, it would make clear that even in cases where an operation has certified to all the required conditions in good faith, there is no protection from the regulatory and permitting requirements if at any point the operation no longer meets those conditions. Operations would be on notice that if they had any doubts about their continued ability to meet the conditions for exclusion, they should decline to "certify out" and should apply for a permit.

Alternative Three-tier Structure: Simplified Certification. EPA is requesting comment on a variation of the three-tier structure being co-proposed today. Under this alternative, operations with > 1,000 AU would be subject to the same requirements as under both of today's co-proposed options, and operations between 300 and 1,000 animal units would be defined as CAFOs, required to obtain an NPDES permit, unless they can certify that they do not meet the conditions for definition as a CAFO. However, the conditions for making this certification would be different than those under the proposed three-tier approach, and the substantive permit requirements for operations between 300 and 1,000 AU that do not certify would also be different.

Under this approach, operations between 300 and 1,000 AU, that are not likely to be significant contributors of pollutants, could avoid definition as a CAFO by certifying to a more limited range of factors. The check list would indicate, for example, adequate facility design to contain manure and runoff in up to a 25-year, 24-hour storm, use of appropriate BMPs, and application of manure at agronomic rates. Under this variation, the check list would be designed to minimize both the required information and the substantive operational requirements for these middle tier facilities on the grounds that, because they are smaller size operations, they are less likely to be the type of concentrated, industrial operations that Congress intended to include as CAFOs. So, for example, the check list could allow several alternatives for appropriate manure storage, including cost-effective BMPs such as stacking manure in certain locations or in certain ways to avoid discharge, in lieu of expanded structural storage capacity. Similarly, the indication that manure is applied at agronomic rates could be based on a simple ratio of animals to crop land, or on the use of a more sophisticated screening tool, such as the USDA developed tool described above, but would not necessarily require preparation of a full CNMP by a certified planner. The check list might also include an assurance by the operator that recipients of off-site manure are provided nutrient test results and information on appropriate manure management.

AFOs in this size category that are not able to certify, according to the check list criteria, that they are not likely to be significant contributors of pollutants to waters of the US would be defined as CAFOs and thus required to obtain an NPDES permit. However, the conditions in the permit would not necessarily be the same as those in permits for operations with > 1,000 AU. In particular, the effluent guidelines described in today's proposal would not be applicable to these facilities. Rather, CAFOs in this size category would be required to operate in accordance with BAT, as determined by the best professional judgement (BPJ) of the permit writer. This is the same as the existing requirement for CAFOs in this size category. Or, EPA might promulgate an alternate set of national effluent guidelines for CAFOs in this subcategory. Such effluent guidelines might include zero discharge from the production area in up to a 25-year, 24-hour storm, implementation of a PNP, appropriate BMPs, and appropriate management of manure shipped off-site.

Under this approach, all 26,665 operations between 300 and 1,000 AU would be affected by the rule, just as under the three-tier approach being proposed today. However, EPA expects that a larger number of facilities would be able to avoid definition as a CAFO and the requirement to obtain a permit than under today's proposed approach. EPA has not estimated the number of operations that would be defined as CAFOs under this alternative three-tier approach, but expects that it would be more than 16,420 but fewer than 31,930 (of which some 13,000 would have over 1,000 AU). For those facilities that did receive a permit, compliance would generally be less expensive. This approach was presented to small entity representatives (SERs) during the SBREFA outreach conducted for this rule, and discussed in detail by the Small Business Advocacy Review Panel that conducted the outreach. While some concerns were expressed, the approach was generally received favorably by both the SERs and the Panel. See the Panel Report (2000) for a complete discussion of the Panel's consideration of this option.

EPA requests comment on this alternative three tier approach. In particular, EPA requests comment on which items should be included in the certification check list, and whether substantive permit requirements for CAFOs in this size category should be left completely up to the BPJ of the permit authority, or based on an alternate set of effluent guidelines, as discussed above. After evaluating public comments, EPA may decide to further explore this option. At that time, EPA would develop and make available for public comment as appropriate a more detailed description of the specific requirements of such an approach, as well as a full analysis of its costs, benefits, and economic impacts. In particular, EPA would add an analysis to the public record of why it would be appropriate to promulgate different effluent guideline requirements, or no effluent guideline requirements, for CAFOs that have between 300 and 1,000 AU as compared to the effluent guidelines for operations with greater than 1,000 AU. This would include an evaluation of whether the available technologies and economic impacts are different for the smaller versus the larger CAFOs.

4. Comparative Analysis

EPA is proposing both the two- and three-tier structures for public comment as they both offer desirable qualities. On the one hand, the two-tier structure is simple and clear, focuses on the larger operations, and provides regulatory relief to smaller businesses. However, it requires permits of all facilities meeting the size threshold. On the other hand, the three-tier structure offers flexibility to States for addressing environmental impacts of AFOs through non-NPDES programs or non-regulatory programs, while focusing the regulation on facilities demonstrating certain risk characteristics. It imposes, however, some degree of burden to all facilities more than 300 AU.

The costs of each of the six alternatives considered by EPA are discussed in Section X of today's proposal, and benefits are discussed in Section XI. Key findings from EPA's analysis are summarized in Table 7–8 for quick reference. See Sections X and XI for full discussions and explanations.

EPA solicits comment on both of today's alternative proposed structures, as well as on the two alternatives discussed above.

EPA is also soliciting comment on whether or not to adopt both the two-tier and the three-tier structures, and to provide a mechanism to allow States to select which of the two alternative proposed structures to adopt in their State NPDES program. Under this option, a State could adopt the structure that best fits with the administrative structure of their program, and that best serves the character of the industries located in their State and the associated environmental problems. This option is viable only if the Agency is able to determine that the two structures provide substantially similar environmental benefits by regulating equivalent numbers of facilities and amounts of manure. Otherwise, States would be in a position to choose a less stringent regulation, contrary to the requirements of the Clean Water Act.

EPA's preliminary assessment is that there appear to be significant differences in the scope of the structures, such that the two-tier structure could be considered less stringent than the three-tier structure, depending upon which structures, criteria and thresholds are selected in the final proposal. As table 7–8 indicates, for example, the co-proposed two-tier structure with a 500 AU threshold would regulated 25,540 operations, whereas the co-proposed three-tier structure would regulate up to 39,320 operations. A two-tier structure with 750 AU would regulate 19,100 operations, whereas the alternative, less stringent, three-tier structure would regulate as few as 16,000 and as many as 32,000. The range of manure covered under these various alternatives ranges from as little as 49% to as much as 72% of all AFO manure. Further, how each animal sector is affected varies with each alternative, with some alternatives being significantly less protective in certain sectors than other alternatives. Section VI of today's preamble provides more information on the affects on each animal sector of various alternatives.

EPA is not able to conclude that the stringency of the two options is equivalent, due to the lack of data and EPA's uncertainty over exactly how many facilities may be subject to regulation under each alternative. Therefore, EPA is not proposing this option. However, EPA seeks comment on the option to allow States to select which of two structures to implement, and requests information on establishing whether two options provide equivalent environmental protection.

TABLE 7–8.—COMPARISON OF REGULATORY ALTERNATIVES FOR SELECT CRITERIA[a]

Criteria	Baseline	2-Tier alternatives			3-Tier alternatives	
	>1000 AU	>750 AU	>500 AU	>300 AU	Proposed	Alter-native
Number Operations that will be Required to Obtain a Permit	12,660	19,100	25,540	39,320	[1] 31,930	[2] >16,420
Percentage of Affected Operations Required to Obtain a Permit	3	5	7	11	9	10
Estimated Compliance Costs to CAFOs ($million/year, pre-tax)	605	721	831	980	930	>680
Percentage Manure Covered by Proposed Regulations	49	58	64	72	72	[3] ND

[1] Three-tier Proposed: Number of affected facilities up to 39,320. Number of permitted facilities between 16,000 and 32,000, rounded.
[2] Three-tier Alternative: Number of affected facilities and industry costs are expected to be greeter than that estimeted for NPDES Scenario 1 ("Status Quo").
[3] ND = Not Determined.

5. Additional Scenarios Considered But Not Proposed

EPA also considered two other scenarios, which would retain the existing three-tier approach.

a. *Scenario 1: Retain Existing Structure*. One of the alternative regulatory scenarios would incorporate all of today's proposed revisions except those related to the tiered structure for defining which AFOs are CAFOs. In other words, the existing three-tier structure (greater than 1,000 AU; 300 AU to 1,000 AU; fewer than 300 AU) would remain in place, and the conditions for defining the middle tier operations would not change. Thus, as under the existing regulation, mid-sized AFOs (300 AU to 1,000 AU) would be defined as CAFOs only if, in addition to the number of animals confined, they also meet one of the two specific criteria governing the method of discharge: (1) Pollutants are discharged through a man-made ditch, flushing system, or other similar man-made device; or (2) pollutants are discharged directly into waters of the United States that originate outside of the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals.

EPA is not proposing this scenario because these conditions have proven to be difficult to interpret and implement for AFOs in the 300 to 1,000 AU size category, and thus have not facilitated compliance or enforcement, and the scenario does not meet the goal of today's proposal to simplify the NPDES regulation for CAFOs. The two criteria governing method of discharge, e.g., "man-made device" and "stream running through the CAFO," are subject to interpretation, and thus difficult for AFO operators in this size range to determine whether or not the permit authority would consider them to be a CAFO. EPA does not believe it is necessary to retain these criteria because all discharges of pollutants from facilities of this size should be considered point source discharges. While the other proposed changes go a long way to improve the effectiveness of the NPDES program for CAFOs, EPA believes the definition criteria for facilities in this size range also need to be amended to make the regulation effective, simple, and enforceable.

b. *Scenario 2: Revised Conditions Without Certification.* The second scenario EPA considered would also retain the existing three-tier structure, and would modify the conditions for defining the middle tier AFOs as CAFOs in the same way that today's proposed three-tier structure does. That is, any AFO that meets the size condition (300 AU to 1,000 AU) would be defined as a CAFO if it met one or more of the following risk-based conditions: (1) Direct contact of animals with waters of the U.S.; (2) insufficient storage and containment at the production area to prevent discharge from reaching waters of the U.S.; (3) evidence of discharge in the last five years; (4) the production area is located within 100 feet of waters of the U.S.; (5) the operator does not have, or is not implementing, a Permit Nutrient Plan; and (6) any manure transported off-site is transferred to recipients of more than twelve tons annually without following proper off-site manure management, described above in the discussion of the three-tier structure (co-proposed with omitting this requirement).

In this scenario, owners or operators of AFOs in the middle tier would not be required to certify to the permit authority that the facility is not a CAFO. However, all facilities that do meet one or more of the conditions would have a duty to apply for an NPDES permit. This scenario is not being proposed because of concerns that there would be no way for the permit authority to know which operations were taking the exemption and which should, in fact, be applying for a permit. The certification scenario provides a measure of assurance to the public, the permit authority, and the facilities' owners or operators, that CAFOs and AFOs are implementing necessary practices to protect water quality.

C. Changes to the NPDES Regulations

In addition to changing the threshold for determining which facilities are CAFOs, EPA is proposing a number of other changes that address how the permitting authority determines whether a facility is an AFO or a CAFO that, therefore, must apply for an NPDES permit. These proposed revisions are discussed in this section and in section D.

1. Change the AFO Definition to Clearly Distinguish Pasture Land

EPA is proposing to clarify the regulatory language that defines the term "animal feeding operations," or AFO, in order to remove ambiguity. See proposed § 122.23(a)(2). The proposed rule language would clarify that animals are not considered to be "stabled or confined" when they are in areas such as pastures or rangeland that sustain crops or forage during the entire time animals are present. Other proposed changes to the definition of AFO are discussed below in section 3.e.

To be considered a CAFO, a facility must first meet the AFO definition. AFOs are enterprises where animals are kept and raised in confined situations. AFOs concentrate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland. The current regulation [40 CFR 122.23(b)(1)] defines an AFO as a "lot or facility where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12 month period; *and where crops, vegetation[,] forage growth, or post-harvest residues are not sustained over any portion of the lot or facility in the normal growing season*" [emphasis added].

The definition states that animals must be kept on the lot or facility for a minimum of 45 days, in a 12-month period. If an animal is at a facility for any portion of a day, it is considered to be at the facility for a full day. However, this does not mean that the same animals must remain on the lot for 45 consecutive days or more; only that some animals are fed or maintained on the lot or at the facility 45 days out of any 12-month period. The 45 days do not have to be consecutive, and the 12-month period does not have to correspond to the calendar year. For example, June 1 to the following May 31 would constitute a 12-month period.

The definition has proven to be difficult to implement and has led to some confusion. Some CAFO operators have asserted that they are not AFOs under this definition where incidental growth occurs on small portions of the confinement area. In the case of certain wintering operations, animals confined during winter months quickly denude the feedlot of growth that grew during the summer months. The definition was not intended to exclude, from the definition of an AFO, those confinement areas that have growth over only a small portion of the facility or that have growth only a portion of the time that the animals are present. The definition is intended to exclude pastures and rangeland that are largely covered with vegetation that can absorb nutrients in the manure. It is intended to include as AFOs areas where animals are confined in such a density that significant vegetation cannot be sustained over most of the confinement area.

As indicated in the original CAFO rulemaking in the 1970s, the reference to vegetation in the definition is intended to distinguish feedlots (whether outdoor confinement areas or indoor covered areas with constructed floors) from pasture or grazing land. If a facility maintains animals in an area without vegetation, including dirt lots or constructed floors, the facility meets this part of the definition. Dirt lots with nominal vegetative growth while animals are present are also considered by EPA to meet the second part of the AFO definition, even if substantial growth of vegetation occurs during months when animals are kept elsewhere. Thus, in the case of a wintering operation, EPA considers the facility an AFO potentially subject to NPDES regulations as a CAFO. It is not EPA's intention, however, to include within the AFO definition pasture or rangeland that has a small, bare patch of land, in an otherwise vegetated area, that is caused by animals frequently congregating if the animals are not confined to the area.

The following examples are presented to further clarify EPA's intent. (1) When animals are restricted to vegetated areas as in the case of rotational grazing, they would not be considered to be confined in an AFO if they are rotated out of the area while the ground is still covered with vegetation. (2) If a small portion of a pasture is barren because, e.g., animals congregate near the feed trough in that portion of the pasture, that area is not considered an AFO because animals are not confined to the barren area. (3) If an area has vegetation when animals are initially confined there, but the animals remove the vegetation during their confinement, that area would be considered an AFO. This may occur, for instance, at some wintering operations.

Thus, to address the ambiguities noted above, EPA is proposing to clarify the regulatory language that defines the term "animal feeding operation" as follows: "An animal feeding operation or AFO is a facility where animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period. Animals are not considered to be stabled or confined when they are in areas such as pastures or rangeland that sustain crops or forage growth during the entire time that animals are present. Animal feeding operations include both the production area and land application area as defined below." EPA is interested in receiving comments regarding whether the proposed revision to the AFO definition clearly distinguishes confinement areas from pasture land.

2. Proposed Changes to the NPDES Permitting Regulation for Determining Which AFOs are CAFOs

To improve the effectiveness and clarity of the NPDES regulation for CAFOs, EPA is proposing to revise the regulation as discussed in the following sections.

a. *Eliminate the Term "Animal Unit".* To remove confusion for the regulated community concerning the definition of the term "animal unit" or "AU," EPA is proposing to eliminate the use of the term in the revised regulation. Instead of referring to facilities as having greater or fewer than 500 animal units, for example, EPA will use the term "CAFO" to refer to those facilities that are either defined or designated, and all others as "AFOs." However, in the text of today's preamble, the term AU will be used in order to help the reader understand the differences between the existing regulation and today's proposal. If this revision is adopted, the term AU will not be used in the final regulation. Section VII.B, above, lists the numbers of animals in each sector that would be used to define a facility as a CAFO.

EPA received comment on the concept of animal units during the AFO Strategy listening sessions, the small business outreach process, and on comments submitted for the draft CAFO NPDES Permit Guidance and Example Permit. EPA's decision to move away from the concept of "animal units" is supported by the inconsistent use of this concept across a number of federal programs, which has resulted in confusion in the regulated community. A common thread across all of the federal programs is the need to normalize numbers of animals across animal types. Animal units have been established based upon a number of different values that include live weight, forage requirements, or nutrient excretion.

USDA and EPA have different "animal unit" values for the livestock sectors. Animal unit values used by USDA are live-weight based, and account for all sizes and breeds of animals at a given operation. This is particularly confusing as USDA's animal unit descriptions result in different values in each sector and at each operation.

The United States Department of Interior (Bureau of Land Management and National Park Service) also references the concept of "animal unit" in a number of programs. These programs are responsible for the collection of grazing fees for federal lands. The animal unit values used in these programs are based upon forage requirements. For Federal lands an animal unit represents one mature cow, bull, steer, heifer, horse, mule, or five sheep, or five goats, all over six months of age. An animal unit month is based on the amount of forage needed to sustain one animal unit for one month. Grazing fees for Federal lands are charged by animal unit months.

In summary, using the total number of head that defines an operation as a CAFO will minimize confusion with animal unit definitions established by other programs. See tables 7–6 and 7–7 above.

b. *How Will Operations With Mixed Animal Types be Counted?* EPA is proposing to eliminate the existing mixed animal provision, which currently requires an operator to add the number of animal units from all animal sectors at the facility when determining whether it is a CAFO. (Poultry is currently excluded from this mixed animal type calculation). While the mixed calculation would be eliminated, once the number of animals from one sector (e.g. beef, dairy, poultry, swine, veal) of one type cause an operation to be defined as a CAFO, manure from all confined animal types at the facility would be covered by the permit conditions. In the event that waste streams from multiple livestock species are commingled, and the regulatory requirements for each species are not equivalent, the permit must apply the more stringent requirements.

In the existing regulation, a facility with 1,000 animal units or the cumulative number of mixed animal types which exceeds 1,000, is defined as a CAFO. Animal unit means a unit of measurement for any animal feeding operation calculated by adding the following numbers: the number of slaughter and feeder cattle multiplied by 1.0, plus the number of mature dairy cattle multiplied by 1.4, plus the number of swine weighing over 25 kilograms (approximately 55 pounds) multiplied by 0.4, plus the number of sheep multiplied by 0.1, plus the number of horses multiplied by 2.0. As mentioned, poultry operations are excluded from this mixed unit calculation as the current regulation simply stipulates the number of birds that define the operation as a CAFO, and assigns no multiplier.

Because simplicity is one objective of these proposed regulatory revisions, the Agency believes that either all animal types, including poultry, covered by the effluent guidelines and NPDES regulation should be included in the formula for mixed facilities, or EPA should eliminate the facility multipliers from the revised rule. Today's rulemaking proposes changes that would have to be factored in to a revised mixed animal calculation which would make the regulation more complicated to implement. For example, EPA is proposing to cover additional animal types (dry chicken operations, immature swine and heifer operations). Thus, EPA is proposing to eliminate the mixed operation calculation rather than revise it and create a more complicated regulation to implement that would potentially bring smaller farms into regulation.

EPA believes that the effect of this proposed change would be sufficiently protective of the environment while maintaining a consistently enforceable regulation. EPA estimates 25 percent of AFOs with less than 1,000 AU have multiple animal types present simultaneously at one location, and only a small fraction of these AFOs would be CAFOs exceeding either 300 AU or 500 AU when all animal types are counted. EPA also believes that few large AFOs possess mixed animals due to the increasingly specialized nature of livestock and poultry production. Therefore, EPA believes that a rule which required mixed animal types to be part of the threshold calculation to determine if a facility is a CAFO would result in few additional operations meeting the definition of a CAFO. In addition, most facilities with mixed animal types tend to be much smaller, and tend to have more traditional, oftentimes more sustainable, production systems. These farms tend to be less specialized, engaging in both animal and crop production. They often have sufficient cropland and fertilizer needs to land apply manure nutrients generated at the farm's livestock or poultry business. Nevertheless, should such an AFO be found to be a significant contributor of pollution to waters of the U.S., it could be designated a CAFO by the permit authority.

EPA is, therefore, proposing to eliminate the mixed animal calculation in determining which AFOs are CAFOs. Once an operation is a CAFO for any reason, manure from all confined animal types at the facility is subject to the permit requirements. EPA is requesting comment on the number of operations that could potentially have the equivalent of 500 AU using the mixed calculation that would be excluded from regulation under this proposal.

c. *Is an AFO Considered a CAFO if it Only Discharges During a 25-Year, 24-Hour Storm?* EPA is proposing to eliminate the 25-year, 24-hour storm event exemption from the CAFO definition (40 CFR 122.23, Appendix B), thereby requiring any operation that meets the definition of a CAFO either to apply for a permit or to establish that it has no potential to discharge. Under the proposed three-tier structure an operation with 300 AU to 1,000 AU may certify that it is not a CAFO if it is designed, constructed, and maintained in accordance with today's effluent guidelines and it does not meet any of the risk-based conditions. See Section VII.B.2.

The existing NPDES definition of a CAFO provides that "no animal feeding operation is a concentrated animal feeding operation * * * as defined above * * * if such animal feeding operation discharges only as the result of a 25-year, 24-hour storm event" (40 CFR § 122.23, Appendix B). This provision applies to AFOs with 300 AU or more that are defined as CAFOs under the existing regulation. (Facilities of any size that are CAFOs by virtue of designation are not eligible for this exemption because, by the terms of designation, it does not apply to them. Moreover, they have been determined by the permit authority to be a significant contributor of pollution to waters of the U.S.)

The 25-year, 24-hour standard is an engineering standard used for construction of storm water detention structures. The term "25-year, 24-hour storm event" means the maximum 24-hour precipitation event with a probable recurrence of once in 25 years, as defined by the National Weather Service (NWS) in Technical Paper Number 40 (TP40), "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or by equivalent regional or State rainfall probability information developed therefrom. [40 CFR Part 412.11(e)]. (Note that the NWS is updating some of the Precipitation Frequency Publications, including part of the TP40. In 1973, the National Atmospheric and Oceanic Administration (NOAA) issued the NOAA Atlas 2, Precipitation Frequency Atlas of the Western United States. The Atlas is published in a separate volume for each of tha eleven western states. An update for four of the State volumes is currently being conducted. In addition, the NWS is updating TP40 for the Ohio River Basin which covers a significant portion of the eastern U.S. The updates will reflect more than 30 years of additional data and will benefit from NWS enhanced computer capabilities since the original documents were generated almost 40 years ago.) As discussed further in section VIII, the 25-year, 24-hour storm event also is used as a standard in the effluent limitation guideline.

The circularity of the 25-year, 24-hour storm event exemption in the existing CAFO definition has created confusion that has led to difficulties in implementing the NPDES regulation. The effluent guidelines regulation, which is applicable to permitted CAFOs, requires that CAFOs be designed and constructed to contain such an event. However, the NPDES regulations allows facilities that discharge only as a result of such an event to avoid obtaining a permit. This exemption has resulted in very few operations actually obtaining NPDES permits, which has hampered implementation of the NPDES program. While there are an estimated 12,000 AFOs likely to meet the current definition of a CAFO, only about 2,500 such facilities have obtained an NPDES permit. Many of these unpermitted facilities may incorrectly believe they qualify for the 25-year, 24-hour storm permitting exemption. These unpermitted facilities operate outside the current NPDES program, and State and EPA NPDES permit authorities lack the basic information needed to determine whether or not the exemption has been applied correctly and whether or not the CAFO operation is in compliance with NPDES program requirements.

EPA does not believe that the definition as a CAFO should hinge on whether an AFO only discharges pollutants dua to a 25-year, 24-hour storm event. Congress clearly intended for concentrated animal feeding operations to be subject to NPDES permits by explicitly naming CAFOs as point sources in the Clean Water Act Section 502(14). Further, Section 101(a) of the Act specifically states that elimination of discharges down to zero is to be achieved where possible, and EPA does not believe that facilities should avoid the regulatory program altogether by merely claiming that they meet the 25-year, 24-hour criterion. This issue is discussed further below in section VII.C.2(c).

The public has expressed widespread concern regarding whether some of these currently unpermitted facilities are, in fact, entitled to this exemption. Based on comments EPA has received in a variety of forums, including during the AFO Strategy listening sessions and on the draft CAFO permit guidance, EPA believes there is a strong likelihood that many of these facilities are discharging pollutants to waters of the U.S. EPA is concerned that, in applying the 25-year, 24-hour storm exemption, operations are not now taking into consideration runoff from their production areas, or are improperly interpreting which discharges are the result of 25-year 24-hour storms and chronic rainfall which may result in breaches and overflows of storage systems, all of which cause pollution to entar waters of the U.S. Additionally, facilities may not be considering discharges from improper land application of manure and wastewater.

EPA is today proposing to eliminate the 25-year, 24-hour storm exemption from the CAFO definition (40 CFR 122.23, Appendix B) in order to: (a) Ensure that all CAFOs with a potential to discharge are appropriately permitted; (b) ensure through permitting that facilities are, in fact, properly designed, constructed, and maintained to contain a 25-year, 24-hour storm event, or to meet a zero discharge requirement, as the case may be; (c) improve the ability of EPA and State permit authorities to monitor compliance; (d) ensure that facilities do not discharge pollutants from their production areas or from excessive land application of mauure and wastewater; (e) make the NPDES permittiug provision consistent with today's proposal to eliminate the 25-year, 24-hour storm design standard from the effluent guidelines for swine, veal and poultry; and (f) achieve EPA's goals of simplifying the regulation, providing clarity to the regulated community, and improving the consistency of implementation.

Under the proposed two-tier structure, any facility that is defined as a CAFO would be a CAFO even if it only discharges in the event of a 25-year, 24-hour storm. Further, the CAFO operator would be required to apply for an NPDES permit, as discussed below regarding the dnty to apply for a NPDES permit. (If the operator believes the facility never discharges, the operator could request a determination of no potential to discharge, as discussed below.) Under the three-tier structure a facility with 300 AU to 1,000 AU would be required to either certify it is not a CAFO, to apply for a permit, or demonstrate it has no potential to discharge. Today's effluent guidelines proposal wonld retain the design specification for beef or dairy facilities, which would allow a permitted facility to discharge due to a 25-year, 24-hour event, as long as the facility's containment system is designed, constructed and operated to handle manure and wastewater plus precipitation from a 25-year, 24-hour storm event (unless a permit writer imposed a more stringent, water quality-based effluent limitation). However, a facility that meets the definition of CAFO and discharges during a 25-year, 24-hour storm event, but has failed to apply for an NPDES permit (or to certify in the three-tier structure), would be subject to enforcement for violating the CWA. Swine, veal and poultry CAFOs would be required to achieve a zero discharge standard at all times.

EPA considered limitiug this change to the very largest CAFOs (e.g., operations with 1,000 or more auimal units), and retaining the exemption for smaller facilities. However, EPA is concerned that this could allow significant discharges resulting from excessive laud application of manure and wastewater to remain beyond the scope of the NPDES permittiug program, thereby resulting in ongoing discharge of CAFO-generated pollutants into waters of the U.S. Moreover, EPA believes that retainiug the exemption for certain operations adds unnecessary complexity to the CAFO definition.

The Small Bnsiness Advocacy Review Panel also considered the idea of removing the 25-year, 24-hour exemption. While the Panel agreed that this was generally appropriate for operations above the 1,000 AU threshold, it was divided on whether it wonld also be appropriate to remove the exemption for facilities below this threshold. The Panel noted that for some such facilities, removing the exemption would not expand the scope of the current regulation, but rather ensure coverage for facilities that should already have obtained a permit. However, the Panel also recognized that eliminating the exemption would require facilities that *do* properly quality for it—e.g., because they do have sufficient manure management and containment in place, or for some other reason, do not discharge except iu a 25-year, 24-hour storm—to obtain a permit or certify that none is needed. The Panel recommended that EPA carefully weigh the costs and benefits of removing the exemption for small entities and that it fully analyze the incremental costs associated with permit applications for those facilities not presently permitted that can demonstrate that they do not discharge iu less thau a 25-year, 24-hour storm event, as well as any costs associated with additional conditions related to land application, nutrient management, or adoption of BMPs that the permit might contain. The Panel further recommended that EPA consider reduced application requirements for small operators affected by the removal of the exemption. The Agency requests comment on whether to retain this exemption for small entities and at what animal unit threshold would be appropriate for doing so.

d. *Who Must Apply for and Obtain an NPDES Permit?* EPA is proposing today to adopt regulations that would expressly require all CAFO owners or operators to apply for an NPDES permit. See proposed § 122.23(c). That is, owners or operators of all facilities defined or designated as CAFOs would be required to apply for an NPDES permit. The existing regulations contain a general duty to apply for a permit, which EPA believes applies to virtually all CAFOs. The majority of CAFO owner or operators, however, have not applied for an NPDES permit. Today's proposed revisions would clarify that all CAFOs owners or operators must apply for an NPDES permit; however, if he or sbe believes the CAFO does oot bave a potential to discharge pollutants to waters of the U.S. from either its production area or its land application area(s), he or she could make a no potential discharge demonstration to the permit authority in lieu of submitting a full permit application. If the permit authority agrees that the CAFO does not have a potential to discharge, the permit authority would not need to issue a permit. Howevor, if the nnpermitted CAFO does indeed discharge, it would be violating the CWA prohibition against discharging without a permit and would he subject to civil and criminal penalties. Thus, au unpermitted CAFO does not get the benefit of the 25-year, 24-hour storm standard established by the effluent guidelines for beef and dairy, nor does it have the benefit of the upset and bypass affirmative defenses.

The duty to apply for a permit under existing regulations. EPA believes that virtually all facilities defined as CAFOs already have a duty to apply for a permit under the current NPDES regulations, because of their past or current discharges or potential for fnture discharge. Under NPDES regulations at 40 CFR Part 122.21(a), any person who discharges or proposes to discharge pollutants to the waters of the United States from a point source is required to apply for an NPDES permit. CAFOs are point sources by definition, under § 502 of the CWA and 40 CFR 122.2. Thus, any CAFO that "discharges or proposes to discharge" pollutants must apply for a permit.

Large CAFOs with greater than 1,000 AU pose a risk of discharge in a number of different ways. For example, a discharge of pollutants to surface waters can occur through a spill from the waste handling facilities, from a breach or overflow of those facilities, or through runoff from the feedlot area. A discharge can also occur through runoff of pollutants from application of manure and associated wastewaters to the laod or through seepage from the production area to ground water where there is a direct hydrologic connection between ground water and surface water. Given the large volume of manure these facilities generate and the variety of ways they may discharge, and based on EPA's aud the States' own experience in the field, EPA helievcs that all or virtnally all large CAFOs have had a discharge in the past, have a current discharge, or have the potential to discharge in the future. A CAFO that meets any one of these three criteria would bc a facility that "discharges or proposes to discharge" pollutants and would therefore need to apply for a permit under the current regulations.

Where CAFO has not discharged in the past, does not now discharge pollutants, aud does not expect to discharge pollutants in the future, EPA believes that the owner or operator of that facility should demonstrate during the NPDES permit application process that it is, in fact, a "no discharge" facility. See proposed § 122.23(e). EPA anticipates that very few large CAFOs will be able to successfully demonstrate that they do not discharge pollutants and do not have a reasonable potential to discharge in the future, and furthermore, that very few large CAFOs will wish to forego the protections of an NPDES permit. For instance, only those beef and dairy CAFOs with an NPDES permit will be authorized to discharge in a 25-year, 24-hour storm.

EPA also believes that a CAFO owner or operator's current obligation to apply for an NPDES permit is based not only on discharges from the feedlot area but also on discharges from the land application areas under the control of the CAFO operator. More specifically, discharges of CAFO-generated manure and/or wastewater from such land application areas should be viewed as discharges from the CAFO itself for the purpose of determining whether it has a potential to discharge. EPA recognizes, however, that it has not previously defined CAFOs to include the land application area. EPA is proposing to explicitly include the land application area in the definition of a CAFO in today's action.

The need for a clarified, broadly applicable duty to apply. EPA believes that virtually all large CAFOs have had a past or current discharge or have the potential to discharge in the future, and that meeting any one of these criteria would trigger a duty to apply for a permit. Today, EPA is proposing to revise the regulations by finding that, as a rebuttable presumption, all CAFOs do have a potential to discharge and, therefore, are required to apply for and to obtain an NPDES permit unless they can demonstrate that they will not discharge. See proposed § 122.23(c). (See section VII(F)3 for a fuller discussion on demonstrating "no potential to discharge.")

EPA has not previously sought to categorically adopt a duty to apply for an NPDES permit for all facilities within a particular industrial sector. The Agency is proposing today to do so for CAFOs for reasons that involve the unique characteristics of CAFOs and the zero discharge regulatory approach that applies to them.

First, as noted, since the inception of the NPDES permitting program in the 1970s, a relatively small number of larger CAFOs has actually sought permits. Information from State permit authorities and EPA's own regional offices indicates that, currently, approximately 2,500 CAFOs have NPDES permits out of approximately 12,000 CAFOs with greater than 1,000 AU.

EPA believes there are a number of reasons why so few CAFOs have sought NPDES permits over the years. The primary reason appears to be that the definition of a CAFO in the current regulations (as echoed in the regulations of some State programs) excludes animal feeding operations that do not discharge at all or discharge only in the event of a 25-year, 24-hour storm. [40 CFR 122.23, Appendix B]. Based on the existing regulation, many animal feeding operations that claim to be "zero dischargers" believe that they are not subject to NPDES permitting because they are excluded from the CAFO definition and thus are not CAFO point sources.

EPA believes that many of the facilities that have relied on this exclusion from the CAFO definition may have misinterpreted this provision. It excludes facilities from the CAFO definition only when they neither discharge pollutants nor have the potential to discharge pollutants in a 25-year, 24-hour storm. In fact, as explained above, a facility that has at least a potential to discharge pollutants (and otherwise meets the CAFO definition) not only is defined as a CAFO but also has a duty to apply for an NPDES permit, regardless of whether it actually discharges. (40 CFR 122.21(a)). Thus, many facilities that have at least a potential to discharge manure and wastewaters may have avoided permitting based on an incorrect reliance on this definitional exclusion.

To compound the confusion under the current regulations, EPA believes, there has been misinterpretation surrounding the issue of discharges from a CAFO's land application areas. As EPA has explained in section VII.D of today's notice, runoff from land application of CAFO manure is viewed as a discharge from the CAFO point source itself. Certain operations may have claimed to be "zero dischargers" when in fact they were not, and are not, zero dischargers when runoff from their land application areas is taken into account.

Another category of operations that may have improperly avoided permitting are those that have had a past discharge of pollutants, and are not designed and operated to achieve zero discharge except in a 25-year, 24-hour storm event. Many of these facilities may have decided not to seek a permit because they believe they will not have any future discharges. However, as explained above, an operation that has had a past discharge of pollutants is covered by the NPDES permitting regulations in the same way as operations that have a "potential" to discharge—*i.e.*, it is not only defined as a CAFO (where it meets the other elements of the definition) but is required to apply for a permit [Carr v. Alta Verde Industries, Inc., 931 F.2d 1055 (5th Cir. 1991)]. Facilities that have had a past discharge meet the criteria of § 122.21(a), in EPA's view, both as "dischargers" and as operations that have the potential for further discharge. Accordingly, they are required to apply for an NPDES permit. Misinterpretation regarding the need to apply for a permit may also have occurred in cases where the past discharges were from land application runoff, as explained above.

Finally, the nature of these operations is that any discharges from manure storage structures to waters of the U.S. are usually only intermittent, either due to accidental releases from equipment failures or storm events or, in some cases, deliberate releases such as pumping out lagoons or pits. The intermittent nature of these discharges, combined with the large numbers of animal feeding operations nationwide, makes it very difficult for EPA and State regulatory agencies to know where discharges have occurred (or in many cases, where animal feeding operations are even located), given the limited resources for conducting inspections. In this sense, CAFOs are distinct from typical industrial point sources subject to the NPDES program, such as manufacturing plants, where a facility's existence and location and the fact that it is discharging wastewaters at all is usually not in question. Accordingly, it is much easier for CAFOs to avoid the permitting system by not reporting their discharges, and there is evidence that such avoidances have taken place.

In sum, EPA believes it is very important in these regulatory revisions to ensure that all CAFOs have a duty to apply for an NPDES permit, including those facilities that currently have a duty to apply because they meet the definition of CAFO under the existing regulations and those facilities which would meet the proposed revised definition of CAFO. Two of the revisions that EPA is proposing today to other parts of the CAFO regulations would themselves significantly address this matter. First, EPA is proposing to eliminate the 25-year, 24-hour storm exemption from the definition of a CAFO. Operations would no longer be able to avoid being defined as CAFO point sources subject to permitting on the basis that they do not discharge or discharge only in the event of a 25-year, 24-hour storm. Second, EPA is proposing to clarify that land application areas are part of the CAFO and any associated discharge from these areas is subject to permitting.

While these two proposed changes would help address the "duty to apply" issue, EPA does not believe they would go far enough. Even with eliminating the 25-year, 24-hour storm exemption from the CAFO definition, EPA is concerned that operations would still seek to avoid permitting by claiming they are "zero dischargers." Specifically, EPA has encountered a further zero discharge conundrum: A facility claims that by controlling its discharge down to zero—the very level that a permit would require—it has effectively removed itself from CWA jurisdiction, because the CWA simply prohibits discharging without a permit, so a facility that does not discharge does not need a permit. EPA believes this would be an incorrect reading of the CWA and would not be a basis for claiming an exemption from permitting (as explained directly below). Therefore, it is important to clarify in the regulations that even CAFOs that claim to be zero dischargers must apply for a permit.

To round out the basis for this proposed revision, EPA is proposing a regulatory presumption in the regulations that all CAFOs have a potential to discharge to the waters such that they should be required to apply for a permit. EPA believes this would be a reasonable presumption on two grounds. First, the Agency believes this is reasonable from a factual standpoint, as is fully discussed in section V of today's preamble.

This factual finding would become even more compelling under today's proposals to eliminate the 25-year, 24-hour storm exemption from the CAFO definition and to clarify that discharges from on-site land application areas, are considered CAFO point source discharges. If these two proposals were put in place, EPA believes, many fewer operations would be claiming that they do not discharge.

Second, a presumption that all CAFOs have a potential to discharge would be reasonable because of the need for clarity on the issues described above and the historical inability under the current regulations to effectuate CAFO permitting. Under today's proposal, the duty would be for each CAFO to apply for a permit, not necessarily to obtain one. A CAFO that believes it does not have a potential to discharge could seek to demonstrate as much to the permitting authority in lieu of submitting a full permit application. (To avoid submitting a completed permit application, a facility would need to receive a "no potential to discharge" determination from the permit authority prior to the deadline for applying for a permit. See section VII.F.3 below.) If the demonstration were successful, the permitting authority would not issue a permit. Therefore, the duty to apply would be based on a rebuttable presumption that each facility has a potential to discharge. Without this rebuttable presumption, EPA believes it could not effectuate proper permitting of CAFOs because of operations that would claim to be excluded from the CWA because they do not discharge.

CWA authority for a duty to apply. In pre-proposal discussions, some stakeholders have questioned EPA's authority under the Clean Water Act to impose a duty for all CAFOs to apply for a permit. EPA believes that the CWA does provide such authority, for the following reasons.

Section 301(a) of the CWA says that no person may discharge without an NPDES permit. The Act is silent, however, on the requirement for permit applications. It does not explicitly require anyone to apply for a permit, as some stakeholders have pointed out. But neither does the Act expressly prohibit EPA from requiring certain facilities to submit an NPDES permit application or from issuing an NPDES permit without one. Section 402(a) of the Act says simply that the Agency may issue an NPDES permit after an opportunity for public hearing.

Indeed, finding that EPA could not require permitting of CAFOs would upset the legislative scheme and render certain provisions of the Act meaningless. Section 301(b)(2)(A), which sets BAT requirements for existing sources and thus is at the heart of the statutory scheme, states that EPA shall establish BAT standards that "require the elimination of discharges of all pollutants if the Administrator finds * * * that such elimination is technologically and economically achievable.* * *" In other words, Congress contemplated that EPA could set effluent standards going down to zero discharge where appropriate. Section 306, concerning new sources, contains similar language indicating that zero discharge may be an appropriate standard for some new sources. Section 402 puts these standards into effect by requiring EPA to issue NPDES permits that apply these standards and ensure compliance with them. Thus, the Act contemplates the issuance of NPDES permits that require zero discharge. These provisions are underscored by Section 101(a) of the Act, which sets a national goal of not just reducing but eliminating the discharge of pollutants to the waters.

This statutory scheme would be negated if facilities were allowed to avoid permitting by claiming that they already meet a zero discharge standard that is established in the CAFO regulations and that a permit would require. Issuing a zero discharge standard would be an act of futility because it could not be implemented through a permit. Under a contrary interpretation, a CAFO could repeatedly discharge and yet avoid permitting by claiming that it does not intend to discharge further. EPA does not believe that Congress intended to tie the Agency's hands in this manner. To be sure, in no other area of the NPDES program are industrial operations allowed to avoid permitting by claiming that they already meet the limits that a permit would require. That would be a plainly wrong view of the Act; Section 301(a) states unequivocally that no person may discharge at all without a permit. The Act does not contemplate a different system for facilities that are subject to a zero discharge standard, and it is the unique nature of the zero discharge standard that makes it appropriate for EPA to require CAFOs to apply for permits.

EPA also finds authority to require NPDES permit applications from CAFOs in Section 308 of the Act. Under Section 308, the Administrator may require point sources to provide information "whenever required to carry out the objective of this chapter," for purposes, among other things, of determining whether any person is in violation of effluent limitations, or to carry out Section 402 and other provisions. Because EPA proposes a presumption that all CAFOs have a potential to discharge pollutants, it is important, and within EPA's authority, to collect information from CAFOs in order to determine if they are in violation of the Act or otherwise need a permit.

EPA solicits comment on the proposed duty to apply.

e. *The Definitions of AFO and CAFO Would Include the Land Areas Under the Control of the Operator on Which Manure is Applied.* In today's proposal, EPA defines an AFO to include both the animal production areas of the operation and the land areas, if any, under the control of the owner or operator, on which manure and associated waste waters are applied. See proposed § 122.23(a)(1). The definition of a CAFO is based on the AFO definition and thus would include the land application areas as well. Accordingly, a CAFO's permit would include requirements to control not only discharges from the production areas but also those discharges from the land application areas. Under the existing regulations, discharges from a CAFO's land application areas that result from improper agricultural practices are already considered to be discharges from the CAFO and therefore, are subject to the NPDES permitting program. However, EPA believes it would be helpful to clarify the regulations on this point.

By the term "production area," EPA means the animal confinement areas, the manure storage areas (e.g. lagoon, shed, pile), the feed storage areas (e.g., silo, silage bunker), and the waste containment areas (e.g., berms, diversions). The land application areas include any land to which a CAFO's manure and wastewater is applied (e.g., crop fields, fields, pasture) that is under the control of the CAFO owner or operator, whether through ownership or a lease or contract. The land application areas do not include areas that are not under the CAFO owner's or operator's control. For example, where a nearby farm is owned and operated by someone other than the CAFO owner or operator and the nearby farm acquires the CAFO's manure or wastewater, by contract or otherwise, and applies those wastes to its own crop fields, those crop fields are not part of the CAFO.

The definition of an AFO under the existing regulations refers to a "lot or facility" that meets certain conditions, including that "[c]rops, vegetation[,] forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility." 40 CFR 122.23(b)(1). In addition, the regulations define "discharge of a pollutant" as the addition of any pollutant to waters of the United States from any point source. 40 CFR 122.2. EPA interprets the current regulations to include discharges of CAFO-generated manure and wastewaters from improper land application to areas under the control of the CAFO as discharges from the CAFO itself. Otherwise, a CAFO could simply move its wastes outside the area of confinement, and over apply or otherwise improperly apply those wastes, which would render the CWA prohibition on unpermitted discharges of pollutants from CAFOs meaningless. Moreover, the pipes and other manure-spreading equipment that convey CAFO manure and wastewaters to land application areas under the control of the CAFO are an integral part of the CAFO. Under the existing regulations, this equipment should be considered part of the CAFO, and discharges from this equipment that reach the waters of the United States as a result of improper land application should be considered discharges from the CAFO for this reason as well. In recent litigation brought by citizens against a dairy farm, a federal court reached a similar conclusion. *See* CARE v. Sid Koopman Dairy, et al., 54 F. Supp. 2d 976 (E.D. Wash., 1999).

One of the goals of revising the existing CAFO regulations is to make the regulations clearer and more understandable to the regulated community and easier for permitting authorities to implement. EPA believes that amending the definition of an AFO (and, by extension, CAFO) to expressly include land application areas will help achieve this clarity and will enable permitting authorities to both more effectively implement the proposed effluent guidelines and to more effectively enforce the CWA's prohibition on discharging without a permit. It would be clear under this revision that the term "CAFO" means the entire facility, including land application fields and other areas under the CAFO's control to which it applies its manure and wastewater. By proposing to include land application areas in the definition of an AFO, and therefore, a CAFO, discharges from those areas would, by definition, be discharges from a point source—i.e., the CAFO. There would not need to be a separate showing of a discernible, confined, and discrete conveyance such as a ditch.

While the CWA includes CAFOs within the definition of a point source, it does not elaborate on what the term CAFO means. EPA has broad discretion to define the term CAFO. Land application areas are integral parts of many or most CAFO operations. Land application is typically the end point in the cycle of manure management at CAFOs. Significant discharges to the waters in the past have been attributed to the land application of CAFO-generated manure and wastewater. EPA does not believe that Congress could have intended to exclude the discharges from a CAFO's land application areas from coverage as discharges from the CAFO point source. Moreover, defining CAFOs in this way is consistent with EPA's effluent limitations guidelines for other industries, which consider on-site waste treatment systems to be part of the production facilities in that the regulations restrict discharges from the total operation. Thus, it is reasonable for EPA to revise the regulations by including land application areas in the definition of an AFO and CAFO.

While the proposal would include the land application areas as part of the AFO and CAFO, it would continue to count only those animals that are confined in the production area when determining whether a facility is a CAFO.

EPA is also considering today whether it is reasonable to interpret the agricultural storm water exemption as not applicable to any discharges from CAFOs. See section VII.D.2. If EPA were to adopt that interpretation, all discharges from a CAFO's land application areas would be subject to NPDES requirements, regardless of the rate or manner in which the manure has been applied to the land.

Please refer to section VII.D for a full discussion of land application, including EPA's proposal with regard to land application of CAFO manure by non-CAFOs.

EPA is requesting comment on this approach.

f. *What Types of Poultry Operations are CAFOs?* EPA is proposing to revise the CAFO regulations to include all poultry operations with the potential to discharge, and to establish the threshold for AFOs to be defined as CAFOs at 50,000 chickens and 27,500 turkeys. See proposed § 122.23(a)(3)(i)(H) and (I). The proposed revision would remove the limitation on the type of manure handling or watering system employed at laying hen and broiler operations and would, therefore, address all poultry operations equally. This approach would be consistent with EPA's objective of better addressing the issue of water quality impacts associated with both storage of manure at the production area and land application of manure while simultaneously simplifying the regulation. The following discussion focuses on the revisions to the threshold for chickens under each of the co-proposed regulatory alternatives.

The existing NPDES CAFO definition is written such that the regulations only apply to laying hen or broiler operations that have continuous overflow watering or liquid manure handling systems (i.e.,"wet" systems). (40 CFR Part 122, Appendix B.) EPA has interpreted this language to include poultry operations in which dry litter is removed from pens and stacked in areas exposed to rainfall, or piles adjacent to a watercourse. These operations may be considered to have established a crude liquid manure system (see 1995 NPDES Permitting Guidance for CAFOs). The existing CAFO regulations also specify different thresholds for determining which AFOs are CAFOs depending on which of these two types of systems the facility uses (e.g., 100,000 laying hens or broilers if the facility has continuous overflow watering; 30,000 laying hens or boilers if the facility has a liquid manure system). When the NPDES CAFO regulations were promulgated, EPA selected these thresholds because the Agency believed that most commercial operations nsed wet systems (38 FR 18001, 1973).

In the 25 years since the CAFO regulations were promulgated, the poultry industry has changed many of its production practices. Many changes to the layer production process have been instituted to keep manure as dry as possible. Consequently, the existing effluent goidelines do not apply to many broiler and laying hen operations, despite the fact that chicken production poses risks to surface water and ground water quality from improper storage of dry manure, and improper land application. It is EPA's understanding that continuous overflow watering has been largely discontinued in lieu of more efficient watering methods (i.e., on demand watering), and that liquid manure handling systems represent perhaps 15 percent of layer operations overall, although in the South approximately 40 percent of operations still have wet manure systems.

Despite the CAFO regulations, nutrients from large poultry operations continue to contaminate surface water and ground water due to rainfall coming in contact with dry manure that is stacked in exposed areas, accidental spills, etc. In addition, land application remains the primary management method for significant quantities of poultry litter (including manure generated from facilities using "dry" systems). Many poultry operations are located on smaller parcels of land in comparison to other livestock sectors, oftentimes owning no significant cropland or pastnre, placing increased importance on the proper management of the potentially large amounts of manure that they generate. EPA also believes that all types of livestock operations should be treated equitably under the revised regulation.

As documented in the Enviroumental Impact Assessment, available in the rulemaking Record, poultry production in concentreted areas such as in the Southeast, the Delmarva Peninsula in the mid-Atlantic, and in key Midwestern States has been shown to cause serious water quality impairments. For example, the Chesapeake Bay watershed's most serious water quality problem is caused by the overabundance of nutrients (e.g. nitrogen and phosphorus). EPA's Chesapeake Bay Program Office estimates that poultry manure is the largest source of excess nitrogen and phosphorous reaching the Chesapeake Bay from the lower Eastern Shore of Maryland and Virginia, sending more than four times as much nitrogen into the Bay as leaky septic tanks and runoff from developed areas, and more than three times as much phosphorus as sewage treatment plants. These discharges of nutrients result from an over-abundance of manure relative to land available for application, as well as the management practices required to deal with the excess manure. The State of Marylend has identified instances where piles of chicken litter have been stored near ditches and creeks that feed tributaries of the Bay. Soil data also suggest that in some Maryland counties with poultry production the soils already contain 90 percent or more of the phosphorus needed by crops. The State of Maryland has surveyed the Pocomoke, Transquaking, and Manokin river systems and has concluded that 70–87 percent of all nutrients reaching those waters came from farms (though not all from AFOs). Based on EPA data, phosphorus concentrations in the Pocomoke Sound have increased more than 25 percent since 1985, suffocating sea grasses that serve as vital habitat for fish and crabs. In 1997, poultry operations were found to be a contributing cause of Pfiesteria outbreaks in the Pokomoke River and Kings Creek (both in Maryland) and in the Chesapeake Bay, in which tens of thousands of fish were killed. Other examples of impacts from poultry manure are discussed in section V of today's proposal.

Dry manure handling is the predominant practice in the broiler and other meat type chicken industries. Birds are housed on dirt or concrete floors that have been covered with a bedding material such as wood shavings. Manure becomes mixed with this bedding to form a litter, which is removed from the house in two ways. After each flock of birds is removed from the house a portion of litter, referred to as cake, is removed. Cake is litter that has become clumped, usually below the wateriog system, although it can also be formed by a concentration of manure. In addition, the operator also removes all of the litter from the honse periodically. The freqnency of the "whole house" clean-out varies but commonly occurs once each year, unless a breach of biosecurity is snspected.

Broiler operations generally house between five and six flocks of birds each year, which means there are between five or six "cake-outs" each year. Roasters have fewer flocks, and small fryers have more flocks, but the volume of "cake-out" removed in a year is comparable. "Cake-outs" will sometimes occur doring periods when it is not possible to land apply the litter (e.g. in the middle of the growing season or during the winter when field conditions may not be conducive to land application). Consequently, it is usually necessary to store the dry litter after removal until it can be laud applied.

Depending on the time of year it occurs, "whole house" clean-out may also require the operator to store the dry manure until it can be land applied. If the manure is stored in open stockpiles over long periods of time, usually greater than a few weeks, runoff from the stockpile may contribute pollutants to surface water and/or ground water that is hydrologically connected to surface water.

The majority of egg laying operations use dry manure handling, although there are operations with liquid manure handling systems. Laying hens are kept in cages and manure drops below the cages in both dry and liquid manure handling systems. Most of the dry manure operations are constructed as high rise houses where the birds are kept on the second floor and the manure drops to the first floor, which is sometimes referred to as the pit. Ventiletion flows through the house from the roof down over the birds and into the pit over the mannre before it is forced out through the sides of the house. The ventilation dries the manure as it piles up into cones. Manure can usually be stored in high rise houses for up to a year before requiring removal.

Problems can occur with dry manure storage in a high rise house when drinking water systems are not properly designed or maintaioed. For example, improper design or maintenance of the water system can result in excess water spilling iuto the pit below, which raises the moisture content of the manure, resulting in the potential for spills and releases of manure from the building.

Concerns with inadequate storage or improper design and maintenance contribute to concerns over dry manure systems for laying hens. As with broiler operations, open stockpiles of litter stored over long periods of time (e.g., greater than a few weeks) mey contribute to pollutant discharge from contaminated runoff and leachate leaving the stockpile. Laying hens operations may also use a liquid manure handling system. The system is similar to the dry manure system except that the manure drops below the cages into a channel or shallow pit and water is used to flush this manure to a lagoon.

The existing regulation already applies to laying hen and broiler operations with 100,000 birds when a continuous flow watering system is used, and to 30,000 birds when a liquid manure handling system is used. In revising the threshold for poultry operations, EPA evaluated several methods for equating poultry to the existing definition of an animal unit. EPA considered laying hens, pullets, broilers, and roasters separately to reflect the differences in size, age, production, feeding practices, housing, waste management, manure generation, and nutrient content of the manure. Manure generation and pollutant parameters considered include: nitrogen, phosphorus, BOD5, volatile solids, and COD. Analysis of these parameters consistently results in a threshold of 70,000 to 140,000 birds as being equivalent to 1,000 animal units. EPA also considered a liveweight basis for defining poultry. The liveweight definition of animal unit as used by USDA defines 455,000 broilers and pullets and 250,000 layers as being representative of 1,000 animal units. EPA data indicates that using a liveweight basis at 1,000 AU would exclude virtually all broiler operations from the regulation.

Consultations with industry indicated EPA should evaluate the different sizes (ages) and purposes (eggs versus meat) of chickens separately. However, when evaluating broilers, roasters, and other meat-type chickens, EPA concluded that a given number of birds capacity represented the same net annual production of litter and nutrients. For example, a farm producing primarily broilers would raise birds for 6–8 weeks with a final weight of 3 to 5 pounds, a farm producing roasters would raise birds for 9–11 weeks with a final weight of 6 to 8 pounds, whereas a farm producing game hens may only keep birds for 4–6 weeks and at a final weight of less than 2 pounds. The housing, production practices, waste management, and manure nutrients and process wastes generated in each case is essentially the same. Layers are typically fed less than broilers of equivalent size, and are generally maintained as a smaller chicken. However, a laying hen is likely to be kept for a year of egg production. The layer is then sold or molted for several weeks, followed by a second period of egg production. Pullets are housed until laying age of approximately 18 to 22 weeks. In all cases manure nutrients and litter generated results in a threshold of 80,000 to 130,000 birds as being the equivalent of 1,000 animal units.

Today's proposed NPDES and effluent guidelines requirements for poultry eliminate the distinction between how manure is handled and the type of watering system that is used. EPA is proposing this change because it believes there is a need to control poultry operations regardless of the manure handling or watering system. EPA believes that improper storage as well as land application rates which exceed agricultural use have contributed to water quality problems, especially in areas with large concentrations of poultry production. Inclusion of poultry operations in the proposed NPDES regulation is intended to be consistent with the proposed effluent guidelines regulation, discussed in section VIII of today's preamble. EPA is proposing that 100,000 laying hens or broilers be considered the equivalent of 1,000 animal units.

Consequently EPA proposes to establish the threshold under the two-tier alternative structure that defines which operations are CAFOs at 500 animal units as equivalent to 50,000 birds. Facilities that are subject to designation are those with fewer than 50,000 birds. This threshold would address approximately 10 percent of all chicken AFOs nationally and more than 70 percent of all manure generated by chickens. On a sector specific basis, this threshold would address approximately 28 percent of all broiler operations (including all meat-type chickens) while addressing more than 70 percent of manure generated by broiler operations. For layers (including pullets) the threshold would address less than 5 percent of layer operations while addressing nearly 80 percent of manure generated by layer operations. EPA believes this threshold is consistent with the threshold established for the other livestock sectors.

Under this two-tier structure, today's proposed changes exclude poultry operations with liquid manure handling systems if they have between 30,000 and 49,999 birds. EPA estimates this to be few if any operations nationally and believes these are relatively small operations. EPA does not believe these few operations pose a significant threat to water quality even in aggregation. EPA also notes that the trend in laying hen operations (where liquid systems may occur) has been to build new operations to house large numbers of animals (e.g., usually in excess of 100,000 birds per house), which frequently employ dry manure handling systems. Given the limited number of existing operations with liquid manure handling systems and the continuing trend toward larger operations, EPA believes the proposed uniform threshold of 50,000 birds is appropriate.

Under the proposed alternative three-tier structure, any operation with more than 100,000 chickens is automatically defined as a CAFO. This upper tier reflects 4 percent of all chicken operations. Additionally those poultry operations with 30,000 to 100,000 chickens are defined as CAFOs if they meet the unacceptable conditions presented in section VII.C. This middle tier would address an additional 10 percent of poultry facilities. By sector this middle tier would potentially cover an additional 45 percent of broiler manure and 22 percent layer manure. In aggregate this scenario would address 14 percent of chicken operations and 86 percent of manure. See VI.A.2 for the additional information regarding scope of the two proposed regulatory alternatives.

EPA acknowledges that this threshold pulls in a substantial number of chicken operations under the definition of a CAFO. Geographic regions with high density of poultry production have experienced water quality problems related to an overabundance of nutrients, to which the poultry industry has contributed. For example northwestern Arkansas and the Dalmarva peninsula in the Mid-Atlantic tend to have smaller poultry farms as compared to other regions. The chicken and turkey sectors also have higher percentages of operations with insufficient or no land under the control of the AFO on which to apply manure. Thus EPA believes this threshold is appropriate to adequately control the potential for discharges from poultry CAFOs.

g. *How Would Immature Animals in the Swine and Dairy Sectors be Counted?* EPA is proposing to include immature swine and heifer operations under the CAFO definition. See proposed § 122.23(a)(3)(i)(C) and (E). In the proposed two-tier structure, EPA would establish the 500 AU threshold equivalent for defining which operations are CAFOs as operations with 5000 or more swine weighing 55 pounds or less, and those with fewer than 5000 swine under 55 pounds are AFOs which may be designated as CAFOs. Immature dairy cows, or heifers, would be counted equivalent to beef cattle; that is, the 500 AU threshold equivalent for defining CAFOs would be operations with 500 or more heifers, and those with fewer than 500 could be designated as CAFOs.

In the proposed three-tier structure, the 300 AU and 1,000 AU equivalents, respectively for each animal type would be: 3,000 head and 10,000 head for immature swine; and 300 head and 1,000 head for heifers.

Only swine over 55 pounds and mature dairy cows are specifically included in the current definition (although manure and wastewater generated by immature animals confined at the same operation with mature animals are subject to the existing requirements). Immature animals were not a concern in the past because they were generally part of operations that included mature animals and, therefore, their manure was included in the permit requirements of the CAFO. However, in recent years, these livestock industries have become increasingly specialized with the emergence of increasing numbers of large stand-alone nurseries. Further, manure from immature animals tends to have higher concentrations of pathogens and hormones and thus poses greater risks to the environment and human health.

Since the 1970s, the animal feeding industry has become more specialized, especially at larger operations. When the CAFO regulations were issued, it was typical to house swine from birth to slaughter together at the same operation known as a farrow to finish operation. Although more than half of swine production continues to occur at farrow-to-finish operations, today it is common for swine to be raised in phased production systems. As described in section VI, specialized operations that only house sows and piglets until weaned represent the first phase, called farrowing. The weaned piglets are transferred to a nursery, either at a separate building or at a location remote from the farrowing operation for biosecurity concerns. The nursery houses the piglets until they reach about 55 to 60 pounds, at which time they are transferred to another site, the grow-finish facility.

The proposed thresholds for swine are established on the basis of the average phosphorus excreted from immature swine in comparison to the average phosphorus excreted from swine over 55 pounds. A similar threshold would be obtained when evaluating live-weight manure generation, nitrogen, COD and volatile solids (VS). See the Technical Development Document for more details.

Dairies often remove immature heifers to a separate location until they reach maturity. These off-site operations may confine the heifers in a manner that is very similar to a beef feedlot or the heifers may be placed on pasture. The existing CAFO definition does not address operations that only confine immature heifers. EPA acknowledges that dairies may keep heifers and calves and a few bulls on site. EPA data indicates some of these animals are in confinement, some are pastured, and some moved back and forth between confinement, open lots, and pasture. The current CAFO definition considers only the mature milking cows. This has raised some concerns that many dairies with significant numbers of immature animals could be excluded from the regulatory definition even though they may generate as much manure as a dairy with a milking herd large enough to be a CAFO. The proportion of immature animals maintained at dairies can vary significantly with a high being a one to one ratio. Industry-wide there are 0.6 immature animals for every milking cow.

EPA considered options for dairies that would take into account all animals maintained in confinement, including calves, bulls and heifers when determining whether a dairy is a CAFO or not. EPA examined two approaches for this option, one that would count all animals equally and another based on the proportion of heifers, calves, and bulls likely to be present at the dairy. EPA is not proposing to adopt either of these options.

The milking herd is usually a constant at a dairy, but the proportion of immature animals can vary substantially among dairies and even at a given dairy over time. Some operations maintain their immature animals on-site, but keep them on pasture most of the time. Some operations keep immature animals on-site, and maintain them in confinement all or most of the time. Some operations may also have one or two bulls on-site, which can also be kept either in confinement or on pasture, while many keep none on-site. Some operations do not keep their immature animals on-site at all, instead they place them offsite, usually in a stand-alone heifer operation. Because of the variety of practices at dairies, it becomes very difficult to estimate how many operations have immature animals on-site in confinement. EPA believes that basing the applicability on the numbers of immature animals and bulls would make implementing the regulation more difficult for the permit authority and the CAFO operator. However, EPA requests comment on this as a possible approach.

EPA also requests comments on using only mature milking cows as the means for determining applicability of the size thresholds. Under the two-tier structure, EPA's proposed requirements for dairies would apply to 3 percent of the dairies nationally and will control 37 percent of the CAFO manure generated by all dairies nationally. This is proportionally lower than other livestock sectors, largely due to the dominance of very small farms in the dairy industry. There are similar trends in the dairy industry as in the other livestock sectors, indicating that the number of large operations is increasing while the number of small farms continues to decline. Under the three-tier structure, EPA's proposed requirements would apply to 6 percent of the dairies nationally, and will control 43 percent of all manure generated at dairy CAFOs annually. See Section VI.A.1.

Inclusion in the proposed NPDES definition of immature swine and heifers is intended to be consistent with the proposed effluent guidelines regulation, described in section VIII of today's preamble.

P. *What Other Animal Sectors Does Today's Proposal Affect?* EPA is proposing to lower the threshold for defining which AFOs are CAFOs to the equivalent of 500 AU in the horse, sheep, lamb and duck sectors under the two-tier structure. See proposed § 122.23(a)(3)(i). This action is being taken to be consistent with the NPDES proposed revisions for beef, dairy, swine and poultry. Under the three-tier structure, the existing thresholds would remain as they are under the existing regulation.

The animal types covered by the NPDES program are defined in the current regulation (Part 122 Appendix B). The beef, dairy, swine, poultry and veal sectors are being addressed by both today's effluent guidelines proposal and today's NPDES proposal. However, today's proposal would not revise the effluent guidelines for any animal sector other than beef, dairy, swine, poultry and veal. Therefore, under today's proposal, any facility in the horse, sheep, lamb and duck sectors with 500 to 1,000 AU that is defined as a CAFO, and any facility in any sector below 500 AU that is designated as a CAFO, will not be subject to the effluent guidelines, but will have NPDES permits developed on a best professional judgment (BPJ) basis.

Table 7–6 identifies those meeting the proposed 500 AU threshold in the two-tier structure. Table 7–7 identifies the numbers of animals meeting the 300 AU, 300 AU to 1,000 AU, and the 1,000 AU thresholds in the three-tier structure.

A facility confining any other animal type that is not explicitly mentioned in the NPDES and effluent guidelines regulations is still subject to NPDES permitting requirements if it meets the definition of an AFO and if the permit authority designates it as a CAFO on the basis that it is a significant contributor of pollution to waters of the U.S. Refer to VII.C.4 in today's proposal for a discussion of designation for AFOs.

The economic analysis for the NPDES rule does not cover animal types other than beef, dairy, swine and poultry. EPA chose to analyze those animal types that produce the greatest amount of manure and wastewater in the aggregate while in confinement. EPA believes that most horses, sheep, and lambs operations are not confined and therefore will not be subject to permitting, thus, the Agency expects the impacts in these sectors to be minimal. However, most duck operations probably are confined. EPA requests comments on the effect of this proposal on the horse, sheep, lamb and duck sectors.

i. *How Does EPA Propose to Control Manure at Operations that Cease to be CAFOs?* EPA is proposing to require operators of permitted CAFOs that cease operations to retain NPDES permits until the facilities are properly closed, i.e., no longer have the potential to discharge. See § 122.23(i)(3). Similarly, today's proposal would clarify that, if a facility ceases to be an active CAFO (e.g., it decreases the number of animals below the threshold that defined it as a CAFO, or ceases to operate), the CAFO must remain permitted until all wastes at the facility that were generated while the facility was a CAFO no longer have the potential to reach waters of the United States.

These requirements mean that if a permit is about to expire and the manure storage facility has not yet been properly closed, the facility would be required to apply for a permit renewal because the facility has the potential to discharge to waters of the U.S. until it is properly closed. Proper facility closure includes removal of water from lagoons and stockpiles, and proper disposal of wastes, which may include land application of manure and wastewater in accordance with NPDES permit requirements, to prevent or minimize discharge of pollutants to receiving waters.

The existing regulations do not explicitly address whether a permit should be allowed to expire when an owner or operator ceases operations. However, the public has expressed concerns about facilities that go out of business leaving behind lagoons, stockpiles and other contaminants unattended and unmanaged. Moreover, there are a number of documented instances of spills and breaches at CAFOs that have ceased operations, leaving behind environmental problems that became a public burden to resolve (see, for example, report of the North Carolina DENR, 1999).

EPA considered five options for NPDES permit requirements to ensure that CAFO operators provide assurances for proper closure of their facilities (especially manure management systems such as lagoons) in the event of financial failure or other business curtailment. EPA examined the costs to the industry and the complexity of administering such a program for all options. The analyses of these options are detailed in the EPA NPDES CAFO Rulemaking Support Document, September 26, 2000.

Closure Option 1 would require a closure plan. The CAFO operator would be required to have a written closure plan detailing how the facility plans to dispose of animal waste from manure management facilities. The plan would be submitted with the permit application and be approved with the permit application. The plan would identify the steps necessary to perform final closure of the facility, including at least:

- A description of how each major component of the manure management facility (e.g., lagoons, settlement basins, storage sheds) will be closed;
- An estimate of the maximum inventory of animal waste ever on-site, accompanied with a description of how the waste will be removed, transported, land applied or otherwise disposed; and
- A closure schedule for each component of the facility along with a description of other activities necessary during closure (e.g., control run-off/run-on, ground water monitoring if necessary).

EPA also investigated several options that would provide financial assurances in the event the CAFO went out of business, such as contribution to a sinking fund, commercial insurance, surety bond, and other common commercial mechanisms. Under Closure Option 2, permittees would have to contribute to a sinking fund to cover closure costs of facilities which abandon their manure management systems. The contribution could be on a per-head basis, and could be levied on the permitting cycle (every five years), or annually. The sinking fund would be available to cleanup any abandoned facility (including those which are not permitted). Data on lagoon closures in North Carolina (Harrison, 1999) indicate that the average cost of lagoon closure for which data are available is approximately $42,000. Assuming a levy of $0.10 per animal, the sinking fund would cover the cost of approximately 50 abandonments nationally per year, not accounting for any administrative costs associated with operating the funding program.

Closure Option 3 would require permittees to provide financial assurance by one of several generally accepted mechanisms. Financial assurance options could include the following common mechanisms: a) Commercial insurance; (b) Financial test; (c) Guarantee; (d) Certificate of Deposit or designated savings account; (e) Letter of credit; or (f) Surety bond. The actual cost to the permittee would depend upon which financial assurance option was available and implemented. The financial test would likely be the least expensive for some operations, entailing documentation that the net worth of the CAFO operator is sufficient such that it is unlikely that the facility will be abandoned for financial reasons. The guarantee would also be inexpensive, consisting of a legal guarantee from a parent corporation or other party (integrator) that has sufficient levels of net worth. The surety bond would likely be the most expensive, typically requiring an annual premium of 0.5 to 3.0 percent of the value of the bond; this mechanism would likely be a last resort for facilities that could not meet the requirement of the other mechanisms.

Option 4 is a combination of Options 2 and 3. Permittees would have to provide financial assurance by one of several generally accepted mechanisms, or by participating in a sinking fund. CAFO operators could meet closure requirements through the most economical means available for their operation.

Option 5, the preferred option in today's proposal, simply requires CAFOs to maintain NPDES permit coverage until proper closure. Under this option, facilities would be required to maintain their NPDES permits, even upon curtailment of the animal feeding operation, for as long as the facility has the potential to discharge. The costs for this option would be those costs associated with maintaining a permit.

Today, EPA is proposing to require NPDES permits to include a condition that imposes a duty to reapply for a permit unless an owner or operator has closed the facility such that there is no potential for discharges. The NPDES program offers legal and financial sanctions that are sufficient, in EPA's view, to ensure that operators comply with this requirement. EPA believes that this option would accomplish its objectives and would be generally easy and effective to implement. However, there are concerns that it would not be effective for abandoned facilities because, unlike some of the other options, no financial assurance mechanism would be in place. EPA is requesting comment on the practical means of addressing the problem of unmanaged waste from closed or abandoned CAFOs, and what authorities EPA could use under the CWA or other statutes to address this problem.

See Section VII.E.5.c of today's proposal, which further discusses the requirement for permit authorities to include facility closure in NPDES permit special conditions.

While EPA is today proposing to only require ongoing permit coverage of the former CAFO, permit authorities are encouraged to consider including other conditions such as those discussed above.

j. *Applicability of the Regulations to Operations That Have a Direct Hydrologic Connection to Ground Water.* Because of its relevance to today's proposal, EPA is restating that the Agency interprets the Clean Water Act to apply to discharges of pollutants from a point source via ground water that has a direct hydrologic connection to surface water. See proposed § 122.23(e). Specifically, the Agency is proposing that all CAFOs, including those that discharge or have the potential to discharge CAFO wastes to navigable waters via ground water with a direct hydrologic connection must apply for an NPDES permit. In addition, the proposed effluent guidelines will require some CAFOs to achieve zero discharge from their production areas including via ground water which has a direct hydrologic connection to surface water. Further, for CAFOs not subject to such an effluent guideline, permit writers would in some circumstances be required to establish special conditions to address such discharges. In all cases, a permittee would have the opportunity to provide a hydrologist's report to rebut the presumption that there is likely to be a discharge from the production area to surface waters via ground water with a direct hydrologic connection.

For CAFOs that would be subject to an effluent guideline that includes requirements for zero discharge from the production area to surface water via ground water (all existing and new beef and dairy operations, and new swine and poultry operations, see proposed § 412.33(a), 412.35(a), and 412.45(a)), the proposed regulations would presume that there is a direct hydrologic connection to surface water. The permittee would be required to either achieve zero discharge from the production area via ground water and perform the required ground water monitoring or provide a hydrologist's statement that there is no direct connection of ground water to surface water at the facility. See 40 CFR 412.33(a)(3), 412.35(a)(3), and 412.45(a)(3).

For CAFOs that would be subject to the proposed effluent guideline at 412.43 (existing swine, poultry and veal facilities) which does not include ground water requirements, if the permit writer determines that the facility is in an area with topographical characteristics that indicate the presence of ground water that is likely to have a direct hydrologic connection to surface water and if the permit writer determines that pollutants may be discharged at a level which may cause or contribute to an excursion above any State water quality standard, the permit writer would be required to include special conditions to address potential discharges via ground water. EPA is proposing that the permittee must either comply with those conditions or provide a hydrologist's statement that the facility does not have a direct hydrologic connection to surface water. 40 CFR 122.23(j)(6) and (k)(5).

If a CAFO is not subject to the Part 412 Subparts C or D effluent guideline (e.g., because it has been designated as a CAFO and is below the threshold for applicability of those subparts; or is a CAFO in a sector other than beef, dairy, swine, poultry or veal and thus is subject to subparts A or B), then the permit writer would be required to decide on a case-by-case basis whether effluent limitations (technology-based and water quality-based, as necessary) should be established to address potential discharges to surface water via hydrologically connected ground water. Again, the permittee could avoid or satisfy such requirements by providing a hydrologist's statement that there is no direct hydrologic connection 40 CFR 122.23(k)(5).

Legal Basis. The Clean Water Act does not directly answer the question of whether a discharge to surface waters via hydrologically connected ground water is unlawful. However, given the broad construction of the terms of the CWA by the federal courts and the goals and purposes of the Act, the Agency believes that while Congress has not spoken directly to the issue, the Act is best interpreted to cover such discharges. The statutory terms certainly do not prohibit the Agency's determination that a discharge to surface waters via hydrologically-connected ground waters can be governed by the Act, while the terms do clearly indicate Congress' broad concern for the integrity of the Nation's waters. Section 301(a) of the CWA provides that "the discharge of any pollutant [from a point source] by any person shall be unlawful" without an NPDES permit. The term "discharge of a pollutant" is defined as "any addition of a pollutant to navigable waters from any point source." 33 U.S.C. § 1362(12). In turn, "navigable waters" are defined as "the waters of the United States, including the territorial seas." 33 U.S.C. § 1362(7). None of these terms specifically includes or excludes regulation of a discharge to surface waters via hydrologically connected ground waters. Thus, EPA interprets the relevant terms and definitions in the Clean Water Act to subject the addition of manure to nearby surface waters from a CAFO via hydrologically connected ground waters to regulation.

Some sections of the CWA do directly apply to ground water. Section 102 of the CWA, for example, requires the Administrator to "develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters and improving the sanitary conditions of surface and underground waters." 33 U.S.C. § 1252. Such references, however, are not significant to the analysis of whether Congress has spoken directly on the issue of regulating discharges via ground water which directly affect surface waters. Specific references to ground water in other sections of the Act may shed light on the question of whether Congress intended the NPDES program to regulate ground water quality. That question, however, is not the same question as whether Congress intended to protect surface water from discharges which occur via ground water. Thus, the language of the CWA is ambiguous with respect to the specific question, but does not bar such regulation. Moreover, the Supreme Court has recognized Congress' intent to protect aquatic ecosystems through the broad federal authority to control pollution embodied in the Federal Water Pollution Control Act Amendments of 1972. Section 101 of the Act clearly states the purpose of the Act "to restore and maintain the chemical, physical, and biological integrity of the Nations' waters." 33 U.S.C. § 1251(a)(1). The Supreme Court found that "[t]his objective incorporated a broad, systemic view of the goal of maintaining and improving water quality: as the House Report on the legislation put it, "the word "integrity" * * * refers to a condition in which the natural structure and function of aquatic ecosystems [are] maintained." *United States* v. *Riverside Bayview Homes,* 474 U.S. 121, 132 (1985). An interpretation of the CWA which excludes regulation of point source discharges to the waters of the U.S. which occur via ground water would, therefore, be inconsistent with the overall Congressional goals expressed in the statute.

Federal courts have construed the terms of the CWA broadly (*Sierra Club* v. *Colorado Refining Co.*, 838 F. Supp. 1428, 1431 (D.Colo. 1993) (*citing Quivera Mining Co.* v. *EPA*, 765 F.2d 126, 129 (10th Cir. 1985)), but have found the language ambiguous with regard to ground water and generally examine the legislative history of the Act. *See e.g., Exxon* v. *Train*, 554 F.2d 1310, 1326–1329 (reviewing legislative history). However, a review of the legislative history also is inconclusive. Thus, courts addressing the issue have reached conflicting conclusions.

Since the language of the CWA itself does not directly address the issue of discharges to ground water which affect surface water, it is proper to examine the statute's legislative history. Faced with the problem of defining the bounds of its regulatory authority, "an agency may appropriately look to the legislative history and underlying policies of its statutory grants of authority." *Riverside Bayview Homes*, 474 U.S. at 132. However, the legislative history also does not address this specific issue. *See Colorado Refining Co.*, 838 F. Supp. at 1434 n.4 (noting legislative history inconclusive).

In the House, Representative Les Aspin proposed an amendment with explicit ground water protections by adding to the definition of "discharge of a pollutant" the phrase "any pollutant to ground waters from any point source." *Legislative History of the Water Pollution Control Act Amendments of 1972*, 93d Cong., 1st. Sess. at 589 (1972) (hereinafter "Legislative History"). While the Aspin amendment was defeated, that rejection does not necessarily signal an explicit decision by Congress to exclude even ground water per se from the scope of the permit program. Commentators have suggested that provisions in the amendment which would have deleted exemptions for oil and gas well injections were the more likely cause of the amendment's defeat. Mary Christina Wood, *Regulating Discharges into Groundwater: The Crucial Link in Pollution Control Under the Clean Water Act*, 12 Harv. Envtl. L. Rev. 569, 614 (1988); *see also* Legislative History at 590–597 (during debate on the amendment, members in support and members in opposition focused on the repeal of the exemption for oil and gas injection wells).

At the least, there is no evidence that in rejecting the explicit extension of the NPDES program to all ground water Congress intended to create a ground water loophole through which the discharges of pollutants could flow, unregulated, to surface water. Instead, Congress expressed an understanding of the hydrologic cycle and an intent to place liability on those responsible for discharges which entered the "navigable waters." The Senate Report stated that "[w]ater moves in hydrologic cycles and it is essential that discharge of pollutants be controlled at the source." Legislative History at 1495. The Agency has determined that discharges via hydrologically connected ground water impact surface waters and, therefore, should be controlled at the source.

Most of the courts which have addressed the question of whether the CWA subjects discharges to surface waters via hydrologically connected ground waters to regulation have found the statute ambiguous on this specific question. They have then looked to the legislative history for guidance. *McClellan Ecological Seepage Situation* v. *Weinberger*, 707 F. Supp. 1182, 1194 (E.D. Cal. 1988), *vacated (on other grounds)*, 47 F.3d 325 (9th Cir. 1995), *cert. denied*, 116 S.Ct. 51 (1995); *Kelley* v. *United States*, 618 F.Supp. 1103, 1105–06 (D.C.Mich. 1985). Even those courts which have not found jurisdiction have acknowledged that it is a close question. *Village of Oconomowoc Lake* v. *Dayton Hudson Corp.*, 24 F.3d 962, 966 (7th Cir. 1994), *cert. denied*, 513 U.S. 930 (1994). As one court noted, "the inclusion of groundwater with a hydrological connection to surface waters has troubled courts and generated a torrent of conflicting commentary." *Potter* v. *ASARCO*, Civ. No. S:56CV555, slip op. at 19 (D.Neb. Mar. 3, 1998). The fact that courts have reached differing conclusions when examining whether the CWA regulates such discharges is itself evidence that the statute is ambiguous.

EPA does not argue that the CWA directly regulates ground water quality. In the Agency's view, however, the CWA does regulate discharges to surface water which occur via ground water because of a direct hydrologic connection between the contaminated ground water and nearby surface water. EPA repeatedly has taken the position that the CWA can regulate discharges to surface water via ground water that is hydrologically connected to surface waters.

For example, in issuing the general NPDES permit for concentrated animal feeding operations ("CAFOs") in Idaho, EPA stated:

"EPA agrees that groundwater contamination is a concern around CAFO facilities. However, the Clean Water Act does not give EPA the authority to regulate groundwater quality through NPDES permits.

"The only situation in which groundwater may be affected by the NPDES program is when a discharge of pollutants to surface waters can be proven to be via groundwater." 62 FR 20177, 20178 (April 25, 1997). In response to a comment that the CAFO general permit should not cover ground water, the Agency stated:

"EPA agrees that the Clean Water Act does not give EPA the authority to regulate groundwater quality through NPDES permits. However, the permit requirements * * * are not intended to regulate groundwater. Rather, they are intended to protect surface waters which are contaminated via a groundwater (subsurface) connection." *Id.*

EPA has made consistent statements on at least five other occasions. In the Preamble to the final NPDES Permit Application Regulations for Storm Water Discharges, the Agency stated: "this rulemaking only addresses discharges to waters of the United States, consequently discharges to ground waters are not covered by this rulemaking (*unless there is a hydrological connection between the ground water and a nearby surface water body.*") 55 FR 47990, 47997 (Nov. 16, 1990)(emphasis added)). *See also* 60 FR 44489, 44493 (August 28, 1995) (in promulgating proposed draft CAFO permit, EPA stated: "[D]ischarges that enter surface waters indirectly through groundwater are prohibited"); EPA, "Guide Manual On NPDES Regulations For Concentrated Animal Feeding Operations" at 3 (December 1995) ("Many discharges of pollutants from a point source to surface water through groundwater (that constitutes a direct hydrologic connection) also may be a point source discharge to waters of the United States.").

In promulgating regulations authorizing the development of water quality standards under the CWA by Indian Tribes for their Reservations, EPA stated:

Notwithstanding the strong language in the legislative history of the Clean Water Act to the effect that the Act does not grant EPA authority to regulate pollution of ground waters, EPA and most courts addressing the issue have recognized that * * * the Act requires NPDES permits for discharges to groundwater where there is a direct hydrological connection between groundwater and surface waters. In these situations, the affected ground waters are not considered "waters of the United States" but *discharges to them are regulated because such discharges are effectively discharges to the directly connected surface waters.* Amendments to the Water Quality Standards Regulations that Pertaiu to Standards ou Indian Reservations, Final Rule, 56 FR 64876, 64892 (Dec. 12, 1991)(emphasis added).

While some courts have not been persuaded that the Agency's pronouncements on the regulation of discharges to surface water via ground water represent a consistent Agency position, others have found EPA's position to be clear. The *Hecla Mining* court noted that "The court in Oconomowoc Lake dismissed the EPA statements as a collateral reference to a problem. It appears to this court, however, that the preamhle explains EPA's policy to require NPDES permits for discharges which may enter surface water via groundwater, as well as those that enter directly." *Washington Wilderness Coalition* v. *Hecla Mining Co.,* 870 F. Supp. 983, 990–91 (E.D. Wash. 1994), *dismissed on other grounds,* (lack of standing) per unpnblished decision (E.D. Wash. May 7, 1997) (citing Preamble, NPDES Permit Reguletions for Storm Water Discharges, 55 FR 47990, 47997 (Nov. 16, 1990)).

As a legal and factual matter, EPA has made a determinatiou that, in general, collected or channeled pollutants conveyed to surface waters via ground water can constitute a discharge subject to the Clean Water Act. The determination of whether a particular discharge to surface waters via ground water which has e direct hydrologic connection is a discharge which is prohibited without eu NPDES permit is a factual inquiry, like all point source determinations. The time and distance by which a point source discharge is connected to surface waters via hydrologically counected surface waters will be affected by many site specific factors, such as geology, flow, end slope. Therefore, EPA is not proposing to esteblish any specific criteria beyond coofining the scope of the regulation to discharges to surface weter vie a "direct" hydrologic connectiou. Thus, EPA is proposing to make clear that *a* general hydrologic connection hetween *all* waters is not sufficient to subject the owner or operator of e point source to liability under the Clean Water Act. Instead, consistent with the case law, there must he information indicating that there is a "diroct" hydrologic connection to the surface water at issue. *Hecla Mining,* 870 F.Supp. at 990 ("Plaintiffs mnst still demonstrate that pollutants from a point source affect surface waters of the United States. It is not sufficient to allege groundwater pollution, and then to assert a general hydrological connection between all waters. Rather, pollutants must he traced from their source to surface waters, in order to come within the purview of the CWA.")

The reasonableness of the Agency's interpretation is supported by the fact that the majority of courts have determined that CWA jurisdiction may extend to surface water discharges via hydrologic connections.[1] As the court in *Potter* v. *ASARCO, Inc.* declared, "in light of judicial precedent, Congress" remedial purpose, the absence of any specific legislative intent pertaining to hydrologically connected ground water and the informal pronouncements of EPA, any pollutants that enter navigable waters, whether directly or indirectly through a specific hydrological connection, are subject to regnlation by the CWA." Slip op. at 26.

The decisions which did not find authority to regulate such discharges under the CWA may, for the most part, be distinguished. In *Village of Oconomowac Lake* v. *Daytan Hudson Corp.,* the Seventh Circuit held that the CWA does not regulate ground water per se. 24 F.3d 962 (7th Cir. 1994), cert. denied, 513 U.S. 930 (1994). In *Oconomowoc,* however, the plaintiff only alluded to a "possibility" of a hydrologic connection. 24 F.3d at 965. In *Kelley* v. *United States,* the district court held that enforcement authority under the CWA did not include ground weter contamination. 618 F. Supp. 1103 (W.D. Mich. 1985). The decision is not well-reasoned, as the *Kelley* court merely states—without further elaboration—that the opinion iu *Exxon* v. *Train,* which specifically "expressed no opinion" on whether the CWA regulated hydrologically connected ground weters, and the legislative history "demonstrete that Cougress did not intend the Clean Water Act to extend federal regulatory enforcement authority over *groundwater contamination." Kelley,* 618 F. Supp. at 1107 (emphasis edded). In *Umatilla,* the court concluded that the NPDES program did not apply to even hydrologically connected ground water. 962 F.Supp. at 1318. The court reviewed the legislative history and existing precedent on the issue, but failed to distinguish between the regulation of ground water per se and the regulation of discharges into waters of the United States which happen to occur via ground water. Moreover, the court failed to give deference to the Agency's interpretation of the CWA. Id. at 1319 (finding that the Agency interpretations cited by the plaintiffs failed to articulate clear reguletory boundaries and were uot sufficiently "comprehensive, definitive or formal" to deserve defereuce, but acknowledging that "neither the statute nor the legisletive history ahsolutely prohibits an iuterpretation that the NPDES requirement applies to discharges of waters—though whether it does or not is an unresolved question. * * * [A] well that ended in such connected ground waters might be within the scope of the [CWA]").

[1] *See e.g., Williams PipeLine Co. v. Bayer Corp.,* 964 F.Supp. 1300, 1319–20 (S.D.Iowa 1997) ("Because the CWA's goal is to protect the quality of surface waters, the NPDES permit system regulates any pollutants that enter such waters either directly or through groundwater."); *Washington Wilderness Coalition* v. *Hecla Mining Co.,* 870 F. Supp. 983, 989–90 (E.D. Wash. 1994), *dismissed on other grounds,* (lack of standing) per unpublished decision (E.D. Wash. May 7, 1997) (finding CWA jurisdiction where pollution discharged from manmade ponds via seeps into soil and ground water and, thereafter, surface waters; and holding that, although CWA does not regulate isolated ground water, CWA does regulate pollutants entering navigable waters via tributary ground waters); *Friends of the Coast Fork* v. *Co. of Lane, OR,* Civ. No. 95–6105–TC (D. OR. January 31, 1997) (reaching same conclusion as court in *Washington Wilderness Coalition v. Hecla Mining Co.,* and finding hydrologically-connected ground waters are covered by the CWA); *McClellan Ecological Seepage Situation,* 763 F. Supp. 431, 436 (E.D. Cal. 1989), *cacated (on other grounds),* 47 F.3d 325 (9th Cir. 1995), *cert. denied,* 116 S.Ct. 51 (1995) (allowing plaintiff to attempt to prove at trial that pollutants discharged to ground water are subsequently discharged to surface water); and *McClellan Ecological Seepage Situation* v. *Weinberger,* 707 F. Supp. 1182, 1195–96 (E.D. Cal. 1988), *vacated (on other grounds),* 47 F.3d 325 (9th Cir. 1995), *cert. denied,* 116 S.Ct.51 (1995) (although NPDES permit not required for discharges to isolated ground water, Congress' intent to protect surface water may require NPDES permits for discharges to ground water with direct hydrological connection to surface waters); *Friends of Sante Fe Co.* v. *LAC Minerals, Inc.,* 892 F. Supp. 1333, 1357–58 (D.N.M. 1995) (although CWA does not cover discharges to isolated, nontributary groundwater, *Quivira* and decisions within Tenth Circuit demonstrating expansive construction of CWA's jurisdictional reach foreclose arguments that CWA does not regulate discharges to hydrologically-connected groundwater); *Sierra club* v. *Colorado Refining Co.,* 838 F. Supp. at 1434 ("navigable waters" encompasses tributary groundwater and, therefore, allegations that defendant violated CWA by discharging pollutants into soils and groundwater, and that pollutants infiltrated creek via groundwater and seeps in creek bank, stated cause of action); and *Quivira Mining Co.* v. *United States EPA,* 765 F.2d 126, 130 (10th Cir. 1985), *cert. denied,* 474 U.S. 1055 (1986) (affirming EPA's determination that CWA permit required for discharges of pollutants into surface arroyos that, during storms, channeled rainwater both directly to streams and into underground aquifers that connected with such streams); *Martin* v. *Kansas Board of Regents,* 1991 U.S.Dist. LEXIS 2779 (D.Kan. 1991) ("Groundwater . . . that is naturally connected to surface waters constitute 'navigable waters' under the Act."); *see also Inland Steel Co.* v. *EPA,* 901 F.2d 1419, 1422–23 (7th Cir. 1990) ("the legal concept of navigable waters might include ground waters connected to surface

pollutants to hydrologically-connected groundwater"). Today's proposal shonld provide the type of formal Agency interpretation that court sought. Two other decisions have simply adopted the reasoning of the Umatilla court. *United States* v. *ConAgra, Inc.*, Case No. CV 96–0134–S–LMB (D. Idaho 1997); *Allegheny Environmental Action Coalition v. Westinghouse*, 1998 U.S. Dist. LEXIS 1838 (W.D.Pa. 1998).

The Agency has utilized its expertise in enviroomeotal science and policy to determine the proper scope of the CWA. The determination of whether the CWA regulates discharges to ground waters connected to surface waters, like the determination of wotlands jurisdiction, "ultimately involves an ecological judgment about the relationship between surface waters and ground waters, it should be left in the first instance to the discretion of the EPA and the Corps." *Town of Norfolk* v. *U.S. Army Corps of Engincers*, 968 F.2d 1438, 1451 (1st Cir. 1992) (citing *United States* v. *Riverside Bayview Homes, Inc.*, 474 U.S. at 134). The Supreme Court, too, has acknowledged the difficulty of determining precisely where Clean Water Act jurisdiction lies and has held that an agency's scientific judgment can support a legal jurisdictional judgment. *United States* v. *Riverside Bayview Homes*, Inc., 474 U.S. 121, 134 (1985) ("In view of the breadth of federal regulatory authority contemplated by the [Clean Water] Act itself and the inherent difficulties of defining precise bounds to regulable waters, the Corps' ecological judgment about the relationship between waters and their adjacent wetlands provides an adequate basis for a legal judgment that adjacent wetlands may be defined as waters under the Act.").

The Agency has made clear the rationale for its construction: "the Act requires NPDES permits for discharges to groundwater where there is a direct hydrological connection between groundwater and surface waters. In these situations, the affected ground waters are not considered 'waters of the United States' but *discharges to them are regulated because such discharges are effectively discharges to the directly connected surface waters.*" Amendments to the Water Quality Standards Regulations that Pertain to Standards on Indian Reservations, Final Rule, 56 FR 64,876, 64892 (Dec. 12, 1991) (emphasis added). The Agency has taken this position because ground water and surfece water are highly interdependent components of the hydrologic cycle. The hydrologic cycle refers to "the circulation of water among soil, ground water, surface water, and the atmosphere." U.S. Environmental Protection Agency, "A Review of Methods for Assessing Nonpoint Source Contaminated Gronnd-Water Discharge to Surface Water" at 3 (April 1991). Thus, a hydrologic connection has been defined as "the interflow and exchange between surface impoundments and surface water throngh an nnderground corridor or groundwater." NPDES Generel Permit and Reporting Requirements for Discharges from Concentrated Animal Feeding Operations, EPA Region 6 Public Notice of Final Permitting Decision, 58 FR 7610, 7635–36 (Feb. 8, 1993). The determination of whether a discharge to ground water in a specific case constitutes an illegal discharge to waters of the U.S. if nnpermitted is a fact specific one. The general jurisdictional determination by EPA that such discharges can be subject to regulation under the CWA is a determination that involves an ecological judgment about the relationship between surface waters and ground waters.

Finally, the Supreme Court has explicitly acknowledged that resolution of ambiguities in agency-administered statutes involves policymaking: "As Chevron itself illustrates the resolution of ambiguity in a statutory text is often more a question of policy than of law. * * * When Congress, through express delegation or the introduction of an interpretive gap in the statutory structure, has delegated policymaking to an administrative agency, the extent of judicial review of the agency's policy determinations is limited." *Pauly* v. *Bethenergy Mines, Inc.*, 116 S.Ct. 2524, 2534 (1991). Congress established a goal for the CWA "to restore and maintain the chemical, physical and biological integrity of the nation's waters and to eliminate the discharge of pollutants into the navigable waters." 33 U.S.C. § 1251(a)(1). Congress also established some parameters for reaching that goal, but left gaps in the statutory structnre. One of those gaps is the issue of discharges of pollutants from point sources which harm navigable waters bnt which happen to occur via gronnd water. The Agency has chosen to fill that gap by construing the statute to regulate such discharges as point source discharges. Given the Agency's knowledge of the hydrologic cycle and aquatic ecosystems, the Agency has determined that when it is reasonably likely that such discharges will reach surface waters, the goals of the CWA can only be fulfilled if those discharges are regulated.

Determining Direct Hydrologic Connection. In recent rulemakings, EPA has used various lithologic settings to describe areas of vulnerability to contamination of ground water. This information can serve as a guide for permit writers to make the initial determination whether or not it is necessary to establish special conditions in a CAFO permit to prevent the discharge of CAFO waste to surface water via ground water with a direct hydrologic connection to snrface water.

During the rulemaking processes for the development of the Ground Water Rule and the Underground Injection Control Class V under the Safe Drinking Water Act, significant stakeholder and Federal Advisory Committee Act (FACA), input was used to define lithologic settings that are likely to indicate ground water areas sensitive to contamination. Areas likely to have snch a connection are those that have ground water sensitive to contamination and that have a likely connection to surface water. The Ground Water Proposed Rule includes language that describes certain types of lithologic settings (karst, fractured bedrock, and gravel) as sensitive to contamination and, therefore, subject to requirements under the rule to mitigate threats to human health from microbial pathogens. [See National Primary Drinking Water Regulations: Ground Water Rule, 65 FR 30193 (2000) (to be codified at 40 CFR Parts 141 and 142) (proposed May 10, 2000). See also Underground Injection Control Regulations for Class V Injection Wells, Revision; Final Rule, 64 FR 68546 (Dec. 7, 1999) (to be codified at 40 CFR Parts 9, 144, 145, and 146). See also Executive Summary, NDWAC UIC/Source Water Program Integration Working Group Meeting (March 25–26, 1999). All are available in the rulemaking Record.]

Under the Class V rule, a facility must comply with the mandates of the regulation if the facility has a motor vehicle waste disposal well (a type of Class V well) that is in an area that has been determined to be sensitive. (See Technical Assistance Document (TAD) for Delineating "Other Sensitive Ground Water Areas", EPA #816–R–00–016—to be published.) States that are responsible for implementing the Class V Rnle, or in the case of Direct Implementation Programs, the EPA Regional Office, are given flexibility to make determinations of ground water sensitivity within certain guidelines.

40 CFR 145.23(f)(12) provides items that States are expected to consider in developing their other sensitive ground water area plan, including:

- Ceologic and hydrogeologic settings,
- Ground water flow and occurrence,

• Topographic and geographic features,
• Depth to ground water,
• *Significance as a drinking water source,
• *Prevailing land use practices, and
• *Any other existing information relating to the susceptibility of ground water to contamination from Class V injection wells.

*The last three factors are not relevant to this rulemaking but are specific to mandates under the Safe Drinking Water Act to protect current and future sources of drinking water.

Geologic and hydrogeologic settings considered sensitive under the Class V Rule include areas such as karst, fractured bedrock or other shallow/unconsolidated aquifers. The Class V Rule lists karst, fractured volcanics and unconsolidated sedimentary aquifers, such as glacial outwash deposits and eolian sands, as examples of aquifer types. Under the Class V Rule, EPA urges States to consider all aquifer types that, based on their inherent characteristics, are likely to be moderately to highly sensitive. Such aquifer types are those that potentially have high permeability, such as: all fractured aquifers; all porous media aquifers with a grain size of sand or larger, including not only unconsolidated aquifers, but sandstone as well; and karst aquifers.

For more information at the regional level, information can be found in the document "Regional Assessment of Aquifer Vulnerability and Sensitivity in the Coterminous United States" [EPA/600/2–91/043] for state maps showing aquifers and portions of aquifers whose transmissivity makes them sensitive/vulnerable. This document may be helpful in identifying areas where existing contaminants are most likely to spread laterally. State and federal geological surveys have numerous geological maps and technical reports that can be helpful in the identification of areas of sensitive aquifers. University geology and earth science departments and consulting company reports may also have helpful information.

Data sources to assist permit writers in making sensitivity determinations can be acquired through many sources as listed above and include federal, state, and local data. For example, USGS maps and databases such as the principal aquifers map, state maps, other programs where such assessments may have been completed, such as State Source Water Assessment Programs (SWAP), state Class V, or Ground Water Rule sensitivity determinations.

Another potential approach to defining areas of ground water sensitivity would be to define a set of characteristics which a facility could determine whether it met by using a set of national, regional and/or local maps. For instance, overburden, that is, soil depth and type, along with depth to water table, hydrogeologic characteristics of the surficial aquifer, and proximity to surface water could be factors used to define sensitive areas for likely ground water/surface water connections. For example, while there is no consistent definition or agreement as to what could be considered "shallow," a depth to the water table less than, say, six feet with sandy soils or other permeable soil type might indicate ground water vulnerability. Data of this nature could be obtained from USDA's Natural Resource Conservation Service (NRCS) national soils maps, available from the NRCS web site (*www.nhq.nrcs.usda.gov/land/index/soils.html*) or from the EPA web site (*www.epa.gov/ostwater/BASINS/metadata/statsgo.htm*).

Once it is determined that the CAFO is in a ground water sensitive area, proximity to a surface water would indicate a potential for the CAFO to discharge to surface water via a direct hydrological connection with ground water. Proximity to surface water would be considered when there is a short distance from the boundary of the CAFO to the closest downstream surface water body. Again, information of this type could be obtained from USGS topographic maps or state maps.

USGS Hydrologic Landscape Regions. Another approach for determining whether CAFOs in a region are generally located in areas where surface water is likely to have hydrological connections with ground water is by using a set of maps under development by the U.S. Geological Survey (USGS). USGS is developing a national map of Hydrologic Landscape Regions that describe watersheds based on their physical characteristics, such as topography and lithology. These maps will, among other things, help to identify physical features in the landscape that are important to water quality such as areas across the country where the geohydrology is favorable for ground water interactions with surface water.

The regions in this map will be delineated based on hydrologic unit codes (HUCs) nationwide and do not provide information at local scales; however, the maps can provide supplemental information that describes physical features within watersheds where interactions between ground water and surface water are found. These areas are the most likely places where ground water underlying CAFO's could be discharged to nearby surface water bodies. While EPA has not fully assessed how this tool might be used to determine a CAFO's potential to discharge an excerpt of the pre-print report is provided here for purposes of discussion. The report describing this tool is anticipated to be published in Spring 2001 (Wolock, Winter, and McMahon, in review).

The concept of hydrologic landscapes is based on the idea that a single, simple physical feature is the basic building block of all landscapes. This feature is termed a fundamental landscape unit and is defined as an upland adjacent to a lowland separated by an intervening steeper slope. Some examples of hydrologic landscapes are as follows:

• A landscape consisting of narrow lowlands and uplands separated by high and steep valley sides, characteristic of mountainous terrain;
• A landscape consisting of very wide lowlands separated from much narrower uplands by steep valley sides, characteristic of basin and range physiography and basins of interior drainage; or
• A landscape consisting of narrow lowlands separated from very broad uplands by valley sides of various slopes and heights, characteristic of plateaus and high plains.

The hydrologic system of a fundamental landscape unit consists of the movement of surface water, ground water, and atmospheric-water exchange. Surface water movement is controlled by land-surface slope and surficial permeability; ground-water flow is a function of gravitational gradients and the hydraulic characteristics of the geologic framework; and atmospheric-water exchange primarily is determined by climate (Winter, in review). The same physical and climate characteristics control the movement of water over the surface and through the subsurface regardless of the geographic location of the landscapes. For example, if a landscape has gentle slopes and low-permeability soils, then surface runoff will be slow and recharge to ground water will be limited. In contrast, if the soils are permeable in a region of gentle slopes, then surface runoff may be limited but ground-water recharge will be high.

The critical features used to describe hydrologic landscapes are land-surface form, geologic texture, and climate. Land-surface form can be used to quantify land-surface slopes and relief. Geologic texture provides estimates of surficial and deep subsurface permeability which control infiltration, the production of overland flow, and ground-water flow rates. Climate characteristics can be used to approximate available water to surface and ground-water systems. The variables used to identify hydrologic settings were averaged within each of the 2,244 hydrologic cataloging units defined by the USGS. This degree of spatial averaging was coarse enough to smooth the underlying data but fine enough to separate regions from each other.

For example, two Hydrological Landscape Regions (HLR) that are likely to have characteristics of ground water and surface water interactions with direct relevance to this proposed rulemaking would be "HLR1" and "HLR9". HLR1 areas are characterized by variably wet plains having highly permeable surface and highly permeable subsurface. This landscape is 92 percent flat land, with 56 percent of the flat land in the lowlands aud 37 percent in the uplands. Land surface and bedrock are highly permeable. Because of the flat sandy land surface, this geologic framework should result in little surface runoff, and recharge to both local and regional ground-water flow systems should be high. Therefore, ground water is likely to be the dominant component of the hydrologic system in this landscape. The water table is likely to be shallow in the lowlands, resulting in extensive wetlands in this part of the landscape.

Major water issues in this hydrologic setting probably would be related to contamination of ground water. In the uplands, the coutamination could affect regional ground-water flow systems. In the lowlands, the thin unsaturated zone and the close interaction of ground water and surface water could result in contamination of surface water. Flooding probably would not be a problem in the uplands, but it could be a serious problem in the lowlands because of the flat landscape and shallow water table.

HLR9 areas are characterized by wet plateaus having poorly permeable surface and highly permeable subsurface. This landscape is 42 percent flat land, with 24 percent in lowlands and 17 percent in uplands. Land surface is poorly permeable and bedrock is highly permeable. Because of the flat poorly permeable land surface, this geologic framework should result in considerable surface runoff and limited recharge to ground water. However, the bedrock is lergely karstic carbonate rock, which probably would result in a considerable amount of surface runoff entering the deep aquifer through sinkholes. This water could readily move through regional ground-water flow systems. Surface runoff and recharge through sinkholes are likely to be the dominant component of the hydrologic system in this landscape. The water table is likely to be shallow in the lowlands, resulting in extensive wetlands in this part of the landscape. Major water issues in this hydrologic setting probably would be related to contamination of surface water from direct surface runoff, and extensive contamination of ground water (and ultimately surface water) because of the ease of movement through the bedrock. The capacity of these carbonate rocks to mediate contaminants is limited. Flooding could be a problem in the lowlands.

EPA is requesting comment on how a permit writer might identify CAFOs at risk of discharging to surface water via ground water. EPA is also requesting comment on its cost estimates for the permittee to have a hydrologist make such a determination. EPA estimates that for a typical CAFO, the full cost of determining whether ground water beneath the facility has a direct hydrologic connection to surface water would be approximately $3,000. See Section X for more information on cost estimates.

Permit requirements for facilities with groundwater that has a direct hydrologic connection with surface water are discussed in Section VII.E.5.d below.

k. *What Regulatory Relief is Provided by Today's Proposed Rulemaking? Two-tier vs. Three-tier Structure.* Each of EPA's proposals effect small livestock and poultry businesses in different ways, posing important trade-offs when selecting ways to mitigate economic impacts. First, by proposing to establish a two-tier structure with a 500 AU threshold, EPA is proposing not to automatically impose the effluent guidelines requirements on operations with 300 to 500 AU. By eliminating this size category, EPA estimates that about 10,000 smaller AFOs are relieved from being defined as CAFOs, and instead would only be subject to permitting if designated by the permit authority dne to being a significant contributor of pollutants.

A three-tier structure, by contrast, only automatically defines all operations over 1,000 AU as CAFOs, instead of 500 AU. However, while all of the 26,000 AFOs between 300 and 1,000 AU wouldn't be required to apply for an NPDES permit, all those operations would be required to either apply for a permit or to certify to the permit authority that they do not meet any of the conditions for being a CAFO. EPA estimates that approximately 19,000 of these operations would have to change some aspect of their operation in order to avoid being permitted, and all 26,000 would be required to develop and implement a PNP. Thus, while in theory fewer operations could be permitted, in fact more small enterprises would incur costs under a three-tier scenario. Section X.J.4 provides a summary of the difference in costs associated with these two options; more detailed information is provided in Section 9 of the Economic Analysis.

The three-tier structure allows States more flexibility to develop more effective non-NPDES programs to assist middle tier operations. The two-tier structure with a 500 AU threshold might limit access to federal funds, such as Section 319 nonpoint source program funds, for operations in the 500 to 1,000 AU range. The detailed conditions in the three-tier structure, however, do not meet the goal of today's proposal to simplify the NPDES regulation for CAFOs because it leaves in place the need for the regulated commnnity and enforcement authorities to interpret a complicated set of conditions.

Chicken Threshold. During deliberations to select a threshold for dry chicken operations, EPA considered various options for relieving small business impacts. Under the two-tier structure, EPA examined a 100,000 bird threshold as well as a 50,000 bird threshold. Although the 50,000 bird threshold effects many more small chicken operations, analysis showed that setting the threshold at 100,000 birds would not be sufficiently environmentally protective in parts of the country that have experienced water quality degradation from the chicken industry. Section VII.C.2.f describes the relative benefits of each of these options. Nonetheless, because wet layer operations are currently regulated at 30,000 birds, raising the threshold to 50,000 birds will relieve some small businesses in this sector.

Elimination of the mixed animal calculation. EPA's is further proposing to mitigate the effects of today's proposal on small businesses by eliminating the mixed animal calculation for determining which AFOs are CAFOs. Thus, operations with mixed animal types that do not meet the size threshold for any single livestock category would not be defined as a CAFO. EPA expects that there are few AFOs with more than a single animal type that would be defined as CAFOs, since most mixed operatious tend to be smaller in size. The Agency determined that the inclusion of mixed operations would disproportionately burden small businesses while resulting in little additional environmental benefit. Since most mixed operations tend to be smaller in size, this exclusion represents important accommodations for small business. EPA's decision not to include smaller mixed operations is consistent with its objective to focus on the largest operations since these pose the greatest potential risk to water quality and public health given the sheer volume of manure generated at these operations.

Operations that handle larger herds or flocks take on the characteristics of being more industrial in nature, rather than having the characteristics typically associated with farming. These facilities typically specialize in a particular animal sector rather than having mixed animal types, and often do not have an adequate land base for agricultural use of manure. As a result, large facilities need to dispose of significant volumes of manure and wastewater which have the potential, if not properly handled, to cause significant water quality impacts. By comparison, smaller farms manage fewer animals and tend to concentrate less manure nutrients at a single farming location. Smaller farms tend to be less specialized and are more diversified, engaging in both animal and crop production. These farms often have sufficient cropland and fertilizer needs to land apply manure nutrients generated at a farm's livestock or poultry business for agricultural purposes.

For operations not defined as a CAFO, the Permit Authority would designate any facility determined to be a significant contributor of pollution to waters of the U.S. as a CAFO, and would consequently develop a permit based on best professional judgement (BPJ).

The estimated cost savings from eliminating the mixed animal calculation is indeterminate due to limited information about operations of this size and also varying cost requirements. EPA's decision is also expected to simplify compliance and be more administratively efficient, since the mixed operation multiplier was confusing to the regulated community and to enforcement personnel, and did not cover all animal types (because poultry did not have an AU equivalent).

Site-specific PNPs Rather than Mandated BMPs. In addition, while facilities that are defined or designated as CAFOs would be subject to specific performance standards contained with the permit conditions, EPA's proposed revisions also provide flexibility to small businesses. In particular, the revised effluent guidelines and NPDES standards and conditions are not specific requirements for design, equipment, or work practices, but rather allow the CAFO operator to write site-specific Permit Nutrient Plans that implement the permit requirements in a manner appropriate and manageable for that business. This will reduce impacts to all facilities, regardless of size, by allowing operators to choose the least costly mix of process changes and new control equipment that would meet the limitations.

Demonstration of No Potential to Discharge. Finally, in both proposals, operations that must apply for a permit would have the additional opportunity to demonstrate to the permit authority that pollutants have not been discharged and have no potential to discharge into waters of the U.S. These operations would not be issued a permit if they can successfully demonstrate no potential to discharge. See section VII.D.3 for a discussion of demonstrating "no potential to discharge."

Measures Not Being Proposed. During the development of the CAFO rulemaking, EPA considered regulatory relief measures under the NPDES permit program that are not being proposed, including: (1) A "Good Faith Incentive," and (2) an "Early Exit" provision. These options are summarized below. More detail is provided in the SBREFA Panel Report (2000).

Under the "Good Faith Incentive," EPA considered incorporating an incentive for small CAFO businesses (i.e., AFOs with a number of animals below the regulatory threshold) to take early voluntary actions in good faith to manage manure and wastewater in accordance with the requirements of a nutrient management plan. In the event that such smaller AFOs have a discharge that would otherwise cause them to be designated as CAFOs, the CAFO regulations would provide an opportunity for these smaller AFOs to address the cause of the one-time discharge and avoid being designated as CAFOs.

Under the "Early Exit" provision, EPA considered a regulatory provision that would explicitly allow CAFOs with fewer animals than the regulatory threshold for large CAFOs to exit the regulatory program after five years of good performance. The regulations could allow such a smaller CAFO to exit the regulatory program if it demonstrates that it had successfully addressed the conditions that caused it to either be defined or designated as a CAFO.

EPA decided not to include either of these provisions in the proposed regulations following the SBAR Panel consultation process. Neither small businesses, SBA, OMB, nor EPA enforcement personnel expressed support for either of these provisions. Also, the Early Exit provision was not deemed to provide additional regulatory relief over the current program, since an operation that has been defined or designated as a CAFO can already make changes at the operation whereby, after complying with the permit for the permit's five year term, the operation would no longer meet the definition of a CAFO and therefore would no longer be required to be permitted.

Both the regulatory relief measures selected and those considered but not selected are discussed in detail in Chapter 9 of the Economic Analysis, included in the Record for today's proposed rulemaking. EPA requests comment on the regulatory relief measures considered but not included in today's proposal.

3. How Does the Proposed Rule Change the Existing Designation Criteria and Procedure?

In the existing regulation, an operation in the middle tier, those with 300 AU to 1,000 AU, may either be defined as a CAFO or designated by the permit authority; those in the smallest category, with fewer than 300 AU, may only be designated a CAFO if the facility discharges: (1) into waters of the United States through a man-made ditch, flushing system, or other similar man-made device; or (2) directly into waters of the United States that originate outside of the facility and pass over, across, or through the facility or otherwise come into direct contact with the confined animals. The permit authority must conduct an on-site inspection to determine whether the AFO is a significant contributor of pollutants. The two discharge criteria have proved difficult to interpret and enforce, making it difficult to take enforcement action against dischargers. Very few facilities have been designated in the past 25 years despite environmental concerns.

EPA's proposals on how, and whether, to amend these criteria vary with the alternative structure. Under a two-tier structure, EPA is proposing to eliminate these two criteria; under a three-tier structure, EPA is proposing to retain these two criteria.

Under the proposed two-tier structure with a 500 AU threshold, or under any other alternative two-tier structure such as with a 750 AU threshold, EPA is proposing to eliminate the two discharge criteria. Raising the NPDES threshold to 500 AU, 750 AU or 1,000 AU raises a policy question for facilities below the selected threshold but with more than 300 AU. Facilities with 300 to 1,000 AU are currently subject to

NPDES regulation (if certain criteria are met). To rely entirely on designation for these operations could be viewed by some as deregulatory, because the designation process is a time consuming and resonrce intensive process that makes it difficult to redress violatious. It could also result in the inability of permit authorities to take enforcement actions against initial discharges unless they are from an independent point source at the facility. Otherwise, the initial discharge can only result in initiatiou of the designation process itself; enforcement could only take place upon a subsequent discharge. Unless the designation process can be streamlined in some way to enable permit authorities to more efficiently address those who are significant contributors of pollutants, raising the threshold too high may also not be snfficiently protective of the environment. While EPA could have proposed to retain the two criteria for those with fewer than 300 AU, and eliminate it only for those with greater than 300 AU but below the regulatory threshold, EPA believes that this would introduce unnecessary complexity into this regulation.

While eliminating the two discharge criteria, this proposal would retain the provision in the existing regulation that any AFO may be designated as a CAFO on a case-by-case basis if the NPDES permit authority determines that the facility is a significant contributor of pollutants to waters of the U.S. Today's proposal would not change the factors that the regulation lists as relevant to whether a facility is a significant contributor—see proposed § 122.23(b)(1) (listing factors such as: the size of the operation; the amount of wastewater discharged; the location of any potential receiviug waters; means of conveyance of animal mannre and process wastewater into waters of the U.S.; slope, vegetation, rainfall and other factors affecting the likelihood or frequency of discharge to receiving waters).

This proposal also retains the existing requirement that the permit authority couduct an on-site inspection before making a designation. No inspection would be required, however, to designate a facility that was previously defined or designated as a CAFO, although the permit authority may chose to do one.

Under a three-tier structure, EPA is proposing to retain the two discharge criteria used to designate an AFO with fewer than 300 AU as a CAFO. In this approach, facilities in the 300 AU to 1,000 AU size range must meet certain conditiuus for being considered a CAFO, and EPA considers this to be snfficiently protective of the environment.

EPA is reqnesting comment on these two proposals, and also requests comment on three other alternatives. EPA conld: (1) retain the two criteria even under a two-tier structure for all operations below the regulatory threshold; (2) retain the two criteria under a two-tier structure for only for those with fewer than 300 AU and eliminate the two criteria for those below the regulatory threshold but with greater than 300 AU; or (3) eliminate the criteria in the three-tier structure for those with fewer than 300 AU.

Significant concern was raised over the issue of designation during the SBREFA Panel process. At the time of the Panel, EPA was not considering eliminating these two criteria, and SERs and Panel members strongly endorsed this position. At that time, EPA's was focusing on a three-tier strncture with revised conditions as the preferred option, and retaining the criteria was consistent with the revisions being considered. Since then, however, EPA's analysis has resulted in a strong option for a two-tier approach that would be simpler to implement and would focus on the largest operations. Once this scenario became a strong candidate, reconsideration of the two designation criteria was introdnced. EPA realizes that this proposal has raised some concern in the small business community. However, EPA does not believe that eliminating these criteria will result in significantly more small operations being designated. Rather, it will enable the permit authority to ensure that the most egregious discharges of significant quautities of pollutants are addressed.

It is likely that few AFOs with less than 300 AU are significant contributors of pollutauts, and permit authorities may be appropriately focusing scarce resources on larger facilities. Further, some also believe that it may be appropriate under a two-tier structure to retain the two criteria as well as the on-site inspection criterion to AFOs under the regulatory threshold, e.g. with fewer than 500 AU or 750 AU. SERs during the SBREFA process indicated that family farmers operating AFOs with fewer than 1,000 AU tend to have a direct interest in environmental stewardship, since their livelihood (e.g., soil quality and drinking water) often depends on it. They also argued that EPA should not divert resources away from AFOs with the greatest potential to discharge—those with 1,000 AU or more. EPA is soliciting comment on whether tu retain the designation criteria for all AFOs below the regulatory threshold in a two-tier structure, and whether this option will be protective of the environment.

While permit authorities have indicated that the reqnirement for an on-site inspection makes the designation process resource intensive, recommendations resulting from the SBREFA small business consultation process encouraged EPA not to remove the on-site inspection requirement. Some were concerned that EPA might do widespread blanket designations of large numbers of operations, especially in watersheds that have been listed under the CWA 303(d), Total Maximum Daily Load (TMDL) process. Thns, EPA is soliciting comment on whether to eliminate the requirement that the inspection be "on-site," perhaps by allowing, in lieu of on-site inspections, other forms of site-specific information gathering, such as use of monitoring data, fly-overs, satellite imagery, etc. Other parts of the NPDES program allow such information gathering and do not require inspections to be "on-site."

If the on-site requirement were eliminated, the permit authority would still need to make a determination that the facility is a significant contributor of pollution, which might necessitate an on-site inspection in many cases. Ou the other hand, in watersheds that are not meeting water quality standards for nutrients, the permit authority could designate all AFOs as CAFOs without couducting individual on-site inspections. Even in 303(d) listed watersheds, however, an operator of an individual facility might be able to demoustrate in the NPDES permit application that it has no potential to discharge, and request that it be exempted from NPDES requirements.

Due to the significant concerns of the small business community, EPA is not proposing at this time to eliminate the on-site inspection requirements, but, rather, EPA is soliciting comment on whether or not to eliminate this provision or to revise it to allow other forms of site-specific data gathering.

Finally, EPA is proposing a technical correction to the designation regulatory language. The existing CAFO NPDES regulations provide for designation of an AFO as a CAFO upon determining that it is a significant contribntor of "pollution" to the waters of the U.S. 40 CFR 122.23(c). EPA is today proposing to change the term to "pollutants." Elsewhere in the NPDES regulations, EPA uses the phrase "significant contributor of pollutants" for designation purposes. 40 CFR 122.26(a)(1)(v). EPA is not aware of any reason the Ageucy would have used different terms for similar designation standards, and is seeking consistency in this proposal. The Agency believes the term "pollutant" is the correct term. The Clean Water Act provides definitions for both "pollutant and "pollution" in Section 502, but the NPDES program of Section 402 focuses specifically on permits "for the discharge of any pollntant, or combination of pollutants." Therefore, EPA believes it is appropriate to establish a designation standard for purposes of permitting CAFOs based on whether a facility is a significant contributor of "pollutants."

4. Dasignation of CAFOs by EPA in Approved States

Today's proposal would explicitly allow the EPA Regional Administrator to designate an AFO as a CAFO if it meets the designatiou criteria in the regulations, even in States with approved NPDES programs. See proposed § 122.23(b). As described in the preceding section, VII.C.4, AFOs that have not been dafined as CAFOs may he designated as CAFOs on a case-by-case basis npon determination that such sources are significant contributors of pollution to waters of the United States. EPA's authority to designate AFOs as CAFOs would be subject to the same criteria and limitations to which State designation authority is subject.

The existing regulatory language is not explicit as to whether EPA has the authority to designate AFOs as CAFOs in States with approved NPDES programs. The current regulations state that "the Director" may designate AFOs as CAFOs. 40 CFR 122.23(c)(1). The existing definition of "Director" states: "When there is an approved State program, 'Director' normally maans the State Director. In some circumstances, however, EPA retains the authority to take certain actions even where there is an approved State program." 40 CFR 122.2. Today's proposal would give EPA the explicit authority to designate an AFO as a CAFO in States with approved programs.

EPA does not propose to assume authority or jurisdiction to issue permits to the CAFOs that the Agency designates in approved NPDES States. That authority would remain with the approved State.

EPA believes that CWA Section 501(a) provides the Agency with the authority to designate point sources subject to regulatiou under the NPDES program, even in States approved to administer the NPDES permit program. This interpretive authority to define point sources and nonpoint sources was recognized by the D.C. Circnit in *NRDC v. Costle*, 568 F.2d 1369, 1377 (D.C. Cir. 1977). The interpretive authority arises from CWA Section 501(a) when EPA interprets the term "point source" at CWA Section 502(14). EPA's proposal wonld ensure that EPA has the same authority to designate AFOs as CAFOs that need a permit as the Agency has to designate other storm water point sources as needing a permit. See 40 CFR 122.26(a)(2)(v).

EPA recognizes that many State agencies have limited resources to implement their NPDES programs. States may be hesitant to desiguate CAFOs hecause of concerns that regulating the CAFOs will require additional resources that could be used for competing priorities. In light of the increased reliauce and success in control of point sources under general permits, however, the Agency believes that there will be only an incremental increase in regulatory burden due to the designated sources.

Ou August 23, 1999, the Agency proposed to provide explicit authority for EPA to designate CAFOs in approved States, but would have limited snch authority to the designation of AFOs where pollutants are discharged into waters for which EPA establishes a total maximum daily load or "TMDL" and designation is necessary to ensure that the TMDL is achieved. 64 FR 46058, 46088 (August 23, 1999). EPA received comments both supporting and opposing the proposal. In promulgating the final TMDL rule, however, the Agency did not take final action on the proposed changes applicable to CAFOs, 65 FR 43586, 43648 (July 13, 2000), deciding instead to take action in this proposed rulemaking.

Today's proposal is intended to help ensure nationally consisteut application of the provisions for designating CAFOs and is not focusing spacifically at AFOs in impaired watersheds. Implementation of the current rule in States with NPDES authorized programs has varied greatly from State to State, with several States choosing to implement non-NPDES State programs rather than a federally enforceable NPDES program. Public concerns have also been raised about lack of access to State non-NPDES CAFO programs. While several of today's proposed revisions would help to correct these disparities, EPA is concerned that there may be instances of significant discharges from AFOs that may not be addressed by State programs, and that are not being required to comply with the same standards and requirements expected of all AFOs. As part of their approved programs, States should designate AFOs that are significant sources of pollutants. EPA wonld have the authority to designate AFOs as CAFOs, should that be necessary.

The Agency invites comment on this proposal.

5. Co-permitting Entities That Exert Snbstantial Operational Control Over a CAFO

EPA is proposing that permit anthorities co-permit entities that exercise substantial operational control over CAFOs along with the owner/operator of the facility. See proposed § 122.23(a)(5) and (i)(4). While the permit authority currently may deem such entities to be "operators" under the Clean Water Act and require them to be permitted under existing legal requirements, today's proposal includes changes to the regulations to identify the circumstances under which co-permitting is required and how permit authorities are expected to implement the requirements. Because the existiug definition of "operator" in 122.2 generally already encompasses operators who exercise substantial operational control, the Agency is seeking comment on whether this additional definition [or provision] is necessary.

For other categories of discharges, EPA's regulations states that contributors to a discharge "may" be co-permittees. See 40 CFR § 122.44(m). § 122.44(m) addresses the situation in which the co-permittees operate distinct sources and a privately owued treatmeut works is the owner of the ultimate point source discharge. In that context, EPA deemed it appropriate to give the permit writer the discretion to permit only the privately owned treatment works or the distinct sources, or hoth, depending on the level of control each exercises over the pollutants. In the context of CAFOs, however, the co-permittees both control some aspects of operations at the point source. Therefore, EPA is proposing that they must either be co-permittaes or each must hold a separate permit.

Processor/Producer Rclationship. As discussed below, proposed § 122.23(a)(5) is intended, at a minimum, to require permit authorities to hold certain entities that exercise substantial operational control over other entities jointly rosponsible for the proper disposition of manure generated at the CAFO. While under today's proposal a permit authority could require an entity that has substantial operational control over a CAFO to be jointly responsible for all of the CAFO's NPDES permit requirements, the proposal would allow the permit authority to allocate individual responsibility for various activities to any of the co-permittees. The proposed rule would specify, however, that the proper disposition of manure must remain the joint responsibility of all the entities covered by the permit.

As discussed in more detail in section IV.C. of this preamble, among the major trends in livestock and poultry production are closer linkages between animal feeding operations and processing firms. Increasingly, businesses such as slaughtering facilities and meat packing plants and some integrated food manufacturing facilities are contracting out the raising or finishing production phase to a CAFO. Oftentimes, production contracts are used in which a contractor (such as a processing firm, feed mill, or other animal feeding operation) retains ownership of the animals and/or exercises substantial operational control over the type of production practices used at the CAFO. More information on the trends in animal agriculture and the evolving contractual relationships between producer and processors is presented in section IV.C of this preamble.

Use of production contracts varies by sector. Production contracting dominates U.S. broiler and turkey production, accounting for 98 percent of annual broiler production and 70 percent of turkey production. About 40 percent of all eggs produced annually are under a production contract arrangement. Production contracting in the hog sector still accounts for a relatively small share of production (about 30 percent of hog production in 1997), but use is rising, especially in some regions. Production contracts are uncommon at beef and dairy operations, although they are used by some operations to raise replacement herd or to finish animals prior to slaughter. Additional detail on the use of production contracts in these sectors is provided in section VI.

Although farmers and ranchers have long used contracts to market agricultural commodities, increased use of production contracts is changing the organizational structure of agriculture and is raising policy concerns regarding who is responsible for ensuring that manure and wastewater is contained on-site and who should pay for environmental improvements at a production facility. As a practical matter, however, regulatory authorities have limited ability to influence who pays for environmental compliance, since the division of costs and operational responsibilities is determined by private contracts, not regulation.

In addition, there is also evidence that the role of the producer-processor relationship may influence where animal production facilities become concentrated, since animal feeding operations tend to locate in close proximity to feed and meat packing plants. This trend may be increasing the potential that excess manure nutrients beyond the need for crop fertilizer are becoming concentrated in particular geographic areas, thus raising the potential for increased environmental pressure in those areas. To further examine this possibility, EPA conducted an analysis of the correlation between areas of the country where there is a concentration of excess manure generated by animal production operations and a concentration of meat packing and poultry slaughtering facilities. This analysis concludes that in some areas of the country there is a strong correlation between areas of excess manure concentrations and areas where there is a large number of processing plants. More information on this analysis is provided in section IV.C.4 of this preamble.

Substantial Operational Control as Basis for Co-Permitting. Today's proposal would clarify that all entities that exercise substantial operational control over a CAFO are subject to NPDES permitting requirements as an "operator" of the facility. EPA's regulations define an owner or operator as "the owner or operator of any 'facility or activity' subject to regulation under the NPDES program." 40 CFR § 122.2. This definition does not provide further detail to interpret the term, and the Agency looks for guidance in the definitions of the term in other sections of the statute: "The term 'owner or operator' means any person who owns, leases, operates, *controls, or supervises* a source." CWA § 306(a)(4) (emphasis added).

Case law defining the term "operator" is sparse, but courts generally have concluded that through the inclusion of the terms owner and operator: "Liability under the CWA is predicated on either (1) performance of the work, or (2) responsibility for or control over the work." *U.S.* v. *Sargent County Water Resources Dist.*, 876 F.Supp 1081, 1088 (N.D. 1992). See also, *U.S.* v. *Lambert*, 915 F.Supp. 797, 802 (S.D.WVa. 1996) ("The Clean Water Act imposes liability both on the party who actually performed the work and on the party with responsibility for or control over performance of the work."); *U.S.* v. *Board of Trustees of Fla. Keys Community College*, 531 F.Supp. 267, 274 (S.D.Fla. 1981). Thus, under the existing regulation and existing case law, integrators which are responsible for or control the performance of the work at individual CAFOs may be subject to the CWA as an operator of the CAFO. With today's proposal, EPA is identifying some factors which the Agency believes indicate that the integrator has sufficient operational control over the CAFO to be considered an "operator" for purposes of the CWA.

Whether an entity exercises substantial operational control over the facility would depend on the circumstances in each case. The proposed regulation lists factors relevant to "substantial operational control," which would include (but not be limited to) whether the entity: (1) Directs the activity of persons working at the CAFO either through a contract or direct supervision of, or on-site participation in, activities at the facility; (2) owns the animals; or (3) specifies how the animals are grown, fed, or medicated. EPA is aware that many integrator contracts may not provide for direct integrator responsibility for manure management and disposal. EPA believes, however, that the proposed factors will identify integrators who exercise such pervasive control over a facility that they are, for CWA purposes, co-operators of the CAFO.

This is a representative list of factors that should be considered in determining whether a co-permit is appropriate, but States should develop additional factors as needed to address their specific needs and circumstances. The greater the degree to which one or more of these or other factors is present, the more likely that the entity is exercising substantial operational control and, thus, the more important it becomes to co-permit the entity. For example, the fact that a processor required its contract grower to purchase and feed its animals feed from a specific source could be relevant for evaluating operational control. EPA will be available to assist NPDES permit authorities in making case-specific determinations of whether an entity is exerting control such that it should be co-permitted. EPA is also taking comment on whether there are additional factors which should be included in the regulation. EPA also requests comment on whether degree of participation in decisions affecting manure management and disposal is one of the factors which should be considered.

EPA is soliciting comment on whether, alternatively, the fact that an entity owns the animals that are being raised in a CAFO should be sufficient to require the entity to be a joint permittee as a owner. EPA believes that ownership of the animals establishes an ownership interest in the pollutant generating activity at the CAFO that is sufficient to hold the owner of the animals responsible for the discharge of pollutants from the CAFO.

In non-CAFO parts of the NPDES regulations, the operator rather than the owner is generally the NPDES permit holder. One reason an owner is not required to get a permit is illustrated by an owner who has leased a factory. When an owner leases a factory to the lessee-operator, the owner gives up its control over the pollution-producing activities. The owner of animals at a feedlot, on the other hand, maintains all current interests in the animal and is merely paying the contract grower to raise the animals for the owner. It is the owner's animals that generate most of the manure and wastewater that is created at a CAFO. Therefore, EPA believes that ownership of the animals may be sufficient to create responsibility for ensuring that their wastes are properly disposed of. This may be particularly true where manure must be sent off-site from the CAFO in order to be properly disposed of.

EPA has previously identified situations where the owner should be the NPDES permittee rather than, or in addition to, the contract operator. In the context of municipal wastewater treatment plants, EPA has recognized that the municipal owner rather than the contract operator may be the proper NPDES permittee where the owner maintains some control over the plant.

If EPA selects this option, it might also clarify that ownership could be determined by factors other than outright title to the animals. This would prevent integrators from modifying their contracts so that they do not own the animals outright. EPA could develop factors for determining ownership such as the existence of an agreement to purchase the animals at a fixed price together with the integrator accepting the risk of loss of the animals prior to sale. EPA solicits comments on whether such criteria are necessary and, if so, what appropriate criteria would be.

Implementation of Co-Permitting. All permittees would be held jointly responsible for ensuring that manure production in excess of what can be properly managed on-site is handled in an environmentally appropriate manner. The effluent guidelines proposes to require a number of land application practices that will limit the amount of CAFO manure that can be applied to a CAFO's land application areas. If the CAFO has generated manure in excess of the amount which can be applied consistent with its NPDES permit, the proposed NPDES regulations impose a number of requirements on co-permittees, described in VII.D.4. See proposed § 122.23(j)(4). The co-permittees could also transfer their excess manure to a facility to package it is as commercial fertilizer, to an incinerator or other centralized treatment, to be transformed into a value-added product, or to any other operation that would not land apply the manure. EPA is proposing that manure that must leave the CAFO in order to be properly managed not be considered within the unique control of any of the entities with substantial operational control over the CAFO. In fact, an integrator that owns the animals at a number of CAFOs in an area which are producing manure in such volumes that it cannot be properly land applied may be in a unique position to be able to develop innovative means of compliance with the permit limits. Today's proposal would specify that the disposition of excess manure would remain the joint responsibility of all permit holders. See proposed § 122.23(i)(9). Integrators would thereby be encouraged to ensure compliance with NPDES permits in a number of ways, including: (a) establishing a corporate environmental program that ensures that contracts have sound environmental requirements for the CAFOs; (b) ensuring that contractors have the necessary infrastructure in place to properly manage manure; and (c) developing and implementing a program that ensures proper management and/or disposal of excess manure. The proposed requirement will give integrators a strong incentive to ensure that their contract producers comply with permit requirements and subject them to potential liability if they do not. Integrators could also establish facilities to which CAFOs in the area could transfer their excess manure. EPA is further proposing to require co-permitted entities to assume responsibility for manure generated at their contract operations when the manure is transferred off-site.

EPA believes that integrators will want to make good faith efforts to take appropriate steps to address the adverse environmental impacts associated with their business. EPA is soliciting comments on how to structure the co-permitting provisions of this rulemaking to achieve the intended environmental outcome without causing negative impacts on growers.

EPA also believes the proposal contains sufficient flexibility for permit authorities to develop creative, and streamlined, approaches to co-permitting. For example, a State might want to develop an NPDES general permit in collaboration with a single integrator or, alternatively, with all integrators in a geographic region (*e.g.*, statewide, watershed, *etc.*). Such a general permit might require integrators to assume responsibility for ensuring that their contractors engage in proper management practices for excess manure. As a condition of the NPDES general permit, the integrator could be obligated to fulfill its commitment or to assume responsibility for violations by its growers.

The proposed regulations would provide that a person is an "operator" when "the Director determines" that the person exercises substantial operational control over the CAFO. EPA also considered whether to delete the referance to a determination by the Director, so that any person who exercised such control over a CAFO would be an operator without the need for a determination by the Director. If EPA were to eliminate the need for a determination before such a person may be an "operator," persons who may meet this definition would be less certain in some cases as to whether they do in fact meet it. On the other hand, if EPA retains the need for a determination by the Director, then because of resource shortages or for other reasons, EPA or the State might not be able to make these determinations in a timely way, or might not make them at all in some cases. These persons would therefore inappropriately be able to avoid liability even though they are exercising substantial operational control of a CAFO. Accordingly, EPA requests comments on whether the final rule should retain the need for a determination by the Director of substantial operational control. Finally, EPA solicits comment on whether to provide that, in authorized States, either the Director or EPA may make the determination of substantial operational control.

Additional Issues Associated With Co-Permitting. The option of co-permitting integrators was discussed extensively by small entity representatives (SERs) and by the Small Business Advocacy Review Panel during the SBREFA outreach process. The SERs included both independent and contract producers. A majority of SERs expressed opposition to such an approach. They were concerned that co-permitting could decrease the operator's leverage in contract negotiations with the corporate entity, increase corporate pressure on operators to indemnify corporate entities against potential liability for non-compliance on the part of the operator, encourage corporate entities to interfere in the operational management of the feedlot in order to protect against such liability, provide an additional pretext for corporate entities to terminate a contract when it was to their financial advantage to do so, restrict the freedom of operators to change integrators, and generally decrease the profits of the operator. These SERs were not convinced that co-permitting would result in any benefit to the environment, given that the operator generally controls those aspects of a feedlot's operations related to discharge, nor were they convinced that such an approach would result in additional corporate resources being directed toward environmental compliance, given the integrator's ability to pass on any additional costs it might incur as a result of co-permitting to the operator. A few SERs, who were not themselves involved in a contractual relationship with a larger corporate entity, favored co-permitting as a way of either leveling the playing field between contact and independent operators, or extracting additional compliance resources from corporate entities. Despite general concern over co-permitting due to the economic implications for the contractor, several SERs voiced their support for placing shared responsibility for the manure on the integrators, especially in the swine sector.

The Panel did not reach consensus on the issue of co-permitting. On the one hand, the Panel shared the SER's concern that co-permitting not serve as a vehicle through which the bargaining power and profits of small contract growers are further constrained with little environmental benefit. On the other, the Panel believed that there is a potential for environmental benefits from co-permitting. For example, the Panel noted (as discussed above), that co-permitted integrators may be able to coordinate manure management for growers in a given geographic area by providing centralized treatment, storage, and distribution facilities, though the Panel also pointed out that this could happen anyway through market mechanisms without co-permitting if it resulted in overall cost savings. In fact, the Agency is aware of situations where integrators do currently provide such services through their production contracts. The Panel also noted that co-permitting could motivate corporate entities to oversee environmental compliance of their contract growers, in order to protect themselves from potential liability, thus providing an additional layer of environmental oversight.

The Panel also expressed concern that any co-permitting requirements may entail additional costs, and that co-permitting can not prevent these costs from being passed on to small operators, to the extent that corporate entities enjoy a bargaining advantage during contract negotiations. The Panel thus recommended that EPA carefully consider whether the potential benefits from co-permitting warrant the costs, particularly in light of the potential shifting of these costs from corporate entities to contract growers. The Panel further recommended that if EPA does propose any form of co-permitting, it address in the preamble both the environmental benefits and any economic impacts on small entities that may result and request comment on its approach.

As discussed in Section VI, EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements. EPA expects that no meat packing or processing facilities in the cattle and dairy sectors will be subject to the proposed co-permitting requirements. Reasons for this assumption are summarized in Section VI of this preamble. Additional information is provided in Section 2 of the Economic Analysis. EPA is seeking comment on this assumption as part of today's notice.

EPA did not precisely estimate the costs and impacts that would accrue to individual co-permittees. Information on contractual relationships between contract growers and processing firms is proprietary and EPA does not have the necessary market information and data to conduct such an analysis. Market information is not available on the number and location of firms that contract out the raising of animals to CAFOs and the number and location of contract growers, and the share of production, that raise animals under a production contract. EPA also does not have data on the exact terms of the contractual agreements between processors and CAFOs to assess when a processor would be subject to the proposed co-permitting requirements, nor does EPA have financial data for processing firms or contract growers that utilize production contracts.

EPA, however, believes that the framework used to estimate costs to CAFO does provide a means to evaluate the possible upper bound of costs that could accrue to processing facilities in those industries where production contracts are more widely utilized and where EPA believes the proposed co-permitting requirements may affect processors. The details of this analysis are provided in Section X..F.2. Based on the results of this analysis, EPA estimates that the range of potential annual costs to hog processors is $135 million to $306 million ($1999, pre-tax). EPA estimates that the range of potential annual costs to broiler processors as $34 million to $117 million. EPA is soliciting comment on this approach.

This approach does not assume any addition to the total costs of the rule as a result of co-permitting, yet it does not assume that there will be a cost savings to contract growers as result of a contractual arrangement with a processing firm. This approach merely attempts to quantify the potential magnitude of costs that could accrue to processors that may be affected by the co-permitting requirements. Due to lack of information and data, EPA has not analyzed the effect of relative market power between the contract grower and the integrator on the distribution of costs, nor the potential for additional costs to be imposed by the integrator's need to take steps to protect itself against liability and perhaps to indemnify itself against such liability through its production contracts. EPA has also not specifically analyzed the environmental effects of co-permitting.

EPA recognizes that some industry representatives do not support assumptions of cost passthrough from contract producers to integrators, as also noted by many small entity representatives during the SBREFA outreach process as well as by members of the SBAR Panel. These commenters have noted that integrators have a bargaining advantage in negotiating contracts, which may ultimately allow them to force producers to incur all compliance costs as well as allow them to pass any additional costs down to growers that may be incurred by the processing firm. EPA has conducted an extensive review of the agricultural literature on market power in each of the livestock and poultry sectors and concluded that there is little evidence to suggest that increased production costs would be prevented from being passed on through the market levels. This information is provided in the docket.

EPA requests comments on its cost passthrough assumptions in general and as they relate to the analysis of processor level impacts under the proposed co-permitting requirements. EPA will give full consideration to all comments as it decides whether to include the proposed requirement for co-permitting of integrators in the final rule, or alternately whether to continue to allow this decision to be made on a case-by-case basis by local permit writers. Several other alternatives to co-permitting are discussed below. EPA also requests comment on how to structure the co-permitting provisions of the rule making to achieve the intended environmental outcome without causing negative impacts on growers, should it decide to finalize them.

Alternatives to Co-Permitting. EPA also considered alternative approaches under which EPA would waive the co-permitting requirement for States and processors that implement effective programs for managing excess manure and nutrients. One such approach would require the disposition of manure that is transported off-site to remain the joint responsibility of the processor and other permit holders, unless an enforceable state program controls the off-site land application of manure. For example, if the State program addressed the off-site land application of manure with PNP development and implementation requirements that are equivalent to the requirements in 40 CFR 412.13(b)(b) and 122.23(j)(2), it would not be necessary to permit the processor in order to ensure the implementation of those requirements.

Another approach would be based on whether the processor has developed an approved Environmental Management System (EMS) that is implemented by all of its contract producers and regularly audited by an independent third party. EPA anticipates that the alternative program would be designed to achieve superior environmental and public health outcomes by addressing factors beyond those required in this proposed regulation, such as odor, pests, etc. The following section describes the principles of such a system.

Environmental Management System as Alternative to Co-Permitting. An increasing number of organizations, in both the private and public sector, are using environmental management systems (EMS) as a tool to help them not only comply with environmental legal requirements, but also address a full range of significant environmental impacts, many of which are not regulated. Environmental management systems include a series of formal procedures, practices, and policies that allow an organization to continually assess its impacts on the environment and take steps to reduce these impacts over time, providing an opportunity and mechanism for continuous improvement. EMSs do not replace the need for regulatory requirements, but can complement them and help organizations improve their overall environmental performance. EPA supports the adoption of EMSs that can help organizations improve their compliance and overall performance and is working with a number of industries to help them adopt industry-wide EMS programs.

Under this alternative, EPA would not require a processor to be co-permitted with their producers if the processor has developed, in conjunction with its contract producers, an EMS program that is approved by the permit authority and EPA, including opportunities for review and comment by EPA and the public. The EMS would identify the environmental planning and oversight systems, and criticel management practices expected to be implemented by all of the processors' contract growers. Independent third-party auditors annually would verify effective implementetion of the EMS to the permit authority and integrator. If a processor egreed to implement such e program, and then one or more of its contract producers failed to meet these requirements, the processor would remove animals from the contract producers farm, in a time and manner as defined in the approved EMS, and not supply additional animals until the contract producer is certified as being in compliance with the EMS by the third party auditor. Once the animals have been removed, processors would not continue contractual relationships with producers not capable or willing to meet the minimum requirements of the EMS. Processors who fail the independent audit would be required to apply for an NPDES permit or be included as a co-permittee on contract producers' permits.

Each permitted facility's EMS would also require that programs be in place to ensure that it remained in compliance with its NPDES permit (if a permitted facility). For all contractors, the EMS would address all activities that could have a significant impact on the environment, including activities not subject to this proposed regulations. These best management practices could be adapted to meet the particular needs of individual States, as appropriate.

To ensure consistency, contract growers and the processor would be required to be annually audited by an independent third party. The permit authority would be expected to develop criteria for the audit, including what constitutes acceptable implementation of the EMS by both contract producers and the processor. Such an EMS would require contract producers to comply with their NPDES permit (if a permitted facility) and to implement the terms of the EMS that address manure management as well as other unregulated impacts like odor, pests, etc. Contract producers would need to employ specific Best Management Practices (BMPs) when addressing unregulated impacts and maintain specific records on their use. BMPs could be adapted to meet the needs of a particular state or region.

The EMS would be required to be consistent with guidance developed by the processor and approved by the permit authority and EPA. Processors would assume responsibility for developing, in conjunction with contract producers, the proposed EMS as well as the proposed third party auditing guidance, which would be subject to approval by the permit authority end EPA. Further, the processors would facilitate implementetion by their producers through training and technical assistance.

Each facility's EMS would be required to successfully complete an audit conducted by an independent third party organization approved by the permit authority. Facilities would also be subject to annual follow up audits designed to determine if the EMS was in place and being adequately implemented. Contractors would not continue contractual relationships with producers that did not remain in compliance and did not continue to adequately implement their EMSs, as determined by annual third party follow-up audits.

Each processor would be required to seek input from local stakeholders as it developed and implemented its EMS. Further, information about EMS implementation, including audit results, would be publicly available.

Because geographic areas tend to be dominated by few processors, contract growers tend to have limited choice in selecting with whom to have a production contract. Thus, EPA expects that processors would provide economic and technical assistance to help contract producers implement the EMS.

EPA sees potential benefits to this type of approach. Besides giving processors an incentive to develop regional approaches to managing excess manure nutrients from CAFO generated manure, it would involve the processors in ensuring that permittees meet their permit requirements, thus relieving burden on the resources of permit authorities and EPA. Further, an EMS goes beyond what NPDES requires, in that it addresses issues beyond the scope of this rulemaking, such as odor, pests, etc., and, most important, it will address manure generated by all CAFOs as well as all AFOs under contract with the processors. Finally, this approach will provide local stakeholders with important information about the operations of producers and give these stakeholders meaningful opportunities to provide inpnt to the facility on its operations throughout the permitting and EMS development process.

On the other hand, an EMS approach could be more difficult to administer and enforce. Some also question whether it would be appropriate to impose the requirements of an EMS on independent growers or AFO operators who trade with the processors, bnt who are not subject to this regulation. Further, it could be a concern that a producer might, seemingly arbitrarily, refuse resources to assist with implementing the EMS, and then subsequently withholding animals from the grower and effectively terminating the contract.

EPA solicits comment on whether EPA should provide an option for States to develop an alternative program for addressing excess manure in lieu of requiring co-permitting. EPA also requests comment on the EMS concept described in detail in this proposal.

6. How Does EPA Propose To Regulate Point Source Discharges at AFOs That Are Not CAFOs?

EPA is proposing to clarify in today's proposed rulemaking that all point source discharges from AFOs are covered by the NPDES regulations even if the facility is not a CAFO (except for certain discharges composed entirely of storm water, as discussed below). See proposed § 122.23(g).

The definition of point source in the CWA and regulations lists both discrete conveyances (such as pipes and ditches) and CAFOs. CWA § 502(14); 40 CFR 122.2. EPA wants to confirm as explicitly as possible that the NPDES regulatory program applies to both types of discharges. Thus, where an AFO is not a CAFO (either because it has not met the definition criteria or has not been designated) discharges from the AFO are still regulated as poiut source discharges under the NPDES program if the discharge is through a discrete conveyance that wonld qualify itself as a point source. An AFO is not excluded from the NPDES regulatory program altogether simply because it is not a CAFO. That is, if an AFO has a point source discharge through a pipe, ditch, or any other type of discernible, confined and discrete conveyance, it is subject to NPDES requirements just the same as any other facility that has a similar point sonrce discharge and that is not an AFO.

Today's proposal would clarify that, even though an AFO is not a CAFO, an AFO may nevertheless require an NPDES permit due to discharges from a point source at the facility. See proposed § 122.23(g). More specifically, under existing regulation and today's proposal, an AFO may be subject to regulation under tha Clean Water Act in any of the following ways:

(1) *Non-storm water discharges.* A non-storm water discharge of pollutants from a point source, such as a ditch, at the production area or land application area of an AFO, into waters of the U.S. is a violation of the CWA unless the owner or operator of the facility has an NPDES permit for the discharge from that point source (as discussed further below); or

(2) *Storm water discharges.* A discharge from a point source, such as a ditch, at the land application area of an AFO that does not qualify for the agricultural storm water discharge exemption may be designated as a regulated storm water point source under § 122.26(a)(1)(v), and, therefore, require an NPDES permit. The agricultural storm water exemption is discussed further in the following section D; or

(3) *Discharge as a CAFO.* An AFO may be designated as a CAFO and, therefore, require an NPDES permit on that basis (as discussed in the section on designation).

In addition to listing "physical" conveyances (snch as pipes and ditches), the definition of point source in the CWA aud EPA's regulations identifies CAFOs as a point source. CWA § 502(14); 40 CFR 122.2. Because all CAFOs are point sources, even surface run off from a CAFO that is not channelized in a discrete conveyance is considered a point source discharge that is subject to NPDES permit requirements. AFOs, on the other hand, are not defined as point sources. Because of that, under today's proposal, AFOs will he subject to NPDES permitting requirements if they have a point source discharge including under the circumstances described above.

First, today's proposal states clearly that an AFO which has a discharge of pollutants through a point source, such as a pipe or ditch, at either the production area or the land application area, to the waters of the United States which is not the direct result of precipitation is in violation of the Clean Water Act. See proposed § 122.23(g). The existing regulations are silent aud some AFO operators have argued that none of their discharges can be considered point source discharges unless their AFO is defined or designated as a CAFO under 40 CFR 122.23. Today's proposal would make it clear that certain discharges at AFOs are subject to NPDES requirements and no designation by the permitting authority is required. For example, if the operator of an AFO with less than 500 animal units (in the two-tier structure) or less than 300 animal units (in the three-tier structure) empties its lagoon via a pipe directly into a stream without an NPDES permit, that would be a violation of the Clean Water Act.

Second, today's proposal clarifies that a storm water discharge composed entirely of storm water from a point source at the land application area of an AFO into waters of the U.S. requires an NPDES permit if: (1) the discharge does not quality for the agricultural storm water discharge exemption, discussed below; and (2) it is designated as a regulated storm water point source. Generally, all point source discharges are prohibited unless authorized by an NPDES permit. Section 402(p) of the Clean Water Act exempts certain storm water discharges from that general prohibition. Section 402(p)(2)(E) and the EPA regulations that implement Section 402(p)(6) provide for regulation of unregulated point sources on a case by case basis upon designation by EPA or the State permitting authority (40 CFR 122.26(a)(1)(v)).

EPA considered proposing that only 40 CFR 122.23 may be used to designate an AFO based on discharges from its land application area. Designation as a CAFO, however, could unnecessarily subject the AFO's production area to NPDES permit requirements. Also, because the land application area of third party applicators of manure may be designated using 122.26(a)(1)(v), EPA is proposing that AFO controlled land application areas could also be designated under that section, even if the AFO has not been designated as a CAFO. AFOs may be required to get a permit based on storm water discharges from their productiou areas only if they have been designated as a CAFO under § 122.23.

An AFO operator is not reqnired to obtain a permit for a point source discharge at the land application area which consists entirely of storm water, and which does not qualify for the agricultural storm water discharge exemption, unless the point source has been designated under 40 CFR 122.26(a)(1)(v). A discharge consists entirely of storm water if it is due entirely to precipitation. It may include incidental pollutants that the storm water picks up while crossing the facility. The discharge would not consist entirely of storm water if, for example, a non-storm water (*e.g.*, process waste water) discharge occurs during the storm and is mixed with the storm water. Once a permit authority has determined that a point source discharge from the land application area of an AFO is not composed entirely of storm water and does not qualify for the agricnltural storm water discharge exemption, the permit anthority may designate that point sourcc as a regulatod storm water point source if the permit authority further determines under 40 CFR 122.26(a)(1)(v) that tho discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the U.S.

Designation under § 122.26 is separate from the designation of an operation as a CAFO. The criteria for designation as a CAFO based on discharges from either the land application or the production area are discussed above in C.4.

D. Land Application of CAFO-generated Manure

1. Why Is EPA Regulating Land Application of CAFO-generated Manure?

As discnssed in Section IV.B of this preamble, agricultural operations, including animal production facilities, are considered a significant source of water pollution in the United States. The recently released National Water Quality Inventory indicates that agriculture is the leading contributor of identified water quality impairments in the nation's rivers and streams, as well as in lakes, ponds, and reservoirs. Agriculture is also identified as a major contributor to identified water quality impairments in the nation's estuaries.

Pollutant discharges from CAFOs arise from two principal routes. The first route of discharges from CAFOs is from manure storage or treatment structures, especially catastrophic failures, which cause significaut volumes of often untreated manure and wastewater to enter waters of the U.S. resulting in fish kills. The second route of pollutant discharges is from the application of mannre to land, usually for its fertilizer value or as a means of disposal. Additional information on how pollutants from CAFOs reach surface waters is provided in Section V.B of this documeut and in the rulemaking record.

The proposed regulation seeks to improve control of discharges that occur from land applied manure end wastewater. Analysis conducted by USDA indicates that, in some regions, the amount of nutrients present in land applied manure has the potential to exceed the nutrient needs of the crops grown in those regions. Actual soil sample information compiled by researchers at various land grant universities provides an indication of areas where therc is widespread phosphorus saturation. Other research by USDA documents the runoff potential of land applied manure under normal and peak precipitation. Fnrthermore, research from a variety of sonrces indicates that there is a high correlatiou between areas with impaired lakes, streams and rivers due to nutrient enrichment and areas where there is dense livestock and poultry production. This information is documented in the Technical Development Document. Additional information is available in the Environmental Assessment of the Proposed Effluent Limitations Guidelines for Concentrated Animal Feeding Operations and other documents that support today's rulemaking.

2. How Is EPA Interpreting the Agricultural Storm Water Exemption With Respect to Land Application of CAFO-generated Manure?

Today, EPA is proposing to define the term "agricultural stormwater discharge" with respect to land application of manure and wastewater from animal feeding operations. Section 502(14) of the Clean Water Act excludes "agricultural stormwater discharges" from the definition of the term point source. The Clean Water Act does not fnrther define the term, and tho Agency has not formally interpreted it. Under today's proposal, an "agricultural stormwater discharge" would be defined as "a discharge composed entirely of storm water, as defined in 40 CFR 122.26(a)(13), from a land area upon which manure and/or wastewater from an animal feeding operation or concentrated animal feeding operation has been applied in accordance with proper agricultural practices, including land application of manure or wastewater in accordance with either a nitrogen-based or, as required, a phosphorus-based manure application rate." § 122.23(a)(1).

The CWA defines a point source as: "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. The term does not include agriculturel stormwater discharges and return flows from irrigated agriculture." 33 U.S.C. § 1362(14).

Congress added the exemption from the definition of point source for "agricultural stormwater discharges" in the Water Quality Act of 1987. There is limited legislative history for this provision; Congress simply stated that the "provision expands the existing exemption for return flows from irrigated agriculture to include agricoltural stormwater discharges." *Legislative History of the Water Quality Act of 1987*, 100th Cong., 2d. Sess. at 538 (1988).

The courts have found that the EPA Administrator has tha discretion to define point aud nonpoint sources. *NRDC* v. *Costle*, 568 F.2d 1369, 1382 (D.C. Cir. 1977). EPA is proposing to exercise that discretion by defining the exemptiou for "agricultural stormwater discharges" to inclnde only those discharges that (1) are composed entirely of storm water; and, (2) occur only after the implementation of proper agricultural practices.

EPA believes the first component is clear on the face of the statute. Only discharges that result from precipitation can qualify for an agricultural storm water discharge exemption. Therefore, the addition of pollutants as a result of a discharge from a point source to waters of the United States that is not dne to precipitation is a violation of the Clean Water Act (except in compliance with an NPDES permit). For example, the application of CAFO manure onto a field in quantities that are so great that gravity conveys the manure through a ditch even in dry weather into a nearby river would not be eligible for the exemption for agricultural storm water discharges. Furthermore, it is possible for a discharge to occur during a precipitation event yet not be considered to be "composed entirely of stormwatur." As the Second Circuit found, a discharge during a storm could be "primarily caused by the over-saturation of the fields rather than the rain and * * * sufficient quantities of manure were present so that the run-off could not be classified as "stormwater'." *CARE* v. *Southview Farms*, 34 f. 3d 114,121 (Sept. 2, 1994).

Second, EPA is proposing that to be eligible for the exemption for agricultural storm water, any addition of manure and/or wastewater to navigable waters must occur despite the use of proper agricultural practices. EPA interprets the statute to reflect Congress' intent not to regulate additions of mannre or wastewater thet are truly agricultural because they occnr despite the use of proper agricultural practices. Application of manure or wasteweter that is not consistent with proper rates and practices such that there are adverse impacts on water quality would be considered waste disposal rather than agricultural usage. In today's action, EPA is proposing to iuterpret the term "propor agricultural prectices" to incorporate the concept of protecting water quality. This is consistent with USDA's Technical Guidance for Developing Comprehensive Nutrient Management Plans, which states that: "[t]he objective of a CNMP is to provide AFO owners/operators with a plan to manage generated nutrients and by-products by combining conservation practices and management activities into a system that, when implemented, will protect or improve water quality." EPA believes that proper agricultural practices do encompass the need to protect water quality. While EPA recognizes that there may be legitimate agricultural needs that conflict with protecting water quality in some instances, EPA believes that its proposed definition of proper agricultural practices strikes the proper balance between these objectives. Since one focus of agricultural management practices, whether through guidance or regulation, at the state or federal level, is the minimization of water quality impacts, and since this is of particular concern to EPA, the Agency is proposing a definition of "agriculture" for Clean Water Act purposes which would be flexible enough so that an assessment of the actual impacts of a discharge of animal waste on a specific waterbody could be factored in. Today's proposal identifies the proper agricultural practices which land appliers seeking to qualify for the agricultural storm water discharge exemption would need to implement. In addition, if a permit authority determined that despite the implementation of the practices identified in today's proposal, discharges from the land application area of a CAFO were having an impact on water quality, the permit writer would need to impose additional agricultural practice requirements to mitigate such impacts. Only discharges that occur despite the implementation of all these proper agricultural practices would be considered "agricultural stormwater discharges" and be eligible for the exemption. EPA requests comment on this interpretation of the agricultural storm water exemption and on the proposal to define proper agricultural practice.

For CAFOs which land apply their manure, the Agency is proposing to require that owners or operators implement specific agricultural practices, including land application of manure and wastewater at a specified rate, development and implementation of a Permit Nutrient Plan, a prohibition on the application of CAFO manure or wastewater within 100 feet of surface water, and, as determined to be necessary by the permit authority, restrictions on application of manure to frozen, snow covered or saturated ground. See proposed §§ 412.31(b) and 412.37; § 122.21(j). The Agency is proposing to require these specific agricultural practices under its CWA authority both to define the scope of the agricultural storm water discharge exemption and to establish the best available technology for specific industrial sectors. Given the history of improper disposal of CAFO waste and Congress' identification of CAFO's as point sources, the Agency believes it should clearly define the agricultural practices which must be implemented at CAFOs.

EPA considered limiting the scope of the proper agricultural practices necessary to qualify for the agricultural storm water discharge exemption to those specified in the effluent guideline and NPDES regulations with no flexibility for the permit authority to consider additional measures necessary to mitigate water quality impacts. EPA chose not to propose this option because EPA was concerned that permit authorities would then be unable to include any additional permit conditions necessary to implement Total Maximum Daily Loads in impaired watersheds. EPA seeks comment on this option and other ways to address this concern.

The Agency is proposing to allow AFO owners or operators who land apply manure (either from their own operations or obtained from CAFOs) and more traditional, row crop farmers who land apply manure obtained from CAFOs to qualify for the agricultural storm water exemption as long as they are applying manure and wastewater at proper rates. As discussed in VII.B, under one of today's co-proposed options, CAFOs that transfer manure to such recipients would be required to obtain a letter of certification from the recipient land applier that the recipient intends to determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using either the Phosphorus Index, Phosphorus Threshold, or Soil Test Phosphorus method as specified in 40 CFR 412.13(b)(1)(iv). For purposes of the CAFO's permit, recipient land appliers need not implement all of the proper agricultural practices identified above which CAFOs would be required to implement at their own land application areas. EPA believes that this proposal enables the Agency to implement Congress' intent to both exclude truly agricultural discharges due to storm water and regulate the disposition of the vast quantities of manure and wastewater generated by CAFOs.

EPA considered defining the agricultural storm water discharge exemption for non-CAFO land appliers to apply only to those discharges which occurred despite the implementation of all the practices required by today's proposal at CAFO land application areas. EPA could require a more comprehensive set of practices for land appliers of CAFO manure and wastewater to qualify for the agricultural storm water discharge exemption. Under any definition of proper agricultural practices, a recipient who failed to implement the required practices and had a discharge through a point source into waters of the U.S. could be designated as a regulated storm water point source. However, that recipient would not be vulnerable to enforcement under the Clean Water Act for discharges prior to designation, and could only be designated as a point source if the permitting authority (or EPA in authorized States) found that the conditions of 40 CFR 122.26(a)(1)(v) were met. See discussion below. EPA is requesting comment on this option.

Whether a discharger (who would otherwise be ineligible for the agricultural storm water discharge exemption) is subject to the Clean Water Act permitting requirements varies, because of the complex interaction among the agricultural storm water discharge exemption, the definition of "point source," and other storm water discharge provisions. The next sections clarify EPA's intentions with regard to such regulation.

3. How is EPA Proposing To Regulate Discharges From Land Application of CAFO-generated Manure by CAFOs?

In today's action, EPA is proposing that the entire CAFO operation (*e.g.* the feedlot/production area and the land application areas under the operational control of a CAFO owner or operator) is subject to the revised effluent limitations guideline and the revised NPDES permitting regulation. See proposed § 122.23(a)(2). Also, as discussed above, EPA is proposing to interpret the CWA to allow CAFO land application areas to be eligible for the agricultural storm water discharge exemption. However, unless the CAFO could demonstrate that it has absolutely no potential to discharge from the production area and the land application area, the facility would be required to apply for an NPDES permit.

See proposed § 122.23(e). While EPA is proposing to interpret the terms of the statute such that CAFOs may qualify for the agricultural storm water exemption, EPA is also proposing that such CAFOs must apply for a permit even if the CAFO's only discharges may potentially qualify for the agricultural storm water discharge exemption. EPA is proposing such a requirement because it has the authority to regulate point source discharges and any discharge from the land application area of a CAFO which is not agricultural storm water is subject to the Clean Water Act. EPA believes that the only way to ensure that all nonagricultural, and therefore point source, discharges from CAFOs are permitted is to require that CAFOs apply for NPDES permits which will establish effluent limitations based on proper agricultural practices.

As noted above, the CWA explicitly defines the term "point source" to include CAFOs, and explicitly excludes agricultural storm water discharges. In today's action, EPA is attempting to interpret both provisions in a way that establishes meaningful controls over a significant source of pollution in our Nation's waters. EPA is proposing to interpret the definition of "point source" such that the exclusion of "agricultural stormwater discharges" may be an exclusion from any and all of the conveyances listed in the definition of "point source," including "concentrated animal feeding operations." The production area of the CAFO would continue to be ineligible for the agricultural storm water discharge exemption because it involves the type of industrial activity that originally led Congress to single out concentrated animal feeding operations as point sources. However, the land application areas under the operational control of the CAFO, where CAFO manure or wastewater is appropriately used as a fertilizer for crop production, appear to have the kind of agricultural activity that Congress intended to exempt. Consequently, EPA proposes to interpret the CWA so that its authority to regulate discharges of CAFO manure due to precipitation from land application areas is used in a way that ensures that any discharge is the result of agricultural practices. Any such discharges would be from the CAFO and, therefore, no separate, confined and discrete conveyance need be present.

Under today's proposal, permit writers would establish effluent limits for land application areas in the form of rates and practices that constitute proper agricultural practices to the extent necessary to fulfill the requirements of the effluent guidelines or based on BPJ, as well as to the extent necessary to ensure that a CAFO's practices are agricultural in that they minimize the operation's impact on water quality.

As noted above, EPA believes the statute does not directly address the interaction between the specific listing of "concentrated animal feeding operations" and the specific exemption of "agricultural stormwater discharges" in the definition of "point source." While EPA is proposing to interpret the Act to allow the land application areas of CAFOs to be eligible for the agricultural storm water discharge exemption, EPA is considering an interpretation of the Act under which all additions of pollutants associated with CAFOs could be regulated as "point source" discharges, and, thus, the agricultural storm water exemption would never apply to discharges from a CAFO. By singling out "concentrated animal feeding operations," a far more specific conveyance reference compared to the other, more general, terms in the definition of "point source" (such as "ditch," "channel," and "conduit"), Congress may have intended the addition of pollutants to waters of the United States from these facilities to be considered "industrial" and not "agricultural" discharges. As such, the tremendous amount of manure and wastewater generated by CAFOs could be considered industrial waste. Thus, any discharge, even if caused by storm water after land application of the manure could be considered a discharge "associated with industrial activity" under the statute's storm water discharge provisions.

EPA is soliciting comments on four additional approaches under which the agricultural storm water exemption would not apply to CAFOs. Each of these approaches would require that all CAFO permits restrict discharges from land application sites to the extent necessary to prevent them from causing or contributing to a water quality impairment.

First, EPA is soliciting comment on an alternate approach that would regulate CAFO waste as "process waste" that is not eligible for the agricultural storm water exemption, when it is applied on land that is owned or controlled by the CAFO owner or operator, because it is industrial process waste and therefore not agricultural. Any storm water associated discharges would be regulated under the existing storm water statutory provisions and EPA's implementing regulations. Under that approach, in addition to the requirements in the proposed effluent limitation guideline, the NPDES permit issued to the CAFO operator would include any additional limitations necessary to protect water quality.

Second, EPA solicits comment on classifying discharges from land application sites as discharges regulated under "Phase I" of the NPDES storm water program (CWA Section 402(p)(2)(B)). EPA's existing storm water regulations already identify discharges from land application sites that receive industrial wastes as a "storm water discharge associated with industrial activity." 40 CFR 122.26(b)(14)(v). Under the storm water regulation, EPA does not currently interpret that category (*i.e.*, storm water discharge associated with industrial activity) to include land application of CAFO manure because the Agency did not assess the cost of such regulation when it promulgated the rule. With today's proposal, however, EPA has calculated the cost of proper land application of CAFO-generated manure and wastewater and could clarify that precipitation-induced discharges from land application areas are subject to the storm water discharge regulations. If EPA finalizes a definition of CAFO which includes the land application area, then EPA could also regulate any storm water discharges from CAFOs under its existing regulations as a storm water discharge associated with industrial activity because facilities subject to storm water effluent guidelines are considered to be engaging in "industrial activity." 40 CFR 122.26 (b)(14)(i). EPA would have to conclude that no discharges from CAFO land application areas qualify for the agricultural storm water discharge exemption, even discharges which occur despite implementation of proper agricultural practices.

Third, EPA could consider discharges from the CAFO's land application area to be discharges of "process wastewater," and, therefore, not "composed entirely of stormwater," rendering the statutory storm water provisions entirely inapplicable. Under this alternate interpretation of the statutory terms, NPDES permit provisions for the CAFO, including both the production area and the land application area, could include both technology-based limits and any necessary water quality-based effluent limits.

Fourth, EPA could clarify that once a facility is required to be permitted because it is a CAFO, the agricultural storm water discharge exemption no longer applies to the land application area subject to the permit. Thus, all permit conditions, including a water quality-based effluent limitation, could be required on both the production area and the land application area.

EPA is also requesting comment on whether the land application practices established under the effluent guidelines will be sufficient to ensure that there will be little or no discharge due to precipitation from CAFO land application areas. If there were no such discharges, then EPA wouldn't need to adopt any of the four alternative approaches described above, because the effluent guidelines requirements would protect water qnality. If there would be significant run-off even when manure is applied in accordauce with agricultural practices, EPA is requesting comment on the extent and the potential adverse water quality impacts from that increment.

4. How is EPA Proposing to Regulate Land Application of Manure and Wastewater by non-CAFOs?

In some instances, CAFO owners or operators transport their manure and/or wastewater off-site. If off-site recipients land apply the CAFO-generated manure, they may be subject to regulation under the Clean Water Act. In addition, AFOs may land apply their own manure and wastewater, and they too may be subject to regulation under the Clean Water Act. A land applier could be subject to regulation if: (1) its field has a point source, as defined under the Act, through which (2) a discharge occurs that is not eligible for the agricultural storm water exemption, and (3) the land applier is designated on a case-by-case basis as a regulated point source of storm water. 40 CFR § 122.26(a)(1)(v). EPA notes that under the three-tier structure, an AFO with between 300 AU and 1,000 AU which has submitted a certification that it does not meet any of the conditions for being CAFO, and therefore does not receive an NPDES permit, would be immediately subject to enforcement and regulation under the Clean Water Act if it has a discharge which is not subject to the agricultural storm water discharge exemption; EPA and the State do not need to designate such a facility as either a CAFO or as a regnlated storm water point source.

With this proposal, EPA intends to give effect to both the agricultural storm water discharge exemption and the other storm water provisions of the Clean Water Act by subjecting to regulation a non-CAFO land applier of AFO and/or CAFO-generated manure and wastewater only if: (1) the discharge is not eligible for the agricultural storm water discharge exemption (which, as discussed above, for AFOs and other non-CAFO land appliers primarily consists of applying the manure in accordance with proper agricultural practice, including soil test, P threshold, or Phosphorus Index methods); and (2) a conveyance at the land applier's operation has been designated as a regulated storm water point source. EPA emphasizes agaiu that this regulatory approach is relevant only to discharges which are composed entirely of storm water. If it is not due to precipitation, a discharge of manure or wastewater through a point source, such as a ditch, into the waters of the U.S. need not he designated to be subject to enforcement and regulation under the Clean Water Act, as discussed in Section VII.C.6 of today's proposal.

In addition, the Director (or Regional Administrator) could exercise his or her authority to designate such dischargers within a geographic area as significant contributors of pollution to waters of the United States. 40 CFR 122.26(a)(9)(i)(D). The geographic area of coucern could be a watershed which is impaired for the pollutants of concern in CAFO waste. To do so, the Director (or Regional Admiuistrator) would need to identify the point source at each land application area or provide a record for presuming that the land application areas in that watershed have point sources, and the designation would only apply to those that do.

As noted above, case-by-case designation of point sources at land application areas which are not under the control of a CAFO owner or operator can already occnr under existing regulations. Under section 122.26(a)(1)(v), either the permitting authority or EPA may designate a discharge which he or she determines contributes to a violation of a water quality staudard or is a significant contributor of pollutants to waters of the U.S. EPA is soliciting comment on whether to clarify the term "significant contributor of pollutants" for the purposes of designatiug a discharge of manure aud/or wastewater. If a land applier is applying manure and/or wastewater such that he or she is not eligible for the agricultural storm water discharge exemption and if the receiving waterbody (into which there are storm water discharges associated with manure and/or wastewater) is not meeting water quality standards for a pollutaut in the waste (such as phosphorus, nitrogen, dissolved oxygen or fecal coliform), then EPA could propose that, by regulation, such a discharge constitutes a "significant contributor of pollutauts." For example, if a laud applier is applying maoure and/or wastewater at a rate above the rate which qualifies the recipient for the agricultural storm water discharge exemption, and if, due to precipitation, waste runs off the laud application area through a ditch into a navigable water that is impaired due to nutrients, then the permit authority may designate that point source as a regulated storm water point source. The designee would then need to apply for an NPDES permit or risk being subject to enforcement for unpermitted discharges.

EPA solicits comment on the proposed means of ensuring that manure and wastewater from AFOs and CAFOs is used in an environmentally appropriate manner, whether on-site at the CAFO or AFO or off-site outside of the control of the CAFO operator.

E. What are the Terms of an NPDES Permit?

EPA is proposing to include several uew requirements in the NPDES permit for CAFOs. See proposed § 122.23(i). As discussed in section VIII on the proposed effluent guidelines, EPA is proposiug to require all CAFO operators to develop and implement a Permit Nutrient Plan, which is a site-specific plan for complying with the effluent limitations requirements contained in the NPDES permit. EPA is proposing to require permit authorities to develop special conditions for each individual or general NPDES permit that address: (1) development of the allowable manure application rate; and (2) timiug and method for land applying manure. Permits would also include a special condition that clarifies the duty to maintain permit coverage until the facility is properly closed.

NPDES permits are comprised of seven sections: cover page; effluent limitations; mouitoriug and reporting requirements; record keeping requirements; special conditions; aud standard conditions, discussed below.

1. What is a Permit Nutrient Plan (PNP) and What is the difference betweeu USDA's CNMP and EPA's PNP?

EPA is proposing to require all CAFO operators to develop and implemeut a Permit Nutrient Plan, or PNP. See proposed § 412.31(b)(1)(i)(iv) and § 122.23(k)(4). The PNP is a site-specific plao that describes how the operator intends to meet the effluent discharge limitations and other requirements of the NPDES permit. Because it is the primary planning document for determining appropriate practices at the CAFO, EPA is also proposing to require that it be developed, or reviewed and modified, by a certified planner. The PNP must be developed within three months of submitting either a uotice of intent for coverage under an NPDES general permit, or an application for an NPDES individual permit.

EPA is proposing to include a permit requirement for the CAFO to develop and implement a PNP and modify it when necessary. EPA believes this approach will maintain flexibility for modifications as the agricultural practices of the CAFO change. PNPs are intended to be living documents that are updated as circumstances change. Formal permit modification procedures would not have to be followed every time the PNP was modified.

As described in section VIII of today's proposed revisions to the effluent guidelines, CAFO operators would be required to prepare a PNP that establishes the allowable manure application rate for land applying manure and wastewater, and that documents how the rate was derived. The plan would also address other site-specific conditions that could affect manure and wastewater application. It would also describe sampling techniques to be used in sampling manure and soils, as well as the calibration of manure application equipment, and would describe operational procedures for equipment at the production area.

EPA is proposing to use the term "Permit Nutrient Plan" in today's proposed regulation in order to have a separate and distinct term that applies solely to the subset of activities in a CNMP that are directly connected with the effluent guideline and NPDES permit requirements, which are related to the best available technology currently available. EPA expects that many CAFOs will satisfy the requirement to develop a PNP by developing a Comprehensive Nutrient Management Plan (CNMP). EPA recognizes that creating a new term has the potential to create some initial confusion, and cause concern about overlapping or duplicative requirements. However, EPA believes the term PNP more clearly articulates to the regulated community the important distinctions between the broad requirements of a CNMP and the more specific effluent guideline requirements for a PNP.

EPA invites comment on today's proposal to define PNPs as the subset of elements in the CNMP that are written to meet the effluent guideline requirements. EPA is especially interested in knowing whether PNP is the best term to use to refer to the regulatory components of the CNMP, and whether EPA's explanation of both the differences and relationship between these two terms (PNP and CNMP) is clear and unambiguous.

In the Unified National Strategy for Animal Feeding Operations, EPA and USDA agreed that the development and implementation of CNMPs was the best way to minimize water quality impairment from confinement facilities and land application of manure and wastewater. The Strategy also articulated the expectation that all AFOs would develop and implement CNMPs, although certain facilities (CAFOs) would be required to do so while others (AFOs) would do so on a voluntary basis.

In December 2000, USDA published its Comprehensive Nutrient Management Planning Technical Guidance (referred to here as the "CNMP Guidance"). **Federal Register:** December 8, 2000 (Volume 65, Number 237) Page 76984–76985. The CNMP Guidance is intended for use by NRCS, consultants, landowners/operators, and others that will either be developing or assisting in the development of CNMPs. USDA published the CNMP Guidance to serve only as a technical guidance document, and it does not establish regulatory requirements for local, tribal, State, or Federal programs. Rather, it is intended as a tool to support the conservation planning process, as contained in the NRCS National Planning Procedures Handbook. The objective of the CNMP technical guidance is to identify management activities and conservation practices that will minimize the adverse impacts of animal feeding operations on water quality. The CNMP Guidance provides a list of elements that USDA believes should be considered when developing a CNMP. The strength of the CNMP Guidance is the breadth of conservation practices and management activities that it recommends AFO operators should consider.

Initially, it was EPA's expectation to simply adopt USDA's voluntary program into its NPDES permitting program. However, by intentionally avoiding establishing regulatory requirements and limiting its role to that of technical guidance only, USDA's CNMP Guidance lacks many of the details EPA believes are necessary to ensure discharges of manure and other process wastewater are adequately controlled and nutrients applied to agricultural land in an acceptable manner. In addition, the CNMP Guidance addresses certain elements that address aspects of CAFO operations that EPA will not include as a part of the effluent guidelines and standards.

Nonetheless, it is important to ensure that the regulatory program that would be established by the effluent guidelines and standards and NPDES permit regulations proposed today is complementary to and leverages the technical expertise of USDA with its CNMP Guidance, rather than present CAFO operators with programs that they might perceive as contradictory. EPA believes this goal will be accomplished by the requirements being proposed today. EPA is proposing that CAFOs, covered by the effluent guideline, develop and implement a PNP that is narrower in scope than USDA's CNMP Guidance, but that establishes specific actions and regulatory requirements.

One of the key differences between the effluent guideline PNP and USDA's CNMP is the scope of elements included in each plan. USDA's CNMP includes certain aspects that EPA does not require CAFO operators to address within the regulatory program. For example, element 4.2.2.1 of USDA's CNMP Guidance ("Animal Outputs—Manure and Wastewater Collection, Handling, Storage, Treatment, and Transfer") tells operators that the CNMP should include insect control activities, disposal of animal medical wastes, and visual improvement considerations. Additionally, Element 4.2.2.1 of the CNMP Guidance ("Evaluation and Treatment of Sites Proposed for Land Application") states the CNMP should identify conservation practices and management activities needed for erosion control and water management. The regulations (and PNP) being proposed today include no such requirement. EPA is not including conservation practices which control erosion as part of a PNP because erosion control is not needed on all CAFO operations and because the costs associated with controlling erosion would add $150 million dollars to the cost of this proposal. These elements of a CNMP are, however, key components to protect water quality from excessive nutrients and sediments. EPA solicits comment and data on the costs and benefits of controlling erosion and whether erosion control should be a required component of PNPs.

There are a number of elements that are addressed by both the CNMP and PNP. Examples of common elements include soil and manure analyses to determine nutrient content; calibration of application equipment; developing nutrient budgets; and records of Plan implementation. However, USDA's CNMP Guidance is indeed presented only as technical *guidance*. The CNMP Guidance identifies a number of elements that AFOs should consider, but there is no avenue for ensuring that AFOs implement any management practices or achieve a particular performance standard. In contrast, EPA's proposed PNP would establish requirements for CAFOs that are consistent with the technical guidance published by USDA experts, but that go beyond that guidance by identifying specific management practices that must be implemented.

For example, EPA is proposing the effluent guidalines to require CAFOs to analyze soil samples at least once every three years, and manure and lagoon samples at least annually. 40 CFR 412.37(a)(4)(ii). The CNMP Guidance addresses such analyses, but imposes no mandatory duty to perform snch analyses, nor to conform to a particular monitoring frequency. Given the degree to which overflows and catastrophic failnres of lagoons have been due to poor operation or maintenance of manure storage structures, EPA is proposing to establish specific requirements under Sections 308 and 402 that would: (1) More precisely monitor lagoon levels to prevent overflows that conld be reasonably avoided; (2) require operators to periodically inspect the structnral integrity of manure handling and storage structures, and expeditiously take corrective action when warranted; and (3) maintain records to ensure the proper operation and maintenance of manure handling and storage structures. USDA's CNMP Guidance establishes no such requirements.

The regulations proposed today would also require permit authorities to establish more specific requirements for application of manure and wastewater to land, where appropriate, including: how the CAFO operator is to calculate the allowable manure application rate; when it is appropriate to apply manure to frozen, snow covered or saturated land; and facility closure.

a. *How are PNPs Developed and What is the Role of Certified Specialists?* Under today's proposed rule, CAFO owners and operators would be required to seek qualified technical assistance for developing PNPs to meet their effluent guidelines and NPDES permit requirements. EPA is proposing that PNPs be developed, or reviewed and modified, by certified planners. See proposed § 412.31(b)(1)(ii).

Since PNPs are a defined subset of activities covered in CNMPs, es described above, owners and operators are expected to take advantage of the same technical assistance that is available for CNMP development, including appropriate Federal agencies, such as the NRCS, State and Tribal agricultural and conservation agency staff, Cooperative Extension Service agents and specialists, Soil and Water Conservation Districts, and Land Grant Universities. In addition, there are a growing number of non-governmental sources of qualified technical assistance, including integrators, industry associations, and private consultants who ara certified to devalop CNMPs, as well as the defined snbset of activities covered in PNPs. In addition to the help of these experts, a growing number of computer-based tools are either available or under development to facilitate development and implementation of CNMPs, and should be equally useful for PNPs.

Although CAFO owners and operators are ultimately responsible for developing and implementing effective PNPs, EPA is today proposing that PNPs be developed and/or reviewed and approved by a certified specialist. A certified PNP specialist is a person who has a demonstrated capability to develop CNMPs in accordance with applicable USDA and State standards, as well as PNPs that meet the EPA effluent guideline, and is certified by USDA or a USDA-sanctioned organization. Certified specialists include qnalified persons who have received certifications through a State or local agency, personnel from NRCS, certification programs recognized as third party vendors of technical assistance, or other programs recognized by States. In addition, USDA is now developing agreements with third-party vendors similar to the 1998 agreement with the Certified Crop Advisors (CCAs) and consistent with NRCS standards and specifications (or State standards if more restrictive). CCAs are expected to be available to provide technical assistance to producers in nutrient management, pest management, and residue management.

The purpose of using certified specialists is to ensure that effective PNPs are developed and/or reviewed and modified hy persons who have the requisite knowledge and expertise to ensure that plans fully and effectively address the uccd for PNPs that meet the minimum effluent guideline requirements in the NPDES permit, and that plans are appropriately tailored to the site-specific needs and conditions at each CAFO.

EPA recognizes that some States already have certification programs in place for nutrient management planning, and expects that tbe USDA aud EPA guidance for AFOs and CAFOs will provide additional impetus for new and improved State certification programs. These programs provide an excellent foundation for producing qualified certified specialists for CNMPs, and cen be modified relatively easily to include a special module on how to develop an effective PNP as a defined suhset of activities in the CNMP. EPA expects that, as a result of experience gained in the initial round of CAFO permitting under the existing regulations (2000—2005), certification programs will be well equipped to deal with both CNMPs and PNPs by the time today's regulations go into effect and States begin issuing the next round of CAFO permits that reflect these regnlations. Thus, PNPs won't be expected to be developed before 2005.

The issue of CNMP preparer requirements was also discussed by the SERs and SBAR Panel during the SBREFA outreach process. (Note that at that time, EPA was still nsing the term CNMP to apply to regulatory as well as voluntary nutrient management plans.) Several SERs were concerned that requiring the use of a certified planner could significantly increase the cost of plan development, as well as limit the operator's influence over the final product. These SERs felt that, with adequate financial and technical assistance, they could write their own plans and suggested that EPA work to facilitate such an option through expanded training and certification of farmers and provision of a nser-friendly computer program to aid in plan development.

The Panel recognized the need for plan preparers to have adequate training to write environmentally sound plans, particularly for large operations. However, the Panel also recognized the potential burden on small entities of having to use certified planners, especially considering the large number of AFOs and the limited number of certified planners currently available. The Panel recommended that EPA work with USDA to explore ways for small entities to minimize costs when developing CNMPs, and indicated that EPA should continue to coordinate with other Federal, State and local agencies in the provision of low-cost CNMP development services and should facilitate operator preparation of plans by providing training, guidance and tools (e.g., computer programs). EPA indicated in the Panel Report that it expected that many operations could become certified through USDA or land grant universities to prepare their own CNMPs.

EPA is requesting comment on the proposal to require that PNPs be developed, or reviewed and modified, by certified planners, and on ways to structure this requirement in order to minimize costs to small operators.

b. *Submittal of Permit Nutrient Plan to the Permit Authority.*—EPA is proposing to require that applicants for individual permits and operators of new facilities submitting notices of intent for coverage under a general permit submit a copy of the cover sheed and executive summary of their draft PNP to the permit authority at the time of application or NOI submittal. § 122.21(i)(1)(iv) and 122.28(b)(2)(ii). Operators of existing facilities seeking coverage under a general permit must submit a notice of final PNP development within 90 days of seeking coverage, but are not required to provide a copy of the PNP to the Permit Authority unless requested. The reporting requirements, including the notice of PNP development and notice of PNP amendment, are discussed in more detail in section VII.E.3 below.

Initial installation of manore control technologies are significantly less costly compared to retrofitting existing facilities, and early development of a PNP will help to eusure that, when a new facility is being designed, the operator is considering optimal control technologies. In addition, in situations where individual permits are warranted, the public interest demands early review of the PNP, rather than waiting for its availability after the permit has been in effect for some time.

EPA is requesting commeut on the proposal to require new facilities seeking coverage under a general permit, as well as applicauts for individual permits, to submit a copy of the cover sheet and executive summary of their PNP to the permit authority along with the NOI or permit application. EPA is further requesting comment on whether the entire draft PNP should be submitted along with the NOI or permit application.

EPA is further requesting comment on whether, for individual permits, the PNP, in part or in its entirety, should be part of the public notice and comment process along with the permit.

c. *Availability of the Permit Nutrient Plan Information to the Public.*—EPA is proposing to require the operator of a permitted CAFO to make a copy of the PNP cover sheet and executive summary available to the public for review. The CAFO oparator could choose to make this information directly available to the public in any of several ways, such as: (1) maintaining a copy of these documents at the facility and making them available to the permit authority as publicly viewable documents upon request; (2) maintaining a copy of these documents at the facility and making them available directly to the requestor; (3) placing a copy of them at a publicly accessible site, such as at a public library; or (4) submitting a copy of them to the permit authority. EPA is proposing that, if the operator has not made the information available by other means, the permit authority would be required, upou request from the public, to obtain a copy of the PNP cover sheet and executive summary and make them available. It is important to ensure that the public has access to this information, which is needed to determine whether a CAFO is complying with its permit, including the land application provisions.

EPA is also considering adding a provision in the final rule that would state that all information in the PNP, not just the cover sheet and executive summary, must be publicly available and cannot be claimed as confidential business informatiou. Some stakeholders have claimed that all or a portion of the PNPs should be entitled to protection as confidential business information (CBI). EPA does not believe that the PNP cover sheet or executive summary would ever contain confidential business information. The information in these two sections of the plan is simply too geueral ever to be considered as CBI. However, EPA is sensitive to the concerns of CAFOs that there may be information in the remaiuing, more detailed portions of the PNP that is legitimately proprietary to the CAFOs' businesses aod that the permit authorities should therefore protect. We therefore request comments on whether the final rule should require the entire PNP to be publicly available, or alternatively, whether the CAFO should be able to make a confidentiality claim as to the remaining information in the PNP. Any such claim of confidentiality would be governed by EPA's regulations at 40 CFR, Part 2 and relevant statutes.

There would be two bases on which EPA could base a determination that no portion of the Permit Nutrient Plans would be entitled to CBI status. First, CWA Section 402(j) states that "[a] copy of each permit application and each permit issued under this section shall be available to the public." It may be that the PNPs that would be required by today's proposal are properly viewed as a part of the CAFO's NPDES permit. The permits would require each CAFO to develop and carry out a PNP, as specified in the proposed Part 122 regulations. In eddition, today's proposed effluent limitations guidelines would specify detailed reqnirements that PNPs must meet. Failure to develop and properly carry out a PNP would be enforceable under each permit as a permit violation. Therefore, for purposes of Section 402(j), EPA may conclude that PNPs are properly viewed as a part of the permit or permit application and, accordingly, must be available to the public.

EPA issued a "Class Determination" in 1978 that addresses this issue. See "Class Determination 1–78" (March 22, 1978) (a copy of which is in the public record for today's proposal). This Class Determination addressed how to reconcile Section 402(j) of the Clean Water Act with Section 308 of the Act. Section 308, which authorizes EPA to collect information, states that information obtained under that section shall be available to the public, except upon a showing satisfactory to the Administrator that the information, if made public, would divulge methods or processes entitled to protection as trade secrets. Upon such a showing, the Administrator shall protect that information as confidential. Section 308 makes an exception for "effluent data," which is not entitled to such protection.

This Class Determination concludes that information contained in NPDES permits and permit applications is not entitled to confidential treatment because Section 402(j) mandates disclosure of this information to the public, notwithstanding the fact that it might be trade secrets or commercial or financial information. Referring to the legislative history of the CWA, the Class Determination notes that Congress sought to treat the information in permits and permit applications differently from information obtained under Section 308. It concludes that Congress intended Section 402(j) to be a disclosure mandate in contrast to the basic approach of Section 308, which provides protection for trade secret information. (Class Determination at pp. 2–4.) Therefore, consistent with the Class Determination, if EPA were to conclude that the PNPs are a part of the permit, the entire PNP would be a public document that would not be entitled to confidentiality protection.

A second basis for finding that PNPs must be available to the public would be that, even apart from Sectioo 402(j), the information in PNPs may be "effluent data" and if so, also would not be entitled to protection under Section 308. EPA's regulations define the term "effluent data," among other things, as "[i]nformation necessary to determine the identity, amount, frequency, coucentration, temperature, or other characteristics (to the extent related to water quality) of any pollutant which has been discharged by the source (or of any pollutant resulting from any discharge from the source), or any combination of the foregoing." 40 CFR 2.302(a)(2)(i). There is a limited exception for information that is related to research and development activities.

EPA believes that the informatiou in PNPs may fit this definition of "effluent data." The information in PNPs has direct bearing on the amount of pollutants that may be discharged by a CAFO and on characteristics of the pollutants that may be discharged (snch as the identity and presence of nutrients) that would be related to water quality.

On the other hand, the Agency could conclude that the information in the PNP is not part of the CAFO's permit. Each permit wonld indeed require the CAFO to develop and carry out a PNP that is approved by a certified specialist. Nevertheless, the CAFO will be developing the terms of the final PNP, as well as periodic modifications to the PNP, outside of the permitting process. It may be appropriate not to consider the PNP to be part of the permit for purposes of section 402(j). If 402(j)—which states that all information *in the permit* must be publicly available—is therefore not a relevant provision, then whether PNPs could be protected as confidential wonld be determined nnder section 308.

Section 308, as noted above, allows information to be protected as CBI where the submitter can demonstrate the trade secret nature of the information to the satisfaction of the Administrator, except that "effluent data" is never coufidential. EPA could find thet the information in PNPs is *not* "effluent data." That is, EPA could conclude that the information in PNPs primarily concerns operatioual practices at the facility and does not heve enongh of a bearing on the characteristics of pollutants in the effluent to be considered "effluent data." Because it would not be "effluent data," the PNP information would not be categorically excluded from being treated as confidential. EPA's regulations at 40 CFR Part 2 specify the procedures for parties to make case-specific claims that information they submit to EPA is confidential and for EPA to evaluate those claims. Consistent with these regulations, each CAFO could claim that the information in its PNP is confidential (except for the cover sheet and executive snmmary). EPA would evaluate these claims and determine in each case whether the CAFO's CBI claim should be approved or denied. In sum, EPA could adopt final regulations that would reqnire a CAFO's CBI claims for the more detailed information in the remaining parts of the PNP to be decided in each case.

The Agency notes that EPA itself would, of course, always be able to request and review the CAFO's full PNP. The issues raised in this discussion concern only the availability of these plans to outside parties.

EPA requests comments on all aspects of this proposal, including whether it would be proper to determine that the full PNP must be publicly available under CWA Section 402(j) and under CWA Section 308 as "effluent data." EPA also requests commeuts on whether the cover sheet aod executive summary should always be made available to the public, as proposed, or whether there are elements of the cover sheet or executive summary that might appropriately be claimed as CBI, and not considered to be either part of the permit or "effluent data."

The PNP would be narrower than the CNMP and would contain only reqnirements that are necessary for pnrposes of the effluent gnideline. A CNMP may contain other elements that go beyond the effluent gnideline. EPA is not proposing any separate requirements for CNMPs themselves to be made publicly available and is not proposing any findings as to whether information in a CNMP may be confidential.

2. What are the Effluent Limitations in the Permit?

The effluent limitations section in the permit serves as the primary mechanism for controlling discharges of pollutants to receiviug waters. This section describes the specific narrative or numeric limitations that apply to the facility and to lend application. It can contain either technology-based effluent limits or water quality-based effluent limits, or both, and can contain additional best management practices, as needed.

a. What Technology Based Effluent Limitations Would be in the Permit? Under the two-tier structure, for CAFOs with 500 AU or more, the effluent guidelines and standards regulations (40 CFR 412) would establish the technology-based effluent limitations to be applied in NPDES permits. Under the three-tier structure, any operation defined as a CAFO would be subject to the revised effluent gnidelines. The proposal to revise the effluent guidelines and standards regulation is described in section VIII of today's proposed rule.

Operations with fewer than 500 AU under the two-tier structure, or fewer than 300 AU under the three-tier structure, which have been designated as CAFOs by the permit authority would not be subject to the effluent guidelines and standards. For these CAFOs, the permit writer would use "Best Professional Judgement," or BPJ, to establish, on a casa-by-case basis, the appropriate technology-based requirements. Often, permit writers adopt requirements similar to, or the same as the effluent guidelinas requirements.

b. What Water Quality-based Effluent Limitations Would be in the Permit? Section 301(h)(1)(C) of the Clean Water Act requires there to be achieved "any more stringent limitation, including those necessary to meet water quality standards." Therefore, where technology-based effluent limitations are not sufficient to meet water quality standards, the permit writer must develop more stringent water quality-based effluent limits. Under today's proposal, the permit writer must inclnde any more stringent effluent limitations for the waste stream from the production area as necessary to meet water quality standards. If necessary to meet water quality standards, permit writers may consider requiring more stringent BMPs (e.g., liners for lagoons to address a direct hydrologic connection to surface waters; covers for lagoons to prevent rainwater from causing overflows; allowing discharges only from catastrophic storms and not from chronic storms; pollutant limits in the overflow; particular treatments, such as grassed waterways for the overflows discharged; etc.).

If EPA chose to promulgate one of the options discussed in section VII.D.2 above under which the agricultural storm water discharge exemption did not apply to land application areas under the operational control of a permitted CAFO, then the permit writer would be required to establish water qnality-based effluent limits where necessary to meet water quality standards. If EPA chose to promulgate the option described in section VII.D.2 above, under which the appropriate rates and practices identified in the effluent guidelines and the NPDES regulations established the scope of the term "agriculture" without additional consideration of water quality impacts or water quality standards, only the limitations and practices required by the effluent guidelines and the NPDES regulations could be required by the permit authority for land application discharges.

c. What Additional Best Management Practices Would be in the Permit? Under § 122.44(k)(4) of the existing NPDES regulations, permit writers may include in permits best management practices "that are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA." Under today's proposal, the permit writer may include BMPs for land application areas in addition to those required by the effluent guidelines, as necessary to prevent adverse impacts on water quality. As discussed in section VII.D.2 above, EPA is today defining proper agricultural practices required to qualify for the agricultural storm water discharge exemption to include practices necessary to minimize adverse water quality impacts. Therefore, if a permit writer determines that despite the implementation of the BMPs required by the effluent guidelines discharges from a CAFO will have adverse water quality impacts, the permit writer should impose additional BMPS designed to minimize such impacts.

3. What Monitoring and Raporting Requirements are Included in the Permit?

The section of the NPDES permit on monitoring and reporting requirements identifies the specific conditions related to the types of monitoring to be performed, the frequencies for collecting samples or data, and how to record, maintain, and transmit the data and information to the parmit authority. This information allows the NPDES permit authority to determine compliance with the permit requirements.

As described in section VIII, today's proposed revisions to the effluent guidelines would require the operator to conduct periodic visual inspectiou and to maintain all manure storage and handling equipment and structures as well as all runoff management devices. See proposed § 412.33(c). The NPDES permit would also require the permittee to: (1) test and calibrate all manure application equipment annually to ensure that manure is land applied in accordance with the proper application rates established in the NPDES permit; (2) sample manure for nutrient content at least once annually, and up to twice annually if manure is applied more than once or removed to be sent off-site more than once per year; and (3) sample soils for phosphorus once every three years. Today's proposed effluent guidelines would also require the operator to review the PNP annually and amend it if practices change either at the production area or at the land application area, and submit notification to the permit authority. Examples of changes in practice necessitating a PNP amendment include: a substantial increase in animal numbers (e.g., more than 20 percent) which would significantly increase the volume of manure and nutrients produced on the CAFO; a change in the cropping program which would significantly alter land application of animal manure and wastewater; elimination or addition of fields receiving animal waste application; or changes in animal waste collection, storage facilities, treatment, or land application method.

As discussed in section VII.E.1.c above, CAFO operators would be required to submit their PNPs, as well as any information necessary to determine compliance with their PNPs and other permit requirements, to the permit authority upon request. The CAFO operator could make a copy of the cover sheet and executive summary of the PNP available to the public iu any of several ways. Operators of new facilities seeking coverage under a general permit and applicants for individual permits would be reqnired to submit a copy of their draft PNP to the permit authority at the time of NOI submittal or application.

EPA is also proposing to require operators to submit a writtan notification to the permit authority, signed by the certified planner, that the PNP has been developed or amended, and is being implemented, accompanied by a fact sheet summarizing certain elements of the PNP. See § 412.31(b)(1)(ii). This written notice of PNP availability would serve an important role in verifying that the permittee is complying with one of the requirements of the NPDES permit. EPA is proposing that the PNP notification and fact sheet contain the following information:

- The number and type of animals covered by the plan
- The number of acres to which manure and wastewaters will be applied
- The phosphorus conditions for those fields receiving the manure
- Nutrient content of the manure
- Application schedule and rate
- The quantity to be transferred off-site
- Date PNP completed or amended
- Key implementation milestones

4. What are the Record Keeping Requirements?

The record keeping requirements section of the permit specifies the types of records to be kept on-site at the permitted facility.

Operation and Maintenance of the CAFO. As described in section VIII of today's proposal, EPA is proposing to require operators to maintain records at the facility that document: (1) the visual inspections, findings, and preventive maintenance; (2) the date, rate, location and methods used to apply manure and wastewater to land under the control of the CAFO operators; (3) the transfer of the CAFO-generated manure off-site; (4) the results of annual manure and wastewater sampling and analyses to determine the nutrient content; and (5) the results of representative soil sampling and analyses conducted at least every three years to determine nutrient content.

Transfer to Off-site Recipients of CAFO Manure. As described in Chapter IV.B and V.B, inappropriate land application of CAFO-generated manure poses a significant risk to water quality. Further, EPA estimates that the majority of CAFO-generated manure is in excess of CAFO's crop needs, and will very likely be transferred off-site. The ultimate success of the CAFO program depeuds on whether recipients handle manure appropriately, and in a mauner that prevents discharge to waters. As discussed fully in section VII.D.4, EPA is not proposing to regulate off-site recipients through CAFO permit requirements, however, EPA believes that the certification and record-keeping requirements described here will help to ensure responsible handling of manure. Thus, EPA is co-proposing additional record keeping requirements under the NPDES program.

Under one co-proposed option, EPA would require that owners or operators of CAFOs obtain from off-site land appliers a certification that, if land applying CAFO-generated manure, they are doing so at proper agricultural rates. In addition, the CAFO owner or operator would be required to maintain records of transfer, including the name of the recipient and quantity transferred, and would be required to provide the recipient with an analysis of the contents of the manure and a brochure describing the recipient's responsibilities for proper management of the manure.. Under auother co-proposed option, EPA would not require the certification, but would require the CAFO owner or operator to keep records and provide information.

Certification Option. Under one option, EPA is proposing that CAFOs obtain a certification and that recipients of CAFO-generated manure so certify, pursuant to § 308 of the CWA. Under § 308, EPA has the authority to require the owner or operator of a point source to establish and maintain records and provide any information the Agency reasonably requires. The Agency has documented historic problems associated with over application of CAFO manure and wastewater by both CAFO operators and recipients of CAFO manure and wastewater. Today's proposal would establish effluent limitations designed to prevent discharges due to over application. Iu order to determine whether or not CAFOs are meeting the effluent limitations which would be established under today's proposals, EPA believes it is necessary for the Agency to have access to information concerning where a CAFO's excess manure is sent. Furthermore, in order to determine whether or not the recipients of CAFO manure should be permitted (which may be required if they do not land apply the CAFO manure in accordance with proper agricultural practices and they discharge from a point sonrce, see section VII.D.2), EPA has determined that it will be necessary for such recipients to provide information about their land application methods. Recipients who certify that they are applying manure in accordance with proper agricultural practices as detailed in section VII.D.2 are responding to a request under Section 308 of the CWA. Therefore, a recipient who falsely certifies is subject to all epplicable civil and criminal penalties under Section 309 of the CWA.

In some cases, CAFOs give or sell manure to many differeut recipients, inclnding those taking small quantities, and this requirement could result in an unreasonable burden. EPA is primarily concerned with recipients who receive and dispose of large quantities, presuming that recipients of small quantities pose less risk of inappropriate disposal or over-application. To relieve the paperwork hurden, EPA is proposing that CAFOs not be required to obtain certifications from recipients that receive less than twelve tons of manure per year from the CAFO. The CAFO would, however, be required to keep records of transfers to such recipients, as described below.

The Agency believes that it would be reasonable to exempt from the PNP certification requirements recipients who receive small amounts of mannre from CAFOs. EPA considered exempting amounts such as a single a truckload per day or a single trnckload per year. EPA decided that au appropriate exemption would be based on an amount that would be typically nsed for personal, rather than commercial, use. The exemption in today's proposal regnlation is based on the amount of manure that would be appropriately applied to five acres of land, since five acres is at the low end of the amount of land that can be profitably farmed. Sec, e.g., "The New Organic Grower," Eliott Coleman (1995).

To determine the maximum amount of manure that could be appropriately applied to five acres of land, an average nutrient requirement per acre of cropland and pasture land was computed. Based on typical crops and uational average yields, 160 pounds of nitrogen and 14.8 pounds of phosphorous are required annually per acre. See "Mannre Nutrient Relative to the Capacity of Cropland and Pastnreland to Assimilate Nutrients," Kellogg et al (USDA, July, 25, 2000). The nutrient content of manure was based on USDA's online software, *Manure Master,* available on the world wide web at *http://www2.ftw.nrcs.usda.gov/ManureMaster/MM21.html.*

The nitrogen content of manure at the time of land application ranges from 1.82 pounds per ton for heifers and dairy calves to 18.46 pounds per ton for hens and pullets. Using the low end rate of 1.82 pounds of nitrogen per ton, 87.4 tons of manure would be needed for a typical acre or 439 tons of manure for five acres in order to achieve the 160 pounds per acre rate. Using the high end rate of 18.46 pounds of nitrogen per ton, 8.66 tuns of manure would be needed for a typical acre or 43.3 tons of manure for five acres in order to achieve the 160 pounds per acre rate. Thns, the quantity of manure needed to meet the nitrogen requirements of a five acre plot would range from 43.3 tons to 439 tons, depending on the animal type.

The phosphate content of manure at the time of land application ranges from 1.10 pounds per ton for heifers and dairy calves to 11.23 pounds per ton for turkeys for breeding. Using the high end 11.23 pound per ton rate for phosphorous, only about 1.3 tons would be needed for an average acre, or 6.5 tons for five acres in order to meet the 14.8 pounds of phosphoroos required annually for a typical acre of crops. Using the low end 1.1 pound per ton rate for phosphorous, about 13.2 tons would be needed for an average acre, or 66 tons for five acres. Using the phosphate conteut for broilers of 6.61 pounds per ton is more typical of the phosphate content of manure and would result iu 2.23 tons per acre being needed for an average acre, or 11.2 tons for five acres.

Clearly, exempting the high end amount of manure based on nitrogen content could lead to excess application of phosphorous. Regulating based on the most restrictive phosphate requirement could lead to manure not being available for personal use.

The exemption is only an exemption from the requirement that the CAFO obtain a certification. The recipient would remain subject to any requirements of State or federal law to prevent discharge of pollution to waters of the U.S.

EPA is proposing to set the threshold at 12 tons per recipient per year. This is rounding the amount based on typical phosphate conteut. It also allows one one-ton pick up load per month, which is consistent with one of the altarnative approaches EPA considered. Recipients that receive more than 12 tons would have to certify that it will be properly managed. EPA is interested in comments on alternative thresholds for exempting small quantity transfers by the CAFO from the requirement that CAFOs receive certifications from the recipients.

For CAFO owners or operators who transfnr CAFO-generated mannre and wastewater to manure haulers who do not land apply the waste, EPA is proposing that the CAFO owner or operator must: (1) obtain the name and address of the recipients, if known; (2) provide the manure hauler with an analysis of the nutrient content of the manure, to be provided to the recipients; and (3) provide the manure hauler with a brochure to be given to the recipients describing the recipient's responsibility to properly manage the land application of the manure to prevent discharge of pollutants to waters of the U.S. The certification form would include the statement,

> "I understand that the information is being collected on behalf of the U.S. Environmental Protection Agency or State and that there are penalties for falsely certifying. The permittee is not liable if the recipient violates its certification."

Concern has been expressed that many potential recipients of CAFO manure will cboose to forego CAFO manure, and bny commercial fertilizers instead, in order to avoid signing such a certification and being brought under EPA regulation. The result could be that CAFO owners and operators might be unable to find a market for proper disposal, therehy turning the manure into a waste rather than a valuable commodity. EPA requests comment on this concern.

This elternative is potentially protective of the environment because non-CAFO laud appliers would be liable for being designated as a point source in the event that there is a discherge from improper land application. EPA's proposed requirements for what constitutes proper agricultural practices, described in VII.D.2 above, would ensure that CAFO-generated manure is properly managed.

No Certification Option. In the second alternative proposal for ensuring proper management of manure that is transferred off-site, EPA is not proposing to require CAFO owners or operators to obtain the certification described above. Rather, CAFO owners or operators would be reqnired to maintain records of transfer, described in the following section.

Concern has been expressed that many potential recipients of CAFO manure will choose to forego CAFO manure, and buy commercial fertilizers instead, in order to avoid signing such a certification and being brought under EPA regulation. The result could be that CAFO owners and operators might be unable to find a market for proper disposal, thereby turning the manure into a waste rather than a valuable commodity.

This alternative is potentially protective of the environment because non-CAFO land appliers would be liable for being designated as a point source in the event that there is a discharge from improper land application. EPA's proposed requirements for what constitutes proper agricultural practices, described in VII.D.2 above, would ensure that CAFO-generated manure is properly managed.

Records of Transfer of Manure Off-site. In both alternative proposals for whether or not to require CAFO owners or operators to obtain certifications from off-site recipients, EPA is proposing to require CAFO operators to maintain records of the off-site transfer of the CAFO-generated manure and wastewater, *e.g.*, when manure is sold or given away for land application on land not under their operational control, to ensure the environmentally acceptable use of the CAFO-generated manure. See § 122.23(i)(5). When CAFO-generated manure is sold or given away to be used for land application, the specific manner of land application does not need to be addressed in the CAFO's PNP. However, to help ensure the environmentally acceptable use of the CAFO-generated manure, the CAFO operator would be required to do the following: See § 122.23(j)(4) and (5).

- Maintain records showing the amount of manure and/or wastewater that leaves the operation;
- Record the name and address of the recipient(s), including the intended recipient(s) of manure and/or wastewater transferred to contract haulers, if known;
- Provide the recipient(s) with representative information on the nutrient content of the manure to be used in determining the appropriate land application rates; and
- Provide the recipient with information provided by the permit authority of his/her responsibility to properly manage the land application of the manure to prevent discharge of pollutants to waters of the U.S.
- [Under one co-proposed option, obtain and retain on-site a certification from each recipient of the CAFO-generated manure and wastewater that they will do one of the following: (a) land apply in accordance proper agricultural practices as defined in today's proposal; (b) obtain an NPDES permit for discharges resulting from non-agricultural spreading; (c) or utilize it for other than land application purposes.]

EPA proposes to require these records to be retained on-site at the CAFO, and to be submitted to the permit authority upon request.

5. What are the Special Conditions and Standard Conditions in an NPDES Permit?

Standard conditions in an NPDES permit list pre-established conditions that apply to all NPDES permits, as specified in 40 CFR 122.41.

The special conditions in an NPDES permit are used primarily to supplement effluent limitations and ensure compliance with the CWA. EPA is proposing at 40 CFR 122.23(i) to (k) to require permit authorities to develop special conditions that: (a) specify how the permittee is to calculate the allowable manure application rate; (b) specify timing restrictions, if necessary, on land application of manure and wastewater to frozen, snow covered or saturated ground; (c) establish requirements for facility closure; (d) specifying conditions for groundwater with a direct hydrological connection to surface water; (e) require certification for off-site transfer of manure and wastewater (co-proposed with omitting this requirement). Finally, EPA is soliciting comment on whether a special condition should be included regarding erosion control.

a. *Determining Allowable Manure Application Rate.* EPA is proposing that the permit authority be required to include a term in the NPDES permit that establishes the method to be used for determining the allowable manure application rate for applying manure to land under the control of the CAFO operator. See proposed § 122.23(j)(1).

As described in detail in section VIII, three methods are available which may be used to determine the allowable manure application rate for a CAFO. These three methods are: (1) the Phosphorus Index; (2) the Soil Phosphorus Threshold Level; and (3) the Soil Test Phosphorus Level.

EPA is proposing to adopt these three methods from USDA Natural Resource Conservation Service's (NRCS) nutrient management standard (Standard 590). State Departments of Agriculture are developing State nutrient standards which incorporate one of these three methods. EPA is proposing to require that each authorized permit authority adopt one or more of these three methods as part of the State NPDES program, in consultation with the State Conservationist. The permit would require the permittee to develop the appropriate land application rates in the site-specific PNP based upon the State's adopted method. EPA solicits comment on whether the special conditions in an NPDES permit should require permit authorities to adopt the USDA Natural Resource Conservation Service's (NRCS) Nutrient Management Standard (Standard 590) in its entirety rather than just the portion that applies to determining the allowable manure application rate.

b. *Would Timing Restrictions on Land Application of CAFO-generated Manure be Required?* EPA is proposing to require that the permit writer include in the CAFO's NPDES permit regionally appropriate prohibitions or restrictions on the timing and methods of land application of manure where necessary. See proposed § 122.23(i)(3). The permit writer would develop the restrictions based on a consideration of local crop needs, climate, soil types, slope and other factors.

The permit would prohibit practices that would not serve an agricultural purpose and would have the potential to result in pollutant discharges to waters of the United States. A practice would be considered not to be agricultural if significant quantities of the nutrients in the manure would be unavailable to crops because they would leach, run off or be lost due to erosion before they can be taken up by plants.

EPA considered establishing a national prohibition on applying CAFO-generated manure to frozen, snow covered or saturated ground in today's proposed effluent guidelines. Disposal of manure or wastewater to frozen, snow covered or saturated ground is generally not a beneficial use for agricultural purposes. While such conditions can occur anywhere in the United States, pollutant runoff associated with such practice is a site specific consideration and is dependent on a number of variables, including climate and topographic variability, distance to surface water, and slope of the land. Such variability makes it difficult to develop a national technology-based standard that is consistently reasonable, and does not impose unnecessary cost on CAFO operators.

While EPA believes that many permit writers will find a prohibition on applying CAFO-generated manure to frozen, snow covered or saturated ground to be reasonably necessary to achieve the effluent limitations and to carry out the purposes and intent of the

CWA, EPA is aware that there are areas where these practices might be allowed provided they are restricted. Application on frozen ground, for example, may be appropriate in some areas provided there are restrictions on the slope of the ground and proximity to surface water. Many States have already developed such restrictions.

While the proposed regulations would not establish a uational technology-based limitation or BMP, EPA is proposing at § 122.23(j)(2) that permit writers consider the need for these limits. Permit authorities would be expected to develop restrictions on timing and method of applicatinn that reflect regional considerations, which restrict applications that are not an appropriate agricultural practice and have the potential to result in pollutant discharges to waters of the United States. It is likely that the operators would need to consider means of ensuring adequate storage to hold manure and wastewater for the period which manure may not be applied. EPA estimates that storage periods might range from 45 to 270 days, depending on the region and the proximity to surface water, and to gronnd water with a direct hydrological connection to surface water. Permit authorities are expected to work with State agricultural departmeots, USDA's Natural Resource Conservation Service, the EPA Regional office, and other local interests to determine the appropriate standard, aud include the standard consistently in all NPDES permits for CAFOs.

EPA's estimate that storage periods would range from 45 days to 270 days is derived nsing published freeze/frost data from the National Oceanic and Atmospheric Administration, Natioual Center for Disease Control. For the purpose of estimating storage requirements to prevent application to frozen gronnd, EPA assumed CAFOs could only apply manure between the last spring frost and the first fall frost, called the "freeze free period". With a 90 percent probability, EPA could also use a 28 degree temperature threshold to determine the storage time reqnired, rounded to the nearest 45 day increment. This calcnlation resnlts in 45 days of storage in the South; 225 days in parts of the Midwest and the Mid-Atlantic; and as high as 270 days storage in the Central region.

EPA is soliciting comment on alternate approaches of prohibiting land application at certain times or using certain methods. For example, EPA might develop a nationally applicable prohibition against applyiug manure ou frozen land that is greater than a certain slope such as 15 percent. EPA is also interested in whether to prohibit application to saturated soils.

c. *Closure.* EPA is proposing to require permit authorities to require the CAFO operator to maintain permit coverage (*e.g.*, after the facility ceases operation as a CAFO or drops below the size for being defined as a CAFO) until all CAFO-generated manure and wastewater is properly disposed and, therefore, the facility no longer has the potential to discharge. See proposed § 122.23(i)(3). Specifically, the permit writer would need to impose a permit condition requiring the owner or operator to reapply for a permit unless and until the owner or operator can demonstrate that the facility has no potential to discharge wastes generated by the CAFO. This requirement would be included as a special condition in the NPDES permits.

EPA considered several options for ensuring that manure and wastewater from CAFOs is properly disposed after the operation terminates or ceases being a CAFO. Section VII.C.2.g above discusses the options in detail. In this proposal, EPA is also proposing to ensure that permits explicitly address closnre requirements. While EPA is today proposing to only require ongoing permit coverage of the former CAFO, permit authorities are encouraged to consider including other conditions such as those discussed in Section VII.C.2.g above.

EPA is soliciting comment on these proposed provisions.

d. *Discharge to Surface Water via a Direct Hydrological Connection with Ground Water.* EPA is proposing requirements to address the serious environmental harms cansed by discharges from CAFOs to surface waters via direct hydrologic connection with ground water. As described in sectiou V.B.2.a, studies in Iowa, the Carolinas, and the Delmarva Peninsula have shown that CAFO lagoons do leak, and that leaks from lagoons contaminate ground water and the surface water to which that ground water is hydrologically connected, often severely. EPA believes that it is reasonable to include a requirement to ensure that discharges to snrface water via a direct hydrologic connection with ground water do not occur from CAFOs, either by requiring the permit applicant to implement appropriate controls or to provide evidence that no such connection exists at the facility.

Section VII.C.2.J of today's preamble discusses the legal and technical basis for the proposed ground water controls, and provides informatioo on tools aud resources available to permit writers to make determinations as to whether the production area of a CAFO may potentially discharge to surface waters via direct hydrologic connection with ground water.

EPA requests comment on the following proposals.

CAFOs Subject to Effluent Guideline Requirements for Ground water. EPA is proposing that, for all CAFOs that are subject to an effluent guideline that includes requiremonts for zero discharge from the production area to surface water via direct hydrologic connection to ground water (all beef and dairy operations, as well as new swine, poultry and veal operations), the permit would require the appropriate controls and monitoring. Sae proposed 40 CFR 412.33(a)(3), 412.35(a)(3) and 412.45(a)(3). The permittee would be able to avoid the requirements by submitting a hydrologist's report demonstrating, to the satisfaction of the permit authority, that the ground water beneath the production area is not connected to surface water through a direct hydrologic connection.

EPA is also requesting comment on other options for determining which CAFOs must implement appropriate monitoring and controls to prevent discharges from the production area to hydrologically connected groundwater. Oue option would be for EPA to narrow the rebuttable presumption to areas with topographical characteristics that indicate the presence of ground water that is likely to have a direct hydrologic connection to surface water. For example, the final rule could specify that only CAFOs located in certain areas, such as an area with certain types of lithologic settings (e.g., karst, fractured bedrock, or gravel); or an area defined by the USGS as a HLR1 or HLR9; or an area with a shallow water table; wonld need to either comply with the groundwater monitoring requirements and appropriate controls in the effluent guideline or provide a hydrologist's statemeut demonstrating that there is no direct hydrologic connection to surface waters. Another option would be to require States, through a public process, to identify the areas of the State in which there is the potential for such discharges. In those areas, CAFOs subject to an effluent guideline that includes requirements to prevent discharges to surface water via hydrologically connected ground water would again need to either comply with the monitoring requirements and appropriate controls in the guideline or provide a hydrologist's statement demonstrating that there is no hydrologic connection to surface waters.

Requirements for CAFOs Not Subject to Effluent Guidelines Ground Water

Provisions. Certain facilities are not subject to today's revised effluent guideline (412 Subpart C and D) that includes requirements to prevent discharges to surface water via hydrologically connected ground water. Such CAFOs include: (1) Facilities below the effluent guideline applicability threshold that are designated as CAFOs; (2) existing swine, poultry and veal operations; and (3) CAFOs in sectors other than beef, dairy, poultry, swine and veal. For such CAFOs not subject to an effluent guideline that includes ground water requirements, EPA is proposing that the permit writer must assess whether the facility is in an area with topographical characteristics that indicate the presence of ground water that is likely to have a direct hydrologic connection to surface water. For instance, if the facility is in an area with topographical characteristics that indicate the presence of ground water that is likely to have a hydrologic nonnection to surface water, as discussed above, the permit writer is likely to determine that there is the potential for a discharge to surface water via ground water with a direct hydrologic connection.

For existing swine, poultry, and veal operations, if the permit writer determines that pollutants may be discharged at a level which may cause or contribute to an excursion above any State water quality standard, the permit writer would be required to decide on a case-by-case basis whether effluent limitations (technology-based and water quality-based, as necessary) should be established to address potential discharges to surface water via hydrologically connected ground water. EPA is proposing that a permittee for whom the permit authority has made the above determinations would be required to comply with those conditions, or could avoid having those conditions imposed by providing a hydrologist's statement that the facility does not have a direct hydrologic connection to surface water. 40 CFR 122.23(j)(6) and (k)(5).

For CAFOs not subject to today's revised effluent guidelines, if the permit writer determines that there is likely to be a discharge from the CAFO to surface waters via a direct hydrologic connection, the permit writer must impose technology-based or water quality-based, or both, effluent limitations, as necessary. Again, EPA is proposing that a permittee for whom the permit authority has made the above determinations would be required to comply with those conditions, or could avoid having those conditions imposed by providing a hydrologist's statement that the facility does not have a direct hydrologic connection to surface water. 40 CFR 122.23(j)(6) and (k)(5).

EPA is soliciting comments on the alternative provisions discussed here. EPA is also requesting comment on the proposal to place the burden on the permittee to establish to the satisfaction of the permitting authority that the ground water beneath the production area is not connected to surface waters through a direct hydrologic connection.

e. *Certification for Off-site Recipients of CAFO Manure.* EPA is co-proposing either to include the following requirement or to omit it. In the inclusionary proposal, EPA would require permit writers to include a special condition in each permit that requires CAFO owners or operators to transfer manure off-site only to recipients who can certify that they will either: (1) Land apply manure according to proper agricultural practices, as defined for off-site land appliers in today's proposed rule; (2) obtain an NPDES permit for potential discharges; or (3) use the manure for purposes other than land application. EPA proposes to define the term "proper agriculture practice" to mean that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using either the Phosphorus Index, Phosphorus Threshold, or Soil Test Phosphorus method as specified in 40 CFR 412.13(b)(1)(iv).

EPA is also proposing to allow States to waive this requirement if the recipient is complying with the requirements of a State program that are equivalent to proposed 40 CFR 412.13(b).

f. *Erosion Control.* EPA is not proposing to specify erosion controls as a necessary element of the PNP, but permit writers should consider whether to add special conditions on a case-by-case basis as appropriate.

As described in previous sections, EPA recognizes that sediment eroding from cropland can have a significant negative impact on surface waters. While EPA realizes that it is not possible to completely prevent all erosion, erosion can be reduced to tolerable rates. In general terms, tolerable soil loss is the maximum rate of soil erosion that will permit indefinite maintenance of soil productivity, *i.e.*, erosion less than or equal to the rate of soil development. The USDA–NRCS uses five levels of erosion tolerance ("T") based on factors such as soil depth and texture, parent material, productivity, and previous erosion rates. These T levels are equivalent to annual losses of about 1–5 tons/acre/year (2–11 mt/ha/year), with minimum rates for shallow soils with unfavorable subsoils and maximum rates for deep, well-drained productive soils (from Ag Management Measures).

Options for controlling erosion are: (1) Implementation of one of the three NRCS Conservation Practices Standards for Residue Management: No-Till and Strip Till (329A), Mulch Till (329B), or Ridge Till (329C) in the state Field Office Technical Guide; (2) requiring a minimum 30 percent residue cover; (3) achieving soil loss tolerance or "T"; or (4) following the Erosion and Sediment Control Management Measure as found in EPA's draft National Management Measures to Control Nonpoint Source Pollution from Agriculture which is substantially the same as EPA's 1993 Guidance Specifying Management Measure for Sources of Nonpoint Pollution in Coastal Waters.

EPA is requesting public comment on the suitability of requiring erosion control as a special condition of an NPDES permit to protect water quality from sediment eroding from fields where CAFO manure is applied to crops. If erosion control is desirable, EPA is soliciting comment as to which method would be the most cost-efficient.

g. *Design Standards for Chronic Rainfall.* In this section, EPA is soliciting comments on whether additional regulatory language is needed to clarify when a discharge is considered to be caused by "chronic rainfall." EPA also solicits comment on whether design standards to prevent discharges due to chronic rainfall should be specified in the effluent limitations or as a special condition in the NPDES permit.

CAFOs in the beef and dairy subcategory [412-subpart C] are prohibited from discharging except during a "25-year, 24-hour rainfall event or chronic rainfall" and then only if they meet the criteria in § 412.13(a)(2). Section 412.13(a)(2)(i) allows a discharge caused by such rainfall events only if "(i) The production area is designed and constructed to contain all process wastewaters including the runoff from a 25-year, 24-hour rainfall event; and (ii) the production area is operated in accordance with the requirements of § 412.37(a)."

The term "25-year, 24-hour rainfall event" is clearly defined in 40 CFR 412.01(b). In addition, proposed § 412.37(c)(1)(iv) would require all surface impoundments to have a depth marker which indicates the design volume and clearly indicates the minimum freeboard necessary to allow for the 25-year, 24-hour rainfall event. A discharge may be caused by a 25-year, 24-hour storm when it occurs despite the fact that the CAFO operator maintained adequate freeboard.

The term "chronic rainfall" has not been specifically defined. Generally, a chronic rainfall event is one that lasts longer than 24 hours and causes a discharge from a system that has been designed, constructed, maintained and operated to contain all process wastewaters plus the runoff from a 25-year, 24-hour rainfall event. Persistent rainfall over a period longer than 24 hours may overwhelm a system designed for the 25-year, 24-hour rainfall event even though such persistent rainfalls may be expected to occur more frequently than every 25 years.

In order for a discharge to be "caused" by chronic rainfall, it would need to be contemporaneous with the rainfall. The discharge could not continue after the event any longer than is necessary. For example, once a flooded lagoon has been drawn down to the level necessary to protect the integrity of the lagoon (which in no case should be below the level of the freeboard necessary for e 25/24-hour storm), the discharge should cease. If the lagoon could not then accept additional waste from the CAFO, no animals that would contribute waste to the lagoon should be brought to the facility until additional capacity can be generated by properly land applying the waste or shipping the waste off-site.

A discharge also would not be considered to be "caused" by the chronic storm if the operator should have foreseen the event in time to properly land apply the waste and thereby have avoided an overflow or the need to apply wastes to saturated grounds. Similarly, a discharge is not considered to be caused by the chronic storm if the operator should have foreseen the event and maintained adequate facilities for managing the waste. Although (in the absence of more specific regulatory requirements) operators would be responsible for foreseeing and planning for chronic rainfall events, they would be liable for discharges during chronic events only where they were not reasonable in their decision regarding what would be adequate capacity.

An approach that would provide more certainty to the operator but place a greater burden on permitting authorities would be for EPA to require permit authorities to specify regionally-specific minimum free board requirements necessary to contain runoff from foreseeable chronic events. For example, it may be known that, in a given area, the free board necessary to contain the runoff from a 25-year, 24-hour storm will not be sufficient to contain the run off that typically accumulates during the region's rainy season, especially when it would not be appropriate to draw down the lagoon by land applying wastes during that time. In that case, it may be necessary for the permit writer to specify a greater freeboard requirement that would apply to the CAFO at the beginning of that season. For example, Nebraska requires CAFOs to be able to capture the average rainfall for the three summer months. EPA notes that such additional permit conditions are already required where they are necessary to eliminate potential discharges that would cause or contribute to violations of state water quality standards.

Another approach would be to require the operator to notify the permitting authority as soon as it knows that a discharge will occur or is occurring and to come to an agreement on how long the discharge will occur. This approach has several disadvantages. Because many facilities located in the same area may be experiencing the same problem, permitting authorities may not have the resources to address several simultaneous requests. It is not clear how a disagreement between the operator and permit authority would be resolved. Perhaps most importantly, this approach also does not address the need to foresee and prepare for such events in advance of the event.

EPA solicits comment on all of these approaches for clarifying when a discharge is considered to be caused by "chronic rainfall," and whether technology guidelines are necessary in either section 412 or 122 to address discharges due to chronic rainfall.

F. What Type of NPDES Permit is Appropriate for CAFOs?

NPDES permit authorities can exercise one of two NPDES permitting options for CAFOs: general permits or individual permits. A general NPDES permit is written to cover a category of point sources with similar characteristics for a defined geographic area.

1. What Changes Are Being Made to the General Permit and NOI Provisions?

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. In the past, about 70 percent of permitted CAFOs have been permitted under an NPDES general permit, and EPA expects this trend to continue. General permits offer a cost-effective approach for NPDES permit authorities because they can cover a large number of facilities under a single permit. The geographic scope of a general permit is flexible and can correspond to political or other boundaries, such as watersheds. At the same time, the general permit can also provide the flexibility for the permittee to develop and implement pollution control measures that are tailored to the site-specific circumstances of the permittee. The public has an opportunity for input during key steps in the permit development and implementation process.

EPA is proposing to clarify that CAFOs may obtain permit coverage under a general permit. See proposed § 122.28(a)(2)(iii). Although section 122.28 currently authorizes CAFOs to be regulated using a general permit, some stakeholders have questioned whether CAFOs fall within the current language of that section. Today's proposal would clarify that permit writers may use a general permit to regulate a category of CAFOs that are appropriately regulated under the terms of the general permit.

A complete and timely NOI indicates the operator's intent to abide by all the conditions of the permit, and the NOI fulfills the requirements for an NPDES permit application. The contents of the NOI are specified in the general permit.

The current regulation requires NOIs to include legal name and address of the owner and operator; facility name and address; type of facility or discharges; and the receiving stream(s). EPA is proposing to amend § 122.28(b)(2)(ii) to require, in addition:

- Type and number of animals at the CAFO
- Physical location, including latitude and longitude of the production area
- Acreage available for agricultural use of manure and wastewater;
- Estimated amount of manure and wastewater to be transferred off-site
- Name and address of any other entity with substantial operational control of facility
- If a new facility, provide a copy of the draft PNP
- If an existing facility, the status of the development of the PNP
- If an area is determined to have vulnerable ground water (karst, sandy soil, shallow water table, or in a hydrological landscape region 1 (HLR1), submit a hydrologist's statement that the

ground water under the production area of the facility is not hydrologically connected to surface water, if the applicant asserts as such

• Provide a topographic map as described in 40 CFR 122.21(f)(7), showing any ground water aquifers and depth to ground water that may be hydrologically connected to surface water

§ 122.21(f) requires the applicant to submit a topographic map extending one mile beyond the facility's boundary that shows potential discharge points and surface water bodies in the area. EPA is proposing to include a requirement that the operator also identify on the topographic map any ground water aquifers that may be hydrologically connected to surface water, as well as the depth to ground water.

EPA is proposing to require permit authorities to make the NOI and the notification of PNP development or amendment available to the public and other interested parties in a timely manner, updated on a quarterly basis. See proposed § 122.23(j)(2). EPA encourages States to develop and use Internet-based sites as a supplemental means to provide ready public access to CAFO NPDES general permits, facility NOIs, and other information.

EPA will explore ways to adapt the Permit Compliance System, EPA's national wastewater database, so that permit authorities may use it to track CAFO compliance information. This information might include: NPDES permit number; facility name; facility location; latitude and longitude of the production of area; animal type(s); number of animals; the name and address of the contract holder (for contract operations); PNP date of adoption or, where a PNP has not yet been developed, the schedule for developing and implementing the PNP, including interim milestones.

EPA is proposing to clarify that CAFOs may obtain permit coverage under a general permit. See proposed § 122.28(a)(2)(iii), which would expressly add "concentrated animal feeding operations" to the list of sources that are eligible for general permits. In fact, CAFOs are already eligible for general permits under the existing regulations at § 122.28(a)(2), both because they are storm water point sources (see subsection (a)(2)(i)) and because they are a category of point sources that involve the same or substantially similar types of operations, may be more appropriately controlled under a general permit than under individual permits, and otherwise meet the criteria of subsection (a)(2)(ii). Some stakeholders, however, have questioned whether CAFOs meet these existing criteria for general permit eligibility. Therefore, to remove any such questions among stakeholders, EPA is proposing to expressly add CAFOs to the list of sources that are eligible for general permits. In sum, this proposed change would be for purposes of clarity only; it would effect no substantive change to the regulations.

2. Which CAFOs May Be Subject to Individual Permits?

Although EPA is not proposing to require NPDES individual permits in particular circumstances, the Agency is proposing additional criteria for when general permits may be inappropriate for CAFOs. See proposed § 122.28(b)(3)(i)(G). Under the existing regulation, the public may petition the permit authority when it believes that, based on the criteria in section 122.28(b)(3)(i), that coverage under a general permit is inappropriate. Finally, EPA is proposing to require the permit authority to conduct a public process for determining which criteria, if any, would require a CAFO owner or operator to apply for an individual permit. See proposed § 122.28(b)(3)(i)(G). Permit authorities would be required to conduct this public process and set forth its policy prior to issuing any general permit for CAFOs. Permit authorities would have flexibility as to how to conduct this public process.

Besides requiring a public process to develop criteria for requiring individual permits, the proposed regulation would also add the following CAFO-specific criteria for when the Director may require an individual permit: (1) CAFOs located in an environmentally or ecologically sensitive area; (2) CAFOs with a history of operational or compliance problems; (3) CAFOs that are exceptionally large operations as determined by the permit authority; and (4) significantly expanding CAFOs. See proposed § 122.28(b)(3)(i)(G)(i)–(iv). Any interested member of the public may petition the Director to require an individual permit for a facility covered by a general permit. Section 122.28(b)(3).

EPA believes these criteria on the availability of general permits for CAFOs are desirable because of keen public interest in participating in the process of issuing permits to CAFOs. The public may participate in notice and comment during the development of general permits, but once issued, public participation regarding facilities submitting notices of intent is limited. On the other hand, the public does have access to notice and comment participation with regard to individual permits.

EPA considered requiring all CAFOs, or all new CAFOs, to obtain an individual permit, but considered this potentially burdensome to permit authorities. Using general permits to cover classes of facilities by type of operation, by jurisdiction, or by geographic boundary such as a watershed, offers positive environmental as well as administrative benefits.

EPA also considered identifying a threshold to establish when exceptionally large facilities would be required to apply for an individual permit, such as 5,000 AU or 10,000 AU, or by defining such a threshold as the largest ten percent or 25 percent of CAFOs within each sector. EPA did not propose this approach because, as shown in table 7–9, it was difficult to establish a consistent basis across sectors for making this determination. While EPA's cost models assume that 30% of operations might obtain individual permits, and thus such thresholds are taken into account in the cost analyses for this proposed regulation, EPA did not believe particular thresholds would be appropriate across all sectors or all states. EPA is interested in comments on whether it should establish a size threshold above which individual permits would be required, recommendations of what the threshold should be, and data to support such recommendations.

TABLE 7–9. POTENTIAL DEFINITION OF "EXCEPTIONALLY LARGE" FACILITIES

Animal sector	5,000 AU	10,000 AU	Top 10% (Est.)		Top 25% (Est.)	
	Head equivalent	Head equivalent	Head	AU	Head	AU
Beef/Heifer	5,000	10,000	11,000	11,000	3,500	3,500

TABLE 7–9. POTENTIAL DEFINITION OF "EXCEPTIONALLY LARGE" FACILITIES—Continued

Animal sector	5,000 AU	10,000 AU	Top 10% (Est.)		Top 25% (Est.)	
	Head equivalent	Head equivalent	Head	AU	Head	AU
Dairy	3,500	7,000	3,800	5,440	2,170	3,100
Veal	5,000	10,000	1,500	1,500	950	950
Swine	12,500	25,000	9,000	3,600	5,000	2,000
Broiler	500,000	1,000,000	150,000	1,500	110,000	1,100
Layer	500,000	1,000,000	500,000	5,000	180,000	1,800
Turkey	275,000	550,000	100,000	1,820	55,000	1,000

Note: Except for beef, these values are interpolations based on best professional judgement.

EPA also considered whether operations that significantly expand should be required to reapply for a permit. Public concern has been expressed as to whether operations that significantly expand should be required to undergo a public process to determine whether new limits are necessitated by the expansion. EPA believes, however, that if the general permit covers operations similar to the newly expanded operation, there would be no basis for requiring an individual permit. In section VIII above, EPA also has explained why it would not be appropriate to classify facilities that expand their production capacities as new sources. If a member of the public believes that the requirements of a proposed general permit are not adequate for CAFOs above a certain size, it should raise that issue when the permit authority proposes the general permit and request that it be limited to certain size operations. As is discussed above, the public could also petition the permit authority if it believes that a specific facility should be covered by an individual permit.

Under existing regulations the permit authority may modify a permit if there are material and substantial alterations to the permitted facility or activity that occur after the permit is issued and justify different permit conditions. 40 CFR 122.62(a)(1). The public would be able to participate in the permit modification process to incorporate the new standards. 40 CFR 123.5(c).

EPA is interested in comment on whether the above procedures are adequate to ensure public participation or whether individual permits should be required for any of the categories of facilities discussed above. Specifically, EPA is interested in comments on whether individual permits should be required for (a) facilities over a certain size threshold, (b) new facilities; (c) facilities that are significantly expanding; (d) facilities that have historical compliance problems; or (e) operations that are located in areas with significant environmental concerns.

3. Demonstrating No Potential to Discharge

As described in section VII.C.2.d above, today's proposal would require all CAFO owners or operators to apply for an NPDES permit, based on a presumption that all CAFOs have a potential to discharge pollutants to waters of the U.S. There would, however, be one exception to this requirement: A CAFO owner or operator would not need to apply for a permit if it received a determination by the permit authority that the CAFO does *not* have a potential to discharge. It would be the CAFO owner's or operator's burden to ask for a "no potential to discharge" determination and to support the request with appropriate data and information. See proposed § 122.23(c) and (e).

The term "no potential to discharge" means that there is no potential for any CAFO manure or wastewaters to be added to waters of the United States from the operation's production or land application areas, without qualification. For example, if a CAFO land applies its manure according to a permit nutrient plan, it may not claim "no potential to discharge" status on the basis that it *would* have runoff, but any runoff would be exempt as agricultural storm water. CAFOs owners or operators should not be able to avoid permitting by claiming that they already meet the land application requirements that would be in a permit—in this case, the requirement of zero discharge from land application areas except for runoff from properly applied manure and wastewater (see today's proposed effluent limitation guidelines). Moreover, today's proposed effluent limitation guidelines would include not only restrictions on the rate of land application but also a set of best management practices to further protect against inadvertent discharges from land applied manure and wastewater (for example, the requirement for 100 foot setbacks, consideration of timing of application, etc.). EPA's intention would be to require a permit that imposes both types of requirements unless an operation has clearly established the absence of a potential to discharge. A CAFO's claim that it already meets the restrictions on the rate of land application would not ensure, as a permit would, that the CAFO has employed and is continuing to employ these additional management practices.

Instead, EPA proposes to allow "no potential to discharge" status in order to provide relief where there truly is no potential for a CAFO's wastes to reach the waters. This would include, for example, CAFOs that are far from any water body, or those that have closed cycle systems for managing their wastes and that do not land apply their wastes. In particular, EPA believes that the act of land applying its manure and wastewater would, in many cases, be enough by itself to indicate that a CAFO does have a potential to discharge. It would be very difficult, in general, for CAFOs that land apply their wastes to demonstrate that they have no potential to discharge (although conceivably such a showing could be made if the physical features of the site, including lack of proximity to the waters, slope, etc. warrant it).

It is only where there is no potential for a CAFO's wastes to reach the waters that EPA believes it is appropriate not to require a permit. Indeed, where a CAFO has demonstrated that it has no potential to discharge, it no longer qualifies as a point source under the Act (see Section 502(14), which defines "point source" to include conveyances such as CAFOs from which pollutants "are or may be" discharged).

Under today's proposal, the burden of proof to show that there is no potential to discharge would be with the CAFO owner or operator, not the permitting authority. There would be a presumption that the CAFO does have the potential to discharge unless the CAFO owner or operator has rebutted this presumption by showing, to the satisfaction of the permit authority, that it does not.

It is not EPA's intention to allow a broad interpretation of this provision but, rather, to establish that "no potential to discharge" is to be narrowly interpreted and applied by permit authorities. This provision is intended to be a high bar that provides an exemption only to those facilities that can demonstrate to a degree of certainty that they have no potential to discharge to the waters of the U.S.

Today's proposal would specify that an operation that has had a discharge within the past five years cannot receive a determination that it has no potential to discharge. The Agency is not proposing to specify further the exact conditions that would indicate that a facility has no potential to discharge. However, any such demonstration would need to account for all manure generated at the facility, specifying how the design of the animal confinement areas, storage areas, manure and wastewater containment areas, and land application areas eliminates any possibility of discharge to surface waters or to groundwater with a direct hydrological connection to surface water. Further, the CAFO operator must be able to provide assurance that all CAFO-generated manure and wastewater that is transported off-site are transferred to a recipient that provides for environmentally appropriate handling, such as by: (1) land applying according to proper agricultural practices as defined in this regulation; (2) obtaining an NPDES permit for discharges resulting from land application; or (3) having other non-land application uses.

If an owner or operator is able to demonstrate no potential to discharge at the production area, but cannot demonstrate an assurance that manure transported off-site is being appropriately disposed of, the facility would be required to apply for a zero discharge permit that includes the record keeping requirements described in section VII.E. of today's proposal.

EPA requests comment on whether it should include additional specific criteria for determining whether a CAFO has "no potential to discharge," and what those criteria should be. The Agency is concerned that without more specific criteria, this provision could be subject to abuse. Therefore, EPA is seeking comment on whether safeguards are necessary to ensure that only those CAFOs which truly pose no risk to the environment are able to avoid permitting requirements.

The fact that a CAFO owner or operator submits a request for a determination that the facility has no potential to discharge would not change the deadline to apply for a permit. The CAFO owner or operator would need to apply for a permit according to the date specified in § 122.23(f) unless it receives a no potential to discharge determination before that date. It would be inappropriate, in EPA's view, to allow otherwise—*i.e.*, to postpone the deadline to apply for a permit if the CAFO has not yet received a determination on its "no potential to discharge" request. Under that approach, even CAFOs owners or operators who could not make a serious claim of "no potential to discharge" could apply for such a determination simply as a way of delaying the permitting process, and the process could in fact be delayed if permitting authorities are faced with large numbers of such requests. We recognize that under the approach we are proposing, some CAFOs who really do have no potential to discharge will be forced to file a complete permit application if their permitting authority has not ruled on their request prior to the deadline for the permit application. However, EPA expects there to be few such cases, since we expect relatively few CAFOs to be able to demonstrate no potential to discharge; and in light of the problems of the alternative approach, EPA's proposed approach seems preferable.

It is important to recognize that if a CAFO receives a "no potential to discharge" determination but subsequently does have a discharge, that operation would be in violation of the Clean Water Act for discharging without a permit. The "no potential to discharge" determination would not identify an operation as forever a non-point source. To the contrary, there would be no basis for excluding an operation from the requirements for point sources if it meets the criteria for being a CAFO and has an actual discharge of pollutants to the waters. The operation, upon discharging, would immediately revert to status as a point source.

EPA is requesting comment on whether the Director's "no potential to discharge" determination should be subject to the same types of administrative procedures that are required for the Director's decision to issue or deny a permit. That is, EPA is considering a requirement that, before EPA or the State could issue a final determination that there is no potential to discharge, the public would have the formal right to comment on, and EPA would have the opportunity to object to (in authorized States), the Director's draft determination. These procedures may be appropriate, for example, in light of anticipated public interest in the Director's determination. Alternatively, EPA requests comment on *not* requiring the Director to follow these procedures for public and EPA input into the Director's decision. EPA could conclude that the types of procedures that apply to permitting decisions are not appropriate here (since the "no potential to discharge" determination is neither the issuance nor denial of a permit), but that the environment is sufficiently protected by the fact that any actual discharge from either the production or land application areas would be a violation of the Clean Water Act. Under this latter interpretation, EPA would not itself follow the types of procedures that apply to permit decisions (such as providing the public with the formal opportunity to submit public comments on the Director's draft decision) and would not require States to follow those procedures; however, States could make those procedures available if they chose, since they would be more stringent than the procedures required by EPA. EPA requests comment on which of these two alternative approaches to adopt in the final rule.

It should be noted that under the three-tier proposal, in some cases owners of operations in the middle tier (300 AU to 1,000 AU) would not need to demonstrate "no potential to discharge" to avoid a permit because they would not be defined as CAFOs in the first instance. That is, if they do not meet any of the conditions under that regulatory option for being defined as a CAFO (insufficient storage and containment to prevent discharge, production area located within 100 feet of waters, evidence of discharge in the last five years, land applying without a PNP, or transporting manure to an off-site recipient without appropriate certification) then they would not be subject to permitting as CAFOs. (They could, however, still be subject to NPDES permitting as other, non-CAFO types of point sources, as discussed elsewhere in this preamble.)

4. NPDES Permit Application Form 2B

EPA is proposing to amend the NPDES permit application form 2B for CAFOs and Aquatic Animal Production Facilities in order to reflect the revisions included in today's proposed rulemaking, and in order to facilitate consideration of the permit application. EPA is proposing to require applicants for individual CAFO permits to submit the following information:

- acreage available for agricultural use of manure and wastewater;
- estimated amount of manure and wastewater to be transferred off-site.

- name and address of any person or entity that owns animals to be raised at the facility, directs the activity of persons working at the CAFO, specifies how the animals are grown, fed, or medicated; or otherwise exercises control over the operations of the facility, in other words, that may exercise substantial operational control.
- provide a copy of the draft PNP.
- whether buffers, setbacks or conservation tillage are implemented to protect water quality.
- On the topographic map required by Form 1, identify latitude and longitude of the production area, and identify depth to ground water that may be hydrologically connected to surface water, if any.

See proposed § 122.21(i)(1).

The existing Form 2B currently only requires: whether the application is for a proposed or existing facility; type and number of animals in confinement (open confinement or housed under roof); number of acres for confinement feeding; if there is open confinement, whether a runoff diversion and control system has been constructed and, if so, indicate whether the design basis is for a 10-year, 24-hour storm, a 25-year, 24-hour storm, or other, including inches; number of acres contributing to drainage; design safety factor; name and official title, phone number, and signature. In addition, § 122.21(f) of the current NPDES regulation reqnires applicants to submit a topographic map extending one mile beyond the facility's boundary that shows discharge points and surface water bodies in the area.

EPA is proposing to update form 2B and requests comment on what information should be required of applicants for individual permits.

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See the instructions on the reverse.

EPA I.D. NUMBER *(copy from Item 1 of Form 1)*

DRAFT - 11/00

FORM **2B** NPDES **EPA**

U.S. ENVIRONMENTAL PROTECTION AGENCY
APPLICATION FOR PERMIT TO DISCHARGE WASTEWATER
CONCENTRATED ANIMAL FEEDING OPERATIONS AND AQUATIC ANIMAL PRODUCTION FACILITIES
Consolidated Permits Program

I. GENERAL INFORMATION

A. TYPE OF BUSINESS	B. LEGAL DESCRIPTION OF FACILITY LOCATION	C. FACILITY OPERATION STATUS
☐ 1. Concentrated Animal Feeding Operation (complete items B, C, D, and section II) ☐ 2. Concentrated Aquatic Animal Production Facility (complete items B, C, and section III)		☐ 1. Existing Facility ☐ 2. Proposed Facility

D. FACILITY OWNERSHIP

1. Does an entity other than the applicant direct the activity of persons working at the facility identified in Form 1 and I.B.? ☐ No ☐ Yes
2. Does an entity other than the applicant own the animals at the facility identified in Form 1 and I.B.? ☐ No ☐ Yes
3. Does an entity other than the applicant specify how the animals at the facility identified in I.B. are grown, fed or medicated? ☐ No ☐ Yes
4. If yes was the answer for questions D1, D2, or D3, what is the name and address of the responsible entity?
   Responsible Entity Name: ____________ Responsible Entity Address: ____________

II. CONCENTRATED ANIMAL FEEDING/OPERATION CHARACTERISTICS

A. TYPE AND NUMBER OF ANIMALS

1. TYPE	2. ANIMALS	
	NO. IN OPEN CONFINEMENT	NO. HOUSED UNDER ROOF

C. TOTAL NUMBER OF ANIMALS CONFINED AT THE FACILITY ____________

D. NUMBER OF ACRES FOR CONFINEMENT FEEDING ____________

B. LAND APPLICATION

1. How much manure is generated annually by the facility? ______ tons
2. Is manure generated by the CAFO land applied?
   ☐ Yes ☐ No
   If Yes, how many acres of land under the control of the applicant are available for applying the CAFOs manure/wastewater? ________ acres
3. Is manure generated by the CAFO transferred to off-site recipients? ☐ Yes ☐ No. If yes, what is the estimated quantity transferred annually? _______ tons

E. IF THERE IS OPEN CONFINEMENT, HAS A RUNOFF DIVERSION AND CONTROL SYSTEM BEEN CONSTRUCTED?

☐ Yes (complete Items 1, 2, & 3 below) ☐ No (go to section IV.)

1. What is the design basis for the control system? ☐ a. 10 year, 24-Hour Storm (specify inches ____) ☐ b. 25 year, 24-Hour Storm (specify inches ____)
   ☐ c. Other (specify inches and type ____________)
2. Report the number of acres of contributing drainage. ________ acres.
3. Report the design safety factor. ____________

F. PERMIT NUTRIENT PLAN (PNP)

Has a certified PNP been developed and is being implemented for the facility? ☐ Yes ☐ No

If yes, the applicant is to include a copy of the PNP with the application.

If No, when will the certified PNP be developed and implemented. Date: ____________. A draft PNP must be submitted with this application that, at a minimum, demonstrates that there is adequate land available to the CAFO operator to comply with the land application provisions of 40 CFR Part 412 or describes an alternative to land application that is being implemented.

G. CONSERVATION PRACTICES

Please check any of the following conservation practices that are being implemented at the facility to control runoff and protect water quality.

☐ Buffers ☐ Setbacks ☐ Conservation Tillage

III. CONCENTRATED AQUATIC ANIMAL PRODUCTION FACIITY CHARACTERISTICS

A. For each outfall give the maximum daily flow, maximum 30-day flow, and the long-term average flow.			
1. Outfall No.	2. Flow *(gallons per day)*		
	a. Maximum Daily	b. Maximum 30 Day	c. Long Term Average

B. Indicate the total number of ponds, raceways, and similar structures in your facility.		
1. Ponds	2. Raceways	3. Other

C. Provide the name of the receiving water and the source of water used by your facility.	
1. Receiving Water	2. Water Source

D. List the species of fish or aquatic animals held and fed at your facility. For each species, give the total weight produced by your facility per year in pounds of harvestable weight, and also give the maximum weight present at any one time

1. Cold Water Species			2. Warm Water Species		
a. Species	b. Harvestable Weight *(pounds)*		a. Species	b. Harvestable Weight *(pounds)*	
	(1) Total Yearly	(2) Maximum		(1) Total Yearly	(2) Maximum

E. Report the total pounds of food fed during the calendar month of maximum feeding.	1. Month	2. Pounds of Food

IV. CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. Name and Official Title *(print or type)*	B. Phone No. (area code and no.)
C. Signature	D. Date Signed

INSTRUCTIONS

General

This form must be completed by all applicants who check "yes" to Item II-B in Form 1. Not all animal feeding operations or fish farms are required to obtain NPDES permits. Exclusions are based on size and occurrence of discharge. See the description of these statutory and regulatory exclusions in the General Instructions that accompany Form 1.

For aquatic animal production facilities, the size cutoffs are based on whether the species are warm water or cold water, on the production weight per year in harvestable pounds, and on the amount of feeding in pounds of food (*for cold water species*). Also, facilities which discharge less than 30 days per year, or only during periods of excess runoff (*for warm water fish*) are not required to have a permit.

Refer to the Form 1 instructions to determine where to file this form.

Item I-A

See the note above and the General Instructions which accompany Form 1 to be sure that your facility is a "concentrated animal feeding operation" (CAFO).

Item I-B

Use this space to give a complete legal description of your facilities location including name, address, and latitude/longitude.

Item I-C

Check "proposed " if your facility is not now in operation or does not currently meet the definition of a CAFO in accordance with the information found in the General Instructions that accompany Form 1

Item I-D

The applicant must answer questions I.D. 1-3 to provide information concerning whether an entity other than the applicant exercises substantial operational control over the facility. If the answer is yes to any of the questions contained in Item I.D. the name and address of the entity are to be provided by the applicant.

Item II

Supply all information in item II if you checked (1) in Item I-A.

Item II-A

Give the maximum number of each type of animal in open confinement or housed under roof (either partially or totally) which are held at your facility for a total of 45 days or more in any 12 month period.

Use the following categories for types of animal:

Mature Dairy Cattle; Veal; Cattle (other than mature dairy or veal); Swine (over 25 kilograms); Swine (less than 25 kilograms); Horses; Sheep or Lambs; Turkeys; Chickens (Laying Hens/Broilers); Ducks.

Item II-B

Provide the total amount of manure generated annually by the facility. Identify if manure generated by the facility is to be land applied and the number of acres, under the control of the CAFO operator, suitable for application. If the answer to question 3. is yes, provide the estimated annual quantity of manure and wastewater that the applicant plans to transfer off-site.

Item II-C

Provide the total number of animals confined at the facility.

Item II-D

Give only the area used for the animal confinement or feeding facility. Do not include any area used for growing or operating feed.

Item II-E

Check "yes" if any system for collection of runoff has been constructed. Supply the information under (1), (2), and (3) to the best of your knowledge.

Item II-F

Provide information concerning the status of the development of a certified PNP for the facility. (Note: for new facilities the certified PNP must be included with Form 2B.) In those cases where the certified PNP has not been completed, provide a draft PNP and an estimated completion date. The draft plan must, at a minimum, demonstrate that there is adequate land available to the operator to comply with the land application provisions of 40 CFR Part 412 or describe an alternative to land application that the operator intends to implement.

Item II-G

Check any of the identified conservation practices that are being implemented at the facility to control runoff and protect water quality.

Item III

Supply all information n Item III if you checked (2) in Item I-A.

Item III-A

Outfalls should be numbered to correspond with the map submitted in Item XI of Form 1 Values given for flow should be representative of your normal operation. The maximum daily flow is the maximum measured flow occurring over a calendar day. The maximum 30-day flow is the average of measured daily flows over the calendar month of highest flow. The long-term average flow is the average of measure daily flows over a calendar year.

Item III-B

Give the total number of discrete ponds or raceways in you facility. Under "other," give a descriptive name of any structure which is not a pond or a raceway but which results in discharge to waters of the United States.

Item III-C

Use names for the receiving water and source of water which correspond to the map submitted in Item XI of Form 1.

Item III-D

The names of fish species should be proper, common, or scientific names as given in special Publication No. 6 of the American Fisheries Society. "A List of Common and Scientific Names of Fishes from the United States and Canada." The values given for total weight produced by your facility per year and the maximum weight present at any one time should be representative of your normal operation.

Item III-E

The value given for maximum monthly pounds of food should be representative of your normal operation.

Item IV

The Clean Water Act provides for severe penalties for submitting false information on this application form.

Section 309(c)(2) of the Clean Water Act provides that "Any person who knowingly makes any false statement, representation, or certification in any application,…shall upon conviction, be punished by a fine of no more than $10,000 or by imprisonment for not more than six months, or both."

Federal regulations require the certification to be signed as follows:

A. For corporation, by a principal executive officer of at least the level of vice president;

B. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or

C. For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.

Paper Reduction Act Notice

The Public reporting burden for this collection of information estimated to average 4 hours per response. This estimate includes time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information to the chief, Information Policy Branch (PM-223), U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., NW, Washington, DC 20460, and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, marked Attention: Desk Officer for EPA.

*****DRAFT – 11/00*****

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It is anticipated that as a result of the requirement that all CAFOs have a duty to apply, there will be a large number of CAFOs applying for NPDES permits. Some of these operations represent a greater risk to water quality than others. In order for the permit writer to prioritize NPDES permit writing activities based on the risk to water quality, Section C is being proposed to add to Form 2B as a screening mechanism. Those facilities without buffers, setbacks, or conservation tillage potentially pose a greater risk to water quality; therefore the permit writer could use this information to develop and issue NPDES permits to these facilities on an expedited basis.

VIII. What Changes to the Feedlot Effluent Limitations Guidelines Are Being Proposed?

A. Expedited Guidelines Approach

EPA has developed today's proposed regulation using an expedited rulemaking process which relies on communication between EPA, the regulated community, and other stakeholders, rather than formal data and information gathering mechanisms. At various stages of information gathering, USDA personnel, representatives of industry and the national trade associations, university researchers, Agricultural Extension agencies, States, and various EPA offices and other stakeholders have presented their ideas, identified advantages and disadvantages to various approaches, and discussed their preferred options.

EPA encourages full public participation in commenting on these proposals.

B. Changes to Effluent Guidelines Applicability

1. Who is Regulated by the Effluent Guidelines?

The existing effluent guidelines regulations for feedlots apply to operations with 1,000 AU and greater. EPA is proposing to establish effluent guidelines requirements for the beef, dairy, swine, chicken and turkey subcategories that would apply to any operations in these subcategories that are defined as a CAFO under either the two-tier or three-tier structure. Also as discussed in detail in Section VII.B.3, EPA is also requesting comment on an option under which the effluent guidelines proposed today would not be applicable to facilities under 1,000 AU. Under this approach, AFOs below this threshold would be permitted based on an alternate set of effluent guidelines, or the best professional judgment of the permit writer. After evaluating public comments EPA may decide to consider this option. At that time EPA would develop and make available for comment an analysis of why it is appropriate to promulgate different effluent guidelines requirements or no effluent guidelines for CAFOs that have between 300 and 1,000 AU as compared to the effluent guidelines for operations with greater than 1,000 AU.

EPA also proposes to establish a new subcategory that applies to the production of veal cattle. Veal production is included in the beef subcategory in the existing regulation. However, veal production practices and wastewater and manure handling are very different from the practices used at beef feedlots; therefore, EPA proposes to establish a separate subcategory for veal.

Under the three-tier structure the proposed effluent guidelines requirements for the beef, dairy, swine, veal and poultry subcategories will apply to all operations defined as CAFOs by today's proposal having at least as many animals as listed below.

200 mature dairy cattle (whether milked or dry);
300 veal;
300 cattle other than mature dairy cattle or veal;
750 swine weighing over 55 pounds;
3,000 swine weighing 55 pounds or less;
16,500 turkeys; or
30,000 chickens.

Under the two-tier structure, the proposed requirements for the beef, dairy, swine, veal and poultry subcategories will apply to all operations defined as CAFOs by today's proposal having at least as many animals as listed below.

350 mature dairy cattle (whether milked or dry);
500 veal;
500 cattle other than mature dairy cattle or veal;
1,250 swine weighing over 55 pounds;
5,000 swine weighing 55 pounds or less;
27,500 turkeys; or
50,000 chickens.

EPA is proposing to apply the Effluent guidelines requirements for the beef, dairy, veal, swine, chicken and turkey subcategories, to all operations in these subcategories that are defined as CAFOs under either of today's proposed permitting scenarios. Operations designated as CAFOs are not subject to the proposed effluent guidelines.

EPA is proposing to rename the Effluent Guidelines Regulations, which is entitled Feedlots Point Source Category. Today's proposal changes the name to the Effluent Guidelines Regulation for the CAFOs Point Source Category. EPA is proposing this change for consistency and to avoid confusion between who is defined as a CAFO under Part 122 and whether the Effluent guidelines apply to the operation.

EPA is not proposing to revise the Effluent guidelines requirements or the applicability for the horses, sheep and lambs and ducks subcategories even though the definition of CAFO for these subcategories is changing as described previously in Section VII. These sectors have not undergone the same level of growth and consolidation that the other livestock sectors have experienced in the past 25 years. In 1992, an estimated 260 farms in these sectors were potentially CAFOs based on size, and relatively few of these operations were expected to maintain horses or sheep in confinement. Finally, the CAFOs in these sectors have not been identified as significant contributors of wastewater pollutants that result in water quality impairment.

EPA has evaluated the technology options described in this section and evaluated the economic achievability for these technologies for all operations with at least as many animals listed above for both the two-tier and three-tier NPDES structures. The technology requirements for operations defined as CAFOs under the two-tier structure are the same requirements for operations defined as CAFOs under the three-tier structure. *Therefore for the purpose of simplifying this discussion and emphasizing the differences in technology requirements for the various technology options, the following discussion will not distinguish between the two CAFO definition scenarios.* For more discussion of the costs and differences in costs between the different CAFO definition scenarios, refer to Section X of this preamble or the EA. For discussion of the benefits achieved for the different technology options and scenarios, refer to Section XI of this preamble.

EPA proposes to make the Effluent guidelines and standards applicable to those operations that are defined as CAFOs as described previously under Section VII. EPA is not proposing to apply the Effluent guidelines to those operations that fall below the proposed thresholds but are still designated as CAFOs. As described in Section VII, EPA anticipates that few AFOs will be designated as CAFOs and that these operations will generally be designated due to site-specific conditions. Examples of these conditions could include, not capturing barnyard runoff which runs directly into the stream, or siting open stockpiles of manure inappropriately. EPA believes that establishing national technology based requirements for designated CAFOs is not efficient or appropriate because historically a small number of facilities has been designated and facilities which are designated in the future will be designated for a wide variety of reasons. EPA believes that a permit will best control pollutant discharges from those operations if it is based on the permit writer's best professional judgment and is tailored to address the specific problems which caused the facility to be designated.

EPA is proposing to make substantial changes to the applicability for chickens, mixed animal operations and immature animals as described below.

Chickens. The current regulations apply to chicken operations with liquid manure handling systems or continuous flow watering systems. Unlimited continuous flow watering systems have been replaced by more efficient systems for providing drinking water to the birds. Consequently, many state permitting authorities and members of the regulated community contend that the existing effluent guidelines do not apply to most broiler and laying hen operations, despite the fact that chicken production poses risks to surface water and groundwater quality from improper storage of dry manure, and improper land application. EPA is proposing to clarify the effluent guidelines to ensure coverage of broiler and laying hen operations with dry manure handling. The proposed applicability is identical to the definition of chicken CAFOs described in Section VII.C.2.f. EPA is thus proposing to establish effluent guidelines for chicken operations that use dry manure handling systems regardless of the type of watering system or manure handling system used. EPA is using the term chicken in the regulation to include laying hens, pullets, broilers and other meat type chickens. See Section VII for more details on the proposed applicability threshold for chickens.

Mixed Animal Types. Consistent with the proposed changes to the definition of CAFO as described in Section VII.C.2.b, EPA is proposing to eliminate the calculation in the existing regulation that apply to mixed animals operations.

Immature Animals. EPA is proposing to apply technology based standards to swine nurseries and to operations that confine immature dairy cows or heifers apart from the dairy. EPA currently applies technology based standards to operations based on numbers of swine each weighing over 55 pounds. Modern swine production has a phase of production called a nursery that only confines swine weighing under 55 pounds. These types of operations are currently excluded from the technology based standards, but are increasing in both number and size. Therefore, EPA proposes to establish technology based standards to operations confining immature pigs. Under the two-tier structure EPA proposes to establish a threshold of 5,000 immature pigs or pigs weighing 55 pounds or less. Under the proposed three-tier structure operations that confine between 3,000 and 10,000 immature pigs could be defined as CAFOs and all operations with more than 10,000 immature pigs would be CAFOs. EPA also proposes to establish requirements for immature heifers when they are confined apart from the dairy, at either stand alone heifer operations similar in management to beef feedlots, or at cattle feedlots. Therefore EPA proposes to include heifer confinement off-site from the dairy under the beef feedlot subcategory, and today's proposed technology standards for beef feedlots would apply to those stand alone heifer operations defined as CAFOs. Also any feedlot that confines heifers along with cattle for slaughter is subject to the beef feedlot requirements.

EPA is proposing to establish a new subcategory for the effluent guidelines regulations which applies to veal operations. The existing regulation includes veal production in the beef cattle subcategory. EPA is proposing to create a distinct subcategory for veal operations because these operations use different production practices than other operations in the beef subcategory however, we are proposing to retain the sized threshold that pertained to veal while included in the beef subcategory. Veal operations maintain their animals in confinement housing as upposed to open outdoor lots as most beef feedlots operate. They also manage their manure very differently than typical operations in the beef cattle subcategory. Due in large part to the diet the animals are fed, the manure has a lower solids content and is handled through liquid manure handling systems, such as lagoons, whereas beef feedlots use dry manure handling systems and only collect stormwater runoff in retention ponds. EPA is proposing to define a veal CAFO as any veal operation which confines 300 veal calves or greater under the three-tier structure, or 500 veal calves or greater under two-tier structure.

C. Changes to Effluent Limitations and Standards

EPA is today proposing to revise BAT and new source performance standards for the beef, dairy, veal, swine and poultry subcategories. EPA is proposing to establish technology-based limitations on land application of manure to lands owned or operated by the CAFO, maintain the zero discharge standard and establish management practices at the production area.

1. Current Requirements

The existing regulations, which apply to operations with 1,000 AU or greater, require zero discharge of wastewater pollutants from the production area except when rainfall events, either chronic or catastrophic cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process generated wastewaters plus runoff from a 10-year, 24-hour event under the BPT requirements and a 25-year, 24-hour event under the BAT and NSPS requirements. In other words, wastewater and wastewater pollutants are allowed to be discharged as the result of a chronic or catastrophic rainfall event so long as the operation has designed, constructed and operated a manure storage and/or runoff collection system to contain all process generated wastewater, including the runoff from a specific rainfall event. The effluent guidelines do not set discharge limitations on the pollutants in the overflow.

2. Authority to Establish Requirements Based on Best Management Practices

The regulations proposed today establish a zero discharge limitation and include provisions requiring CAFOs to implement best management practices (BMPs) to prevent or otherwise contain CAFO waste to meet that limitation at the production area. The regulations also establish non-numeric effluent limitations in the form of other BMPs when CAFO waste is applied to land under the control of the CAFO owner or operator. For toxic pollutants of concern in CAFO waste, specifically cadmium, copper, lead, nickel, zinc and arsenic, EPA is authorized to establish BMPs for those pollutants under CWA section 304(e). EPA also expects reductions in conventional and nonconventional water pollutants as a result of BMPs. To the extent these pollutants are in the waste streams subject to 304(e), EPA has authority under that section to regulate them. EPA also has independent authority under CWA sections 402(a) and 501(a) and 40 CFR 122.44(k) to require CAFOs to implement BMPs for pollutants not subject to section 304(e). In addition, EPA has authority to establish non-numeric effluent limitations guidelines, such as the BMPs proposed today, when it is infeasible to establish numeric effluent limits. Finally, EPA is authorized to impose the BMP monitoring requirements under section 308(a).

Production Area. EPA has determined that the BMPs for the production area are necessary because the requirement of zero discharge has historically not been attained. As described in Section V, of this preamble, there are numerous reports of discharges from CAFOs that are unrelated to storm events which would be less likely to occur if the proposed BMPs described below were required.

Section 304(e) provides that "[t]he Administrator, after consultation with appropriate Federal and State agencies and other interested persons, may publish regulations, supplemental to any effluent limitations specified under (b) and (c) of this section for a class or category of point sources, for any specific pollutant which the Administrator is charged with a duty to regulate as a toxic or hazardous pollutant under section 1317(a)(1) or 1321 of this title, to control plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage which the Administrator determines are associated with or ancillary to industrial manufacturing or treatment process within such class or category of point sources and may contribute significant amounts of such pollutants to navigable waters." § 304(e). There are studies showing the presence of a number of listed metals in animal manure. Numerous sources such as the American Society of Agricultural Engineers, and Universities such as North Carolina State University have acknowledged the presence of metals in manure. Metals are present in the manure because they are added or present in the animal feed. EPA has estimated metal loadings being applied to land before and after this regulation would take effect. Although the concentration of metals present in untreated manure are less than the limits for metals established in EPA's biosolids regulations (40 CFR Part 503), EPA still anticipates that there would be a substantial reduction in pollutant loadings reaching the edge of the field through use of the land application practices included in today's proposal. See the Development Document for more discussion.

EPA's authority to require these BMPs does not require a determination that the toxics present in CAFO waste are significant. The federal courts have held that EPA has extensive authority to carry out its duties under the Clean Water Act:

EPA is not limited by statute to the task of establishing effluent standards and issuing permits, but is empowered by section 501(a) of the Act to prescribe regulations necessary to carry out its functions under the Act. 33 U.S.C. § 1361(a). It is also clear that permissible conditions set forth in NPDES permits are not limited to establishing limits on effluent discharge. To the contrary, Congress has seen fit to empower EPA to prescribe as wide a range of permit conditions as the agency deems appropriate in order to assure compliance with applicable effluent limits. 33 U.S.C. § 1342(a)(2); *see also id.* § 1314(e). *NRDC* v. *EPA*, 822 F.2d 104, 122 (D.C. Cir. 1987).

This authority operates independent of section 304(e). EPA's authority under section 402(a)(2) to establish NPDES permit conditions, including BMPs, for any pollutant when such conditions are necessary to carry out the provisions of the statute has been further implemented through regulations at 40 CFR 122.44(k). Although a requirement to establish and implement BMPs of the type proposed in this regulation could be imposed on a case-by-case basis, EPA has decided to promulgate this requirement on a categorical basis for those facilities which are CAFOs by definition. In light of the more than twenty years of experience with the regulation of CAFOs and their failure to achieve the zero discharge limit originally promulgated, EPA has determined that certain management practices are necessary to ensure that the zero discharge limit is actually met. The stated goal of the Clean Water Act is to eliminate the discharge of pollutants into the Nation's waters. CWA section 101(a)(1). EPA has determined that these BMPs, by preventing or controlling overflows, leaks or intentional diversions, are an important step toward that goal.

Finally, EPA has authority to impose monitoring and recordkeeping requirements under section 308 of the Act. As described below EPA is proposing to require that CAFOs periodically sample their manure and soils to analyze for nutrient content. This is necessary to both determine what is the appropriate rate to land apply manure and to ensure that the application rate is appropriate. The proposed rule would also require CAFOs to conduct routine inspections around the production area to ensure that automated watering lines are functioning properly, and to ensure that the manure level for liquid systems is not threatening a potential discharge. The CAFO would also maintain records that document manure application, including equipment calibration, volume or amount of manure applied, acreage receiving manure, application rate, weather conditions and timing of manure application, application method, crops grown and crop yields. These records will provide documentation that tha manure was applied in accordance with the PNP and has not resulted in a discharge of pollutants in excess of the agricultural use. EPA has determined that these practices are necessary in order to determine whether an owner or operator of a CAFO is complying with the effluent limitation. Establishment and maintenance of records, reporting, and the installation, use and maintenance of monitoring equipment are all requirements EPA has the authority to impose. 33 U.S.C. § 1318(a).

Land Application Areas. For the land application areas of a CAFO, EPA is proposing a nonnumeric effluent limitation consisting of best management practices. The D.C. Circuit has concluded that "[w]hen numerical effluent limitations are infeasible, EPA may issue permits with conditions designed to reduce the level of effluent discharges to acceptable levels." *NRDC* v. *Costle*, 568 F.2d 1369, 1380 (D.C. Cir. 1977); 40 CFR 122.44(k)(3). EPA has determined that it is infeasible to establish a numeric effluent limitation for discharges of land applied CAFO waste and has also determined that the proposed BMPs are the appropriate ones to reduce the level of discharge from land application areas.

The proposed BMPs constitute the effluent limitation for one wastestream from CAFOs. The statutory and regulatory definition of "effluent limitation" is very broad—"any restriction" imposed by the permitting authority on quantities, discharge rates and concentrations of a pollutant discharged into a water of the United States. Clean Water Act § 502(11), 40 CFR 122.2. Neither definition requires an effluent limitation to be expressed as a numeric limit. Moreover, nowhere in the CWA does the term "numeric effluent limitation" even appear and the courts have upheld non-numeric restrictions promulgated by EPA as effluent limitations. *See NRDC* v. *EPA*, 656 F.2d 768, 776 (D.C. Cir. 1981) (holding that a regulation which allows municipalities to apply for a variance from the normal requirements of secondary sewage treatment is an "effluent limitation" for purposes of review under § 509(b): "[W]hile the regulations do not contain specific number limitations in all cases, their purpose is to prescribe in technical terms what the Agency will require of section 1311(h) permit applicants."). Thus, the statutory definition of "effluent limitation" is not limited to a single type of restriction, but rather contemplates a range of restrictions that may be used as appropriate. Likewise, the legislative history does not indicate that Congress envisioned a single specific type of effluent limitation to be applied in all circumstances. Therefore, EPA has a large degree of discretion in interpreting the term "effluent limitation," and determining whether an effluent limitation must be expressed as a numeric standard. EPA has defined BMPs as "schednles of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States." 40 CFR 122.2. A BMP may take any number of forms, depending upon the problem to be addressed. Because a BMP must, by definition, "prevent or reduce the pollution of waters of the United States," the practices and prohibitions a BMP embodies represent restrictious cousistent with the definitiou of an effluent limitation set out in CWA § 502(11).

Effluent limitations in the form of BMPs are particularly suited to the regulation of CAFOs. The regulation of CAFOs often consists of the regulation of discharges associated with storm water. Storm water discharges can be highly intermittent, are usnally characterized by very high flows occurring over relatively short time intervals, and carry a variety of pollutants whose nature and extent varies according to geography and local land use. Water qnality impacts, in tnrn, also depend on a wide range of factors, including the magnitnde and duration of rainfall events, the time period between events, soil conditions, the fraction of land that is impervious to rainfall, other land use activities, and the ratio of storm water discharga to receiving water flow. CAFOs would be required to apply their manure and wastewater to land in a manner and rate that represents agricultural use. The manure provides nutrients, organic matter and micronutrients which are very beneficial to crop production when applied appropriately. The amount or rate at which manure can be appliad to provide the nutrient benefits without cansing excassive pollutant discharge will vary based on site specific factors at the CAFO. These factors include the crop being grown, the expected crop yield, the soil types, and soil concentration of nutrients (especially phosphorus), and the amount of other nntrient sources to be applied. For these reasons, EPA has determined that establishing a numeric effluent limitation guideline is iufeasible.

EPA has determined that the various BMPs specified in today's proposed regulation represent the minimum elements of an effective BMP program. By codifying them into a regulation of general applicability, EPA intends to promote expeditions implementation of a BMP program and to ensure uniform and fair application of the baseline requirements. EPA is proposing only those BMPs which are appropriate on a nationwide basis, while giving both States and permittees the flexibility to determine the appropriate practices at a local level to achieve the effluent limitations. The BMP's (described below) that are inclnded in the proposed technology options are necessary to ensure that manure and wastewater are utilized for their nutrient content in accordance with agricultural requirements for producing crops or pastures. EPA also believes that the proposed regulations represent an appropriate and efficient use of its technical expertise and resources that, when exercised at the national level, relieves state permit writers of the burden of implementing this aspect of the Clean Water Act on a case-by-case basis.

3. Best Practicable Control Technology Limitations Currently Available (BPT)

EPA is proposing to establish BPT limitations for the beef, dairy, swine, veal chicken and turkey subcategories. There are BPT limitations in the existing regnlations which apply to CAFOs with 1,000 AU or more in the beef, dairy swine and turkey subcategories. BPT requires that these operations achieve zero discharge of process wastewater from the production area except in the event of a 10-year, 24-hour storm event. EPA is proposing to revise this BPT requirement and to expand the applicability of BPT to all oparations defined as CAFOs in these subcategories including CAFOs with fewer than 1,000 AU.

The Claan Water Act requires that BPT limitations reflect the consideration of the total cost of application of technology in relation to tha effluent reduction benefits to be achieved from such applications. EPA considered two options as the basis for BPT limitations.

Option 1. This option would require zero discharge from a facility designed, maintained and operated to hold the waste and wastewater, including storm water, from runoff plus the 25-year 24-hour storm event. Both this option and Option 2 would add record keeping requirements and practices that ensure this zero discharge standard is met. As described in Section V there are numerous reports of operations discharging pollutants from the production area during dry weather. The reason for these discharges varies from intentional discharge to poor maintenance of the manure storage area or confinement area. EPA's cost models reflect the different precipitation and climatic factors that affect an operations ability to meet this requirement; see Section X and the Devalopment Document for further details.

Option 1 would require weekly inspection to ensure thet any storm water diversions at the animal confinement and manure storage areas are free from debris, and daily inspections of the automated systems providing water to the animals to ensure they are not leaking or spilling. The manure storage or treatment facility would have to be inspected weekly to ensnre structural integrity. For liquid impoundments, the berms would need to be inspected for leaking, seepage, erosion and other signs of structural weakness. The proposal requires that records of these inspections would be maintained on-site, as well as records documenting any problems noted and corrective actions taken. EPA believes these inspections are necessary to ensure proper maintenance of the prodnction area and prevent discharges apart from those associated with a storm event from a catastrophic or chronic storm.

Liquid impoundments (e.g., lagoons, ponds and tanks) that are open and capture precipitation would be required to have depth markers installed. The depth marker indicates the maximum volume that should be maintained under normal operating conditions allowing for the volume necessary to contain the 25-year, 24-hour storm event. The depth of the impoundment would have to be noted during each week's inspection and when the depth of manure and wastewater in the impoundment exceeds this maximum depth, the operation would be required to notify the Permit Authority and inform him or her of the action will be taken to address this exceedance. Closed or covered liquid impoundments must also have depth markers installed, with the depth of the impoundment notad during each week's inspection. In all cases, this liquid may be land applied only if doue in accordance with the permit nntrient plan (PNP) described below. Without such a depth marker, a CAFO operator may fill the lagoons such that even a storm less than a 25-year, 24-hour storm causes the lagoon to overflow, contrary to the discharge limit proposed by the BPT requirements.

An alternative technology for monitoring lagoon and impound meat levels is remote sensors which monitor liquid levels in lagoons or impoundments. This sensor technology can be used to monitor changes in liquid levels, either rising or dropping levels, when the level is changing rapidly can trigger an alarm. These sensors can also trigger an alarm when the liquid level has reached a critical level. The alarm can transmit to a wireless receiver to alert the CAFO owner or operator and can also alert the permit authority. The advantages of this type of system is the real time warning it can provide the CAFO owner or operator that his lagoon or impoundment is in danger of overflowing. It can provide the CAFO operator an opportunity to better manage their operations and prevent catastrophic failures. These sensors are more expensive than depth markers; however, the added assurance they provide in preventing catastrophic failures may make them attractive to some operations.

Option 1 would require operations to handle dead animals in ways that prevent contributing pollutants to waters of the U.S. EPA proposes to prohibit any disposal of dead animals in any liquid impoundments or lagoons. The majority of operations have mortality handling practices that prevent contamination of surface water. These practices include transferring mortality to a rendering facility, burial in properly sited lined pits, and composting.

Option 1 also would establish requirements to ensure the proper land application of manure and other process wastes and wastewaters. Under Option 1 land application of menure and wastewater to land owned or operated by the CAFO would heve to be performed in accordance with a PNP that establishes applicetion rates for manure and wastewater based on the nitrogen requirements for the crop. EPA believes that application of manure and wastewater in excess of the crop's nitrogen requirements would increese the pollutant runoff from fields, because the crop would not need this nitrogen, increasing the likelihood of it being released to the environment.

In addition, Option 1 includes e requirement that manure be sampled at least once per year and anelyzed for its nutrient content including nitrogen, phosphorus and potassium. EPA believes that annual sampling of manure is the minimum frequency to provide the necessary nutrient content on which to establish the appropriate rate. If the CAFO applies its manure more frequently than once per year, it may choose to sample the manure more frequently. Sampling the manure as close to the time of application as practical provides the CAFO with a better measure of the nitrogen content of the manure. Generally, nitrogen content decreases through volatilization during manure storage when the manure is exposed to air.

The manure application rate established in the PNP would have to be based on the following fectors: (1) the nitrogen requirement of the crop to be grown based on the agricultural extension or land grant university recommendation for the operation's soil type and crop; and (2) realistic crop yields that reflect the yields obtained for the given field in prior years or, if not available, from yields obtained for same crop at nearby farms or county records. Once the nitrogen requirement for the crop is established the manure application rate would be determined by subtracting any other sources of nitrogen available to the crop from the crop's nitrogen requirement. These other sources of nitrogen can include residual nitrogen in the soil from previous applications of organic nitrogen, nitrogen credits from previous crops of legumes, and crop residues, or applications of commercial fertilizer, irrigation water and biosolids. Application rates would be based on the nitrogen content in the manure and should also account for application methods, such as incorporation, and other site specific practices.

The CAFO would have to maintain the PNP on-site, along with records of the application of manure and wastewater including: (1) the amount of manure applied to each field; (2) the nutrient content of manure; (3) the amount and type of commercial fertilizer and other nutrient sources applied; and (4) crop yields obtained. Records must also indicate when manure was applied, application method and weather conditions at the time of application.

While Option 1 would require manure to be sampled annually, it would not require soil sampling and analysis for the nitrogen content in the soil. Nitrogen is present in the soil in different forms and depending on the form the nitrogen will have different potentiel to move from the field. Nitrogen is present in an organic form from to the decay of proteins and urea, or from other organic compounds that result from decaying plant meterial or organic fertilizers such as manure or biosolids. These organic compounds are broken down by soil bacteria to inorganic forms of nitrogen such as nitrate and ammonia. Inorganic nitrogen or urea may be applied to crop or pasture land as commercial fertilizer. Inorganic nitrogen is the form taken up by the plant. It is also more soluble and readily volatile, and can leave the field through runoff or emissions. Nitrogen can also be added to the soil primarily through cultivation of legumes which will "fix" nitrogen in the soil. At all times nitrogen is cycling through the soil, water, and air, and does not become adsorbed or built up in the soil in the way that phosphorus does, as discussed under Option 2. Thus, EPA is not proposing to require soil sampling for nitrogen. EPA would, however, require that, in developing the appropriate application rate for nitrogen, any soil residue of nitrogen resulting from previous contributions by organic fertilizers, crop residue or legume crops should be taken into account when determining the appropriate nitrogen application rate. State Agricultural Departments and Land Grant Universities have developed methods for accounting for residual nitrogen contributed from legume crops, crop residue and organic fertilizers.

Option 1 would also prohibit application of manure and wastewater within 100 feet of surface waters, tile drain inlets, sinkholes and agricultural drainage wells. EPA strongly encourages CAFOs to construct vegetated buffers, however, Option 1 only prohibits applying manure within 100 feet of surface water and would not require CAFOs to take crop land out of production to construct vegetated buffers. CAFOs may continue to use land within 100 feet of surface water to grow crops. Under Option 1, EPA included costs for facilities to construct minimal storage, typically three to six months, to comply with the manure application rates developed in the PNP. EPA included these costs because data indicate pathogen concentrations in surface waters adjacent to land receiving manure are often not significantly different from pathogen levels in surface waters near lands not receiving manure when the manure hes been stored and aged prior to land application. EPA believes the 100 foot setback, in conjunction with proper manure applicetion, will minimize the potential runoff of pathogens, hormones such as estrogen, and metals and reduce the nutrient and sediment runoff.

EPA is aware of concerns that the presence of tile drain inlets, sinkholes and agricultural drainage wells may be widespread in some parts of the country. This could effectively preclude manure based fertilization of large areas of crop land. EPA requests comment on the presence of such features in crop land and the extent to which a 100 foot setback around such features would interfere with land application of manure. EPA also requests comment on how it might revise the setback requirement to address such concerns and still adequately protect water quality.

EPA analysis shows application rates are the single most effective means of reducing runoff. Nevertheless, no combination of best management practices can prevent pollutants from land application from reaching surface waters in all instances; vegetated buffers provide an extra level of protection. Buffers are not designed to reduce pollutants on their own; proper land application and buffers work in tandem to reduce pollutants from reaching surface waters. Data on the effectiveness of vegetated buffers indicate that a 35 to 66 foot vegetated buffer (depending primarily on slope) achieves the most cost-effective removal of sediment and pollutants from surface runoff. However, EPA chose not to propose requiring operations to take land out of production and construct a vegetated buffer because a buffer may not be the most cost-effective application to control erosion in all cases. There are a variety of field practices that should be considered for the control of erosion. EPA encourages CAFOs to obtain and implement a conservation management plan to minimize soil losses, and also to reduce losses of pollutant bound to the soils.

Today's proposal requires a greater setback distance than the optimum vegetated buffer distance. Since EPA is not requiring the construction of a vegetated buffer, the additional setback distance will compensate for the loss of pollutant reductions in the surface runoff leaving the field that would have been achieved with a vegetated buffer without requiring CAFOs to remove this land from production.

EPA solicits comment on additional options to control erosion which would, in turn, reduce the amount of pollutants reaching waters of the U.S. The options for controlling erosion include: (1) implementing one of the three NRCS Conservation Practice Standards for Residue Management: No-Till and Strip Till (329A), Mulch Till (329B), or Ridge Till (329C) in the state Field Office Technical Guide; (2) requiring a minimum 30% residue cover; (3) achieving soil loss tolerance or "T"; or (4) implementing of the Erosion and Sediment Control Management Measure as found in EPA's draft *National Management Measures to Control Nonpoint Source Pollution from Agriculture.* This measure is substantially the same as EPA's 1993 *Guidance Specifying Management Measure for Sources of Nonpoint Pollution in Coastal Waters* which says to:

"* * * Apply the erosion control component of a Resource Management System (RMS) as defined in the 1993 Field Office Technical Guide of the U.S. Department of AgricultureBNational Resources Conservation Service to minimize delivery of sediment from agricultural lands to surface waters, or design and install a combination of management and physical practices to settle the settleable solids and associated pollutants in runoff delivered from the contributing area for storms of up to and including a 10-year, 24-hour frequency."

Farmers entering stream buffers in the Conservation Reserve Program's (CRP) Continuous Sign-Up receive bonus payments, as an added incentive to enroll, include a 20 percent rental bonus, a $100 per acre payment up-front (at the time they sign up), and another bonus at the time they plant a cover. These bonus payments more than cover costs associated with enrolling stream buffers, (*i.e.*, rents forgone for the duration of their 10 or 15 year CRP contracts, and costs such as seed, fuel, machinery and labor for planting a cover crop). The bonuses provide a considerable incentive to enroll stream buffers because the farmers receive payments from USDA well in excess of what they could earn by renting the land for crop production. Farmers can enter buffers into the CRP program at any time.

EPA may also consider providing CAFOs the option of prohibiting manure application within 100 feet or constructing a 35 foot vegetated buffer. EPA solicits comment on any and all of these options.

Option 2. Option 2 retains all the same requirements for the feedlot and manure storage areas described under Option 1 with one exception: Option 2 would impose a BMP that requires manure application rates be phosphorus based where necessary, depending on the specific soil conditions at the CAFO.

Manure is phosphorus rich, so application of manure based on a nitrogen rate may result in application of phosphorus in excess of crop uptake requirements. Traditionally, this has not been a cause for concern, because the excess phosphorus does not usually cause harm to the plant and can be adsorbed by the soil where it was thought to be strongly bound and thus environmentally benign. However, the capacity for soil to adsorb phosphorus will vary according to soil type, and recent observations have shown that soils can and do become saturated with phosphorus. When saturation occurs, continued application of phosphorus in excess of what can be used by the crop and adsorbed by the soil results in the phosphorus leaving the field with storm water via leaching or runoff. Phosphorus bound to soil may also be lost from the field through erosion.

Repeated manure application at a nitrogen rate has now resulted in high to excessive soil phosphorus concentrations in some geographic locations across the country. Option 2 would require manure application be based on the crop removal rate for phosphorus in locations where soil concentrations or soil concentrations in combination with other factors indicate that there is an increased likelihood that phosphorus will leave the field and contribute pollutants to nearby surface water and groundwater. Further, when soil concentrations alone or in combination with other factors exceed a given threshold for phosphorus, the proposed rule would prohibit manure application. EPA included this restriction because the addition of more phosphorus under these conditions is unnecessary for ensuring optimum crop production.

Nutrient management under Option 2 includes all the steps described under Option 1, plus the requirement that all CAFOs collect and analyze soil samples at least once every 3 years from all fields that receive manure. EPA would require soil sampling at 3 year intervals because this reflects a minimal but common interval used in crop rotations. This frequency is also commonly adopted in nutrient management plans prepared voluntarily or under state programs. When soil conditions allow for manure application on a nitrogen basis, then the PNP and record keeping requirements are identical to Option 1. Permit nutrient plans would have to be reviewed and updated each year to reflect any changes in crops, animal production, or soil measurements and would be rewritten and certified at a minimum of once every five years or concurrent with each permit renewal. EPA solicits comment on conditions, such as no changes to the crops, or herd or flock size, under which rewriting the plan would not be necessary and would not require the involvement of a certified planner.

The CAFO's PNP would have to reflect conditions that require manure application on a phosphorus crop removal rate. The manure application rate based on phosphorus requirements takes into account the amount of phosphorus that will be removed from the field when the crop is harvested. This defines the amount of phosphorus and the amount of manure that may be applied to the field. The PNP must also account for the nitrogen requirements of the crop. Application of manure on a phosphorus basis will require the addition of commercial fertilizer to meet the crop requirements for nitrogen. Under Option 2, EPA believes there is an economic incentive to maximize proper handling of manure by conserving nitrogen and minimizing the expense associated with commercial fertilizer. EPA expects manure handling and management practices will change in an effort to conserve the nitrogen content of the manure, and encourages such practices since they are likely to have the additional benefit of reducing the nitrogen losses to the atmosphere.

EPA believes management practices that promote nitrogen losses during storage will resnlt in higher applications of phosphorus because in order to meet the crops requirements for nitrogen a larger amount of manure must be applied. Nitrogen volatilization exacerbates the imbalance in the ratio of nitrogen to phosphorus in the manure as compared to the crop's requirement. Thus application of manure to meet the nitrogen requirements of the crop will result in over application of phosphorus and the ability of the crops and soil to assimilate phosphorus will reach a point at which the facility must revise the PNP to reflect phosphorus based application rates. EPA solicits comment on additional incentives that can be used to discourage those manure storage, treatment, and handling practices that result in nitrogen volatilization.

Under both Option 1 (N) and Option 2 (P), the application of nitrogen from all sources may not exceed the crop nutrient requirements. Since a limited amount of nutrients can be applied to the field in a given year, EPA expects facilities will select the site-specific practices necessary to optimize use of those nntrients. Facilities that apply manure at inappropriate times run the risk of losing the value of nutrients and will not be permitted to reapply nutrients to compensate for this loss. Consequently crop yields may suffer, and in subsequent years, the allowable applicatiou rates will be lower. For these reasons, facilities with no storage are assumed to need a minimal storage capacity to allow improved use of nutrients.

Option 2 provides three methods for determining the manure application rate for a CAFO. These three methods are:

- Phosphorus Index
- Soil Phosphorus Threshold Level
- Soil Test Phosphorus Level

These three methods are adapted from NRCS' nutrient management standard (Standard 590), which is being used by States' Departments of Agriculture to develop State nutrient standards that incorporate one or a combination of these three methods. EPA is proposing to require that each authorized state Permit Authority adopt one of these three methods in consultation with the State Conservationist. CAFOs would then be required to develop their PNP based on the State's method for establishing the application rate. In those states where EPA is the permitting authority, the EPA Director would adopt one of these three methods in consultation with that State's Conservationist.

Phosphorus Index—This index assesses the risk that phosphorus will be trausported off the field to surface water and establishes a relative value of low, medium, high or very high, as specified in § 412.33. Alternatively, it may establish a numeric ranking. At the present time there are several versions of the P-Index under development. Many states are working on a P-Index for their state in response to the NRCS 590 Standard, and NRCS itself developed a P-Index template in 1994 and is in the process of updating that template at the present time. There are efforts underway in the scientific community to standardize a phosphorus index and assign a numeric ranking.

At a minimum the phosphorus index must consider the following factors:

- Soil erosion
- Irrigation erosion
- Runoff class
- Soil P test
- P fertilizer application rate
- P fertilizer applicatiou method
- Organic P source application rate
- Organic P source application method

Other factors could also be included, such as:

- Subsurface drainage
- Leaching potential
- Distance from edge of field to surface water
- Priority of receiving water

Each of these factors is listed in a matrix with a score assigned to each factor. For example, the distance from edge of field to surface water assigns a score to different ranges of distance. The greater the measured distance, the lower the score. Other factors may not be as straightforward. For example, the snrface runoff class relates field slope aud soil permeability in a matrix, and determines a score for this element based on the combination of these factors. The same kind of approach could also be used for the subsurface drainage class, relating soil drainage class with the depth to the seasoual high water table. The values for all variables that go into determining a P-Index can either be directly measured, such as distance to surface water, or can be determined by data available from the state, such as soil drainage class that is based on soil types found in the state and assigned to all soil types. Finally, each factor is assigned a weight depending on its relative importance in the transport of phosphorus.

When a P-Index is used to determine the potential for phosphorus transport in a field and the overall score is high, the operations would apply manure on a phosphorus basis (e.g., apply to meet the crop removal rate for phosphorns). Wheu a P-Index determines that the transport risk is very high, application of manure would be prohibited. If the P-Index results in a rating of low or medium, then manure may be applied to meet the nitrogen requirements of the crop as described nnder Option 1. However, the CAFO must continue to collect soil samples at least every three years. If the phosphorus concentration in the soil is sharply increasing, the CAFO may want to consider managing its mannre differeutly. This may include changing the feed formulations to reduce the amount of phosphorus being fed to the animals, precision feeding to account for nutrient needs of different breeds and ages of animals. It may also include changing manure storage practices to rednce nitrogen losses. There is a great deal of research on feed management, including potential effects on milk production when phosphorus in rations fed to dairy cows is redneed, and the cost savings of split sex and multistage diets and the addition of or adding the enzyme phytase to make the phosphorus more digestible by poultry and swine. Phytase additions in the feed of monogastrics have proven effective at increasing the ability of the animal to assimilate phosphorus and can reduce tha amount of phosphorns excreted. Phytase use is also reported to increase bioavailability of proteius and essential minerals, reducing the need for costly supplamental phosphorns, and reducing necessary calcium supplements for layers. The CAFO may also consider limiting the application of manure. For example, the CAFO may apply manure to one field to meet the nitrogen requiremeuts for that crop but not return to that field until the crops have assimilated the phosphorus that was applied from the manure application.

Phosphorus Threshold—This threshold which would be daveloped for different soil types is a measure of phosphorns in the soil that reflects the level of phosphorus at which phosphorus movement in the field is acceptable. Scientists are currently using a soluble phosphorus concentration of 1 part per million (ppm) as a measure of acceptable phosphorus movement. When the soil concentration of phosphorus reaches this threshold the concentration of phosphorus in the runoff would be expected to be 1 ppm. The 1 ppm value has been used as an indicator of acceptable phosphorus concentration because it is a concentration that has been applied to POTWs in their NPDES permits. An alternative phosphorus discharge value could be the water quality concentration for phosphorus in a given receiving stream.

States which adopt this method in their state nutrient management standard would need to establish a phosphorus threshold for all types of soils found in their state.

Use of the phosphorus threshold in developing an application rate allows for soils with a phosphorus concentration less than three quarters the phosphorus threshold to apply manure on a nitrogen basis. When soils have a phosphorus concentration between 3/4 and twice the phosphorus threshold then manure must be applied to meet the crop removal requirements for phosphorus. For soils which have phosphorus concentrations greater than twice the phosphorus threshold, no manure may be applied.

Soil Test Phosphorus—The soil test phosphorus is an agronomic soil test that measures for phosphorus. This method is intended to identify the point at which the phosphorus concentration in the soil is high enough to ensure optimum crop production. Once that concentration range (often reported as a "high" value from soil testing laboratories) is reached, phosphorus is applied at the crop removal rate. If the soil test phosphorus level reaches a very high concentration, then no manure may be applied. Most soils need to be nearly saturated with phosphorus to achieve optimum crop yields. The soil phosphorus concentration should take into account the crop response and phosphorus application should be restricted when crop yield begins to level off.

The soil test phosphorus method establishes requirements based on low, medium, high and very high soil condition, and applies the same restrictions to these measures as are used in the P-Index. States that adopt this method must establish the soil concentration ranges for each of these risk factors for each soil type and crop in their state.

EPA anticipates that in most states, the permit authority will incorporate the State's nutrient standard (590 Standard) into CAFO permits. For example, if the permit authority, in consultation with the State Conservationist, adopts a Phosphorus Index, then CAFO permits would include the entire P-Index as the permit condition dictating how the application rate must be developed. If a permit authority selects the Phosphorus Threshold, then the CAFO permits must contain soil concentration limitations that reflect phosphorus-based application, as well as the level at which manure application is prohibited.

Each State Conservationist, in consultation with land grant university scientists and the state, must develop a Phosphorus Index for that state by May 2001. EPA may consider eliminating the use of the soil phosphorus threshold level and the soil test phosphorus level as methods for determining the manure application rate for a CAFO and requiring the use of the state Phosphorus Index. Scientists studying phosphorus losses from agricultural lands are supporting the development and use of the Phosphorus Index since it combines the factors critical in determining risk of phosphorus rate and transport to surface waters, including the soil phosphorus threshold level, when developed. EPA is soliciting comment on this option.

Finally, under Option 2 EPA is proposing to require CAFOs that transfer manure off-site to provide the recipient of the manure with information as to the nutrient content of the manure and provide the recipient with information on the correct use of the manure. See Section VII.E.4, for a complete discussion of the requirements for off-site transfer of manure.

As discussed in Section VI, compliance costs for manure transfer assessed to the CAFO include hauling costs and record keeping. If the recipient is land applying the manure, the recipient is most likely a crop farmer, and the recipient is assumed to already have a nutrient management plan that considers typical yields and crop requirements. The recipient is also assumed to apply manure and wastes on a nitrogen basis, so the application costs are offset by the costs for commercial fertilizer purchase and application. EPA assumes the recipient may need to sample soils for phosphorus, and costs for sampling identically to the CAFO, i.e. every three years. EPA has not accounted for costs that would result from limiting the amount or way recipients are currently using manure. EPA solicits comment on the impact to recipients who currently use manure and may have to change their practices as a result of this requirement. In cases where manure is received for alternative uses, the recipient is deemed to already maintain the appropriate records.

EPA solicits comments on whether there should be required training for persons that will apply manure. There are some states which have these requirements. Proper application is critical to controlling pollutant discharges from crop fields. Some states have establish mandatory training for persons that apply manure. EPA will consult with USDA on the possibility of establishing a national training program for manure applicators.

Rotational Grazing. At the request of the environmental community, EPA has investigated rotational grazing as an alternative to confinement-based livestock production. Any pasture or grazing operation is by definition not a form of confinement, therefore use of these practices are outside of the scope of these regulations.

Intensive rotational grazing is known by many terms, including intensive grazing management, short duration grazing, savory grazing, controlled grazing management, and voisin grazing management. This practice involves rotating livestock and poultry among several pasture subunits or paddocks, often on a daily basis, to obtain maximum efficiency of the pasture land.

Due to the labor, fencing, water, and land requirements for intensive rotational grazing, typically only small dairy operations with less than 100 head use this practice. Few beef feedlots practice intensive rotational grazing. Poultry on pasture is usually housed in a portable building or pen holding up to 100 birds that is moved daily; rarely are more than 1,000 birds in total raised in this manner. Swine have also been successfully raised on pasture, most frequently as a seasonal farrowing operation in combination with seasonal sheep or cow grazing. Climate and associated growing seasons make it very difficult for operations to use an intensive rotational grazing system throughout the entire year. Most dairy operations and beef feedlots that use rotational grazing typically operate between 3 and 9 months of the year, with 12 months most likely only in the southern states. Poultry on pasture are produced for about 6 months, and pigs are typically farrowed once per year.

Grazing systems are not directly comparable to confined feeding operations, as one system can not readily switch to the other. Intensive rotational grazing systems are reported to have advantages over confined feeding operations: reduced housing and feed costs, improved animal health, less manure handling, and more economic flexibility. Intensive rotational grazing also encourages grass growth and development of healthy sod, which in turn reduces erosion. In a good rotational system, manure is more evenly distributed and will break up and disappear from the surface faster.

Despite these advantages, studies do not indicate significant reductions of pathogens or nutrients in runoff to nearby streams as compared to manured fields. Rotational grazing systems may still require manure maintenance near watering areas and paths to and from the paddock areas. There are also limits to the implementation of intensive rotational grazing systems, which are highly dependent upon: available acreage, herd size, land resources, labor, water availability, proximity of pasture area to milking center for dairy operations, and feed storage capabilities. Grazing systems usually produce lower animal weight gain and milk production levels, provide limited manure handling options, and do not provide the level of biosecurity that confinement farms can obtain.

Proposed Basis for BPT Limitations. EPA is not proposing to establish BPT requirements for the beef, dairy, swine, veal and poultry subcategories on the basis of Option 1, because it does not represent the best practicable control technology. In areas that have high to very high phosphorus build up in the soils, Option 1 would not require that manure application be restricted or eliminated. Thus, the potential for phosphorus to be discharged from land owned or controlled by the CAFOs would not be controlled by Option 1. Consequently Option 1 would not adequately control discharges of phosphorus from these areas. Option 2 would reduce the discharge of phosphorus in field runoff by restricting the amount of phosphorus that may be applied to the amount that is appropriate for agricultural purposes or prohibiting the application of manure when phosphorus concentrations in the soil are very high and additional phosphorus is not needed to meet crop requirements.

EPA is proposing to establish BPT limitations for the beef, dairy, swine, veal and poultry subcategories on the basis of Option 2 with the exception that it is co-proposing options with and without the certification regulations for off-site land application of manure. EPA's decision to base BPT limitations on Option 2 treatment reflects consideration of the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application. Option 2 is expected to cost $549 million under the two-tier structure and achieve 107 million pounds of pollutant reductions for a total cost to pound ratio of $0.57. The three-tier structure is estimated to cost $551 for a total cost to pound ratio of $0.51.

The Option 2 technology is one that is readily applicable to all CAFOs. The production area requirements represent the level of control achieved by the majority of CAFOs in the beef, dairy, swine, poultry and veal subcategories. USDA and the American Society of Agricultural Engineers cite the 25-year, 24-hour storm as the standard to which storage structures should comply. This has been the standard for many years, and most existing lagoons and other open liquid containment structures are built to this standard. As described above, the land application requirements associated with Option 2 are believed to represent proper agricultural practice and to ensure that CAFO manure is applied to meet the requirements of the crops grown and not exceed the ability of the soil and crop to absorb nutrients.

EPA believes any of the three methods for determining when manure should be applied on a phosphorus basis would represent BPT. Each method has distinct advantages which, depending on the circumstances, could make one method preferred over another. There has been considerable work done in this area within the past few years and this work is continuing. EPA believes that this proposed BPT approach provides adequate flexibility to allow states to develop an approach that works best for the soils and crops being grown within their state. Nonetheless, EPA will continue to work with soil scientists and may consider standardizing the factors included in the phosphorus index to develop a standard rating scale, for the purpose of CAFO requirements. EPA also solicits comment on whether there should be some EPA oversight or approval of the phosphorus method developed by the states. Specifically EPA solicits comment whether of EPA should establish standards that must be included in a phosphorus index. These standards may include specifying additional criteria which should be considered in the index, such as distance to surface water. EPA also seeks comment on whether it should establish minimum standards on how these criteria must be factored into a Phosphorus Index, such as specifying the weight to be assigned to the various criteria included in the Index and assigning the values for specific ranges for each criteria. EPA may consider establishing a minimum standard for the phosphorus threshold method for example requiring that at a minimum the phosphorus threshold be based on the soil phosphorus concentration that would result in a soluble phosphorus concentration in the runoff of 1 ppm. EPA may also consider establishing specific sampling protocols for collecting manure and soil samples and analyzing for nutrients.

CAFOs must also develop and implement a PNP that establishes the appropriate manure application rate. EPA believes the land application rates established in accordance with one of the three methods described in today's proposed regulation, along with the prohibition of manure application within 100 feet of surface water, will ensure manure and wastewater are applied in a manner consistent with proper agricultural use. EPA has included a discussion of how to develop a PNP in section VIII.C.6.

EPA believes that state sampling and analytical protocols are effective; however, soil phosphorus levels can vary depending on how the soil samples are collected. For example, a CAFO that surface-applies manure will deposit phosphorus in the surface layer of the soil and should collect soil samples from the top layer of soil. If this CAFO collects soil samples to a depth of several inches the analysis may understate the phosphorus concentrations in the soil. EPA solicits comments on the need to establish sampling protocols for soil sampling.

4. Best Control Technology for Conventional Pollutants (BCT)

In evaluating possible BCT standards, EPA first considered whether there are any candidate technologies (*i.e.*, technology options); that are technologically feasible and achieve greater conventional pollutant reductions than the proposed BPT technologies. (Conventional pollutants are defined in the Clean Water Act as including: Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), pH, oil and grease and fecal coliform.) EPA considered the same BAT technology options described below and their effectiveness at reducing conventional pollutants. EPA's analysis of pollutant reductions has focused primarily on the control of nutrients, nitrogen and phosphorus. However, the Agency has also analyzed what the technology options can achieve with respect to sediments (or TSS), metals, and pathogens. Although livestock waste also contains BOD, EPA did not analyze the loadings or loadings reductions associated with the technology options for BOD. Thus, the only conventional pollutant considered in the BCT analysis is TSS. EPA identified no technology option that achieves greater TSS removals than the proposed BPT technologies (see the Technical Development Document). EPA does not believe that these technology options would substantially reduce BOD loads. There are therefore no candidate technologies for more stringent BCT limits. If EPA had identified technologies that achieve greater TSS rednctions than the proposed BPT, EPA would have performed the two part BCT cost test. (See 51 FR 24974 for a description of the methodology EPA employs when setting BCT standards.) EPA solicits comment on the assumptions it nsed in considering BCT.

EPA is proposing to establish BCT limits for conventional pollutants equivalent to the proposed BPT limits.

5. Best Available Technology Economically Achievable (BAT)

EPA is considering six technology options to control discharges from CAFOs in the beef, veal and poultry snbcategories, and seven technology options for the dairy and hog subcategories. All of the technology options include restrictions on land application of mannre, best management practices (BMPs), inspections and record keeping for the animal confinement areas, and wastewater storage or treatment structures. The following table snmmarizes the reqnirements for each of the seven technology options. Note that a given technology option may include a combination of technologies.

TABLE 8–1.—REQUIREMENTS CONSIDERED IN THE TECHNOLOGY OPTIONS

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Zero Discharge w/overflow when a 25–24 Design Standard is met	X	X	X	X	Cattle & Dairy		
Depth markers for lagoons	X	X	X	X	Cattle & Dairy	X	X
Annual Manure Testing	X	X	X	X	X	X	X
N-based PNP	X						
100′ LA setback	X	X	X	X	X	X	X
P-based PNP (where necessary)		X	X	X	X	X	X
Soil Test—every 3yrs.		X	X	X	X	X	X
Zero discharge without any allowance for overflow					Swine & Poultry		
Hydrologic Link Assessment & Zero Discharge to Groundwater beneath Production Area			X	X			
Ambient Surface Water Sampling (N,P,TSS)				X			
Anaerobic Digestion w/power generation					Swine	Swine & Dairy	
Frozen/snow covered/saturated application prohibitions							X

X = All Subcategories.

Option 1. This option is equivalent to Option 1 described under BPT Section VIII.3. Option 1 would require zero discharge from the production area and that liquid storage be designed, constructed and maintained to handle all process wastewater and storm water rnnoff from the 25-year, 24-hour storm event. In addition, Option 1 requires management practices to ensure that the production area (which includes manure and wastewater storaga) is being adequately maintained.

Option 1 also wonld establish a requirement to develop a PNP which establishes tha proper land application rate for manure and wastewater to meet the nitrogen requirements for the crops being grown by the CAFO and require a 100 foot setback from snrface water, sinkholes, tile drain inlets and agricultural drainage wells.

Option 2. This option is equivalent to Option 2 described nnder BPT (section VII.3). Option 2 includes all of the requirements established under Option 1. However, Option 2 would further restrict the amount of manure that can be applied to crop land owned or controlled by the CAFO. The CAFO would be required to apply manure and wastewater at the appropriate rate taking into account the nutrient requirements of the crop and soil conditions. Specifically, Option 2 would require that manure be applied at crop removal rate for phosphorus if soil conditions warrant and, if soils have a very high level phosphorus build-up, no manure or wastewater could be applied to the crop land owned or controlled by the CAFO.

Option 3. Option 3 inclndes all the requirements for Option 2 and would require that all operations perform an assessment to determine whether the ground water beneath the feedlot and mannre storage area has a direct hydrological connection to surface water. As described in Section VII, EPA has authority to control discharges to surface water through ground water that has a direct hydrological connection to snrface water. A hydrological connection refers to the interflow and exchange between surface impoundments and surface water through an underground corridor or ground water. EPA is relying on the permitting authority to establish the region-specific determination of what constitutes a direct hydrological link. Option 3 would require all CAFOs to determine whether they have a direct hydrological connection between the gronnd water beneath the production area and surface waters. If a link is established, the facility would have to monitor ground water up gradient and down gradient of the production area to ensure that they are achieving zero discharge to ground water. EPA has assumed that CAFOs would comply with the zero discharge reqnirement by installing liners of synthetic material beneath lagoons and ponds, and impervious pads below storage of dry mannre stockpiles. EPA's costs for liners reflect both a synthetic liner and compacted clay to protect the liner and prolong its useful life.

CAFOs with a direct hydrologic link would be reqnired to sample the groundwater from the monitoring wells (located up gradient and down gradient of the production area) at a minimum frequency of twice per year. These samples are necessary to ensure that pollutants are not being discharged through groundwater to surface water from the production area. The samples shall be monitored for nitrate, ammonia, total coliform, fecal coliform, Total Dissolved Solids (TDS) and total chloride. Differences in concentration of these pollutants between the monitoring well(s) located up gradient and down gradient of the production area are assumed to represent a discharge of pollutants and must be prevented. As noted below, coliforms are not necessarily good indicators of livestock discharges. Also, it is difficult to determine "concentrations" of coliforms as they are not necessarily evenly distributed in the way chemical contaminants generally are. EPA requests comment on technical concerns associated with including total and fecal coliforms in the groundwater monitoring and protection requirements and on ways to address such concerns.

Option 4. Option 4 includes all the requirements for Option 3 and would require sampling of surface waters adjacent to feedlots and/or land under control of the feedlot to which manure is applied. This option would require CAFOs to sample surface water both upstream and downstream from the feedlot and land application areas following a one half inch rain fall (not to exceed 12 sample events per year). The samples would be analyzed for concentrations of nitrogen, phosphorus and total suspended solids (TSS). EPA selected these pollutants because it believes these pollutants provide an adequate indication of whether a discharge is occurring from the operation. All sampling results would be reported to the permit authority. Any difference in concentration between the upstream and downstream samples would be noted. This monitoring requirement could provide some indication of discharges from the land application or feedlot areas.

EPA also considered requiring that pathogens and BOD_5 be analyzed in samples collected. EPA decided that this would not be practical, because sampling under Option 4 is linked to storm events which limits the ability to plan in advance for analysis of the samples and making arrangements for shipping samples to laboratories. Fecal coliform and BOD samples all have very short holding times before they need to be analyzed. Most CAFOs are located in rural areas with limited access to overnight shipping services and are probably not near laboratories that can analyze for these pollutants. Further, fecal coliform and similar analytes that are typically used as indicators in municipal wastewater are not necessarily good indicators of livestock discharges. If CAFOs were required to monitor for pathogens which could indicate discharges of manure or CAFO wastewater, it would be better to require monitoring for fecal enterococci, or even specific pathogens such as salmonella, Giardia, and Cryptosporidium. However, the cost for analyzing these parameters is very high and the holding times for these parameters are also very short.

Furthermore, EPA determined pathogen analyses are also inappropriate because the pathogens in manure are found in areas without animal agriculture. For example Enterobacter, Klebsiella, Bacillus cereus, Clostridium, and Listeria are all naturally occurring soil and plant microorganisms and are found in soils that have never received manure. Pathogens may also be deposited onto land from wildlife. Thus, EPA concluded that requiring analysis for these pollutants was impractical at best and potentially very expensive.

Option 5. Option 5 includes the requirements established by Option 2 and would establish a zero discharge requirement from the production area that does not allow for an overflow under any circumstances. By keeping precipitation from contacting with the animals, raw materials, waste handling and storage areas, CAFOs could operate the confinement areas and meet zero discharge regardless of rainfall events. Option 5 includes the same land application requirements as Option 2, which would restrict the rate of manure and wastewater application to a crop removal rate for phosphorus where necessary depending on the specific soil conditions at the CAFO. Additionally, as in Option 2, application of manure and wastewater would be prohibited within 100 feet of surface water.

EPA considered Option 5 for the poultry, veal and hog subcategories, where it is common to keep the animals in total confinement, feed is generally maintained in enclosed hoppers and the manure and wastewater storage can be handled so as to prevent it from contacting storm water. EPA considered a number of ways a facility might meet the requirements of no discharge and no overflow. In estimating the costs associated with Option 5, EPA compared the total costs and selected the least expensive technology for a given farm size, geographic region, and manure management system. Costs also depend on whether the facility's PNP indicates land application must be based on nitrogen or phosphorus, and how many acres the facility controls. The technologies described below were used singularly or in combination to meet the requirements of Option 5.

Many facilities can achieve Option 5 by covering open manure and storage areas, and by constructing or modifying berms and diversions to control the flow of precipitation. EPA costed broiler and turkey operations for storage sheds sufficient to contain six months of storage. Some poultry facilities, particularly turkey facilities, compost used litter in the storage sheds, allowing recycle and reuse of the litter. EPA costed swine, veal, and poultry facilities which use lagoons or liquid impoundments for impoundment covers.

EPA believes that operations which have excess manure nutrients and use flush systems to move manure out of the confinement buildings will have an incentive to construct a second lagoon cell. A second storage or treatment cell should accomplish more decomposition of the waste and will allow flush water to be recycled out of the second cell or lagoon, thus reducing the addition of fresh water to the system. Reducing the total volume of stored waste reduces the risk of a catastrophic failure of the storage structure. In the absence of large volumes of water, facilities with an excess of manure nutrients will be able to transfer the excess manure off-site more economically due to a lower volume of waste needing to be hauled. Water reduction also results in a more concentrated product which would have a higher value as a fertilizer.

Covered systems substantially reduce air emissions, and help maintain the nutrient value of the manure. Covered systems also may benefit facilities by reducing odors emenating from open storage. This option also creates a strong incentive for facilities to utilize covered lagoon digesters or multistage covered systems for treatment. The use of covers will allow smaller and more stable liquid impoundments to be constructed. Finally, the use of covered impoundments encourages treatment and minimal holding times, resulting in pathogen die-off and reduction of BOD and volatile solids.

Other technologies can be effectively used at some facilities, such as conversion of flush systems to scrape systems, or by retrofit of slatted floor housing to V-shaped under house pits that facilitate solid liquid separation. Solids can be stored or composted in covered sheds, while the urine can be stored in small liquid impoundments.

In the event the facility has insufficient land to handle all nutrients generated, EPA evaluated additional nutrient management strategies. First, the manure could pass through solid separation, resulting in a smaller volume of more concentrated nutrients that is more effectively transported offsite. Second, land application could be based on the uppermost portion of a covered lagoon containing a more dilute concentration of nutrients. Data indicates much of the phosphorus accumulates in the bottom sludge, which is periodically removed and could be transported offsite for proper land application. Though many facilities report sludge removal of a properly operating lagoon may occur as infrequently as every 20 years, EPA assumed facilities would pump out the phosphorus and metals enriched sludge every three years. This is consistent with the ANSI/ASAE standards for anaerobic treatment lagoons (EP403.3 JUL99) that indicates periodic sludge removal and liquid drawdown is necessary to maintain the treatment volume of the lagoon. Third, swine and poultry farms can implement a variety of feeding strategies, as discussed under Option 2 (see Section VII.C.3). Feed management including phytase, multistage diets, split sex feeding, and precision feeding have been shown to reduce phosphorus content in the manure by up to 50%. This results in less excess nutrients to be transported offsite, and allows for more manure to be land applied at the CAFO.

EPA is aware of a small number of swine facilities that are potentially CAFOs and use either open lots or some type of building with outside access to confine the animals. EPA data indicate these types of operations are generally smaller operations that would need to implement different technologies than those described above. CAFOs that provide outdoor access for the animals need to capture contaminated storm water that falls on these open areas. Open hog lots would find it difficult to comply with a requirement that does not allow for overflows in the event of a large storm. EPA costed these facilities to replace the open lots with hoop houses to confine the animals and storage sheds to contain the manure. Hoop structures are naturally ventilated structures with short wooden or concrete sidewalls and a canvas, synthetic, or reflective roof supported by tubes or trusses. The floor of the house is covered with straw or similar bedding materials. The manure and bedding is periodically removed and stored. The drier nature of the manure lends to treatment such as composting as well as demonstrating reduced hauling costs as compared to liquid manure handling systems.

EPA considered a variation to Option 5 that would require CAFOs to use dry or drier manure handling practices. This variation assumed conversion to a completely dry manure handling system for hogs and laying hens using liquid manure handling systems. In addition to the advantages of reduced water use described above, a completely dry system is more likely to minimize leaching to ground water and, where directly connected hydrologically to surface water, will also reduce loads to surface waters. For the beef and dairy subcategories EPA assumes that the liquid stream would be treated to remove the solids and the solids would be composted. It is not practical to assume beef and dairy operations can avoid the generation of liquid waste because operations in both subcategories tend to have animals in open areas exposed to precipitation resulting in a contaminated storm water that must be captured. Also dairies generate a liquid waste stream from the washing of the milking parlor.

Option 6. Option 6 includes the requirements of Option 2 and requires that large hog and dairy operations (hog operations and dairies with 2,000 AUs) would install and implement enclosed anaerobic digestion to treat their manure and use the captured methane gas for energy or heat generation. With proper management, such a system can be used to generate additional on-farm revenue. The enclosed system will reduce air emissions, especially odor and hydrogen sulfide, and potentially reduces nitrogen losses from ammonia volatilization. The treated effluent will also have less odor and should be more transportable relative to undigested manure, making offsite transfer of manure more economical. Anaerobic digestion under thermophilic or heated conditions would achieve additional pathogen reductions.

Option 7. Option 7 includes the requirements of Option 2 and would prohibit manure application to frozen, snow covered or saturated ground. This prohibition requires that CAFOs have adequate storage to hold manure for the period of time during which the ground is frozen or saturated. The necessary period of storage ranges from 45 to 270 days depending on the region. In practice, this may result in some facilities needing storage to hold manure and wastes for 12 months. EPA requests comment on whether there are specific conditions which warrant a national standard that prohibits application when the ground is frozen, snow covered or saturated.

6. Proposed Basis for BAT

BAT Requirements for the Beef and Dairy Subcategories. EPA is proposing to establish BAT requirements for the beef and dairy subcategories based on the same technology option. The beef subcategory includes stand-alone heifer operations and applies to all confined cattle operations except for operations that confine mature dairy cattle or veal. Under the two-tier structure, the BAT requirements would apply to any beef operation with 500 head of cattle or more. Under the three-tier structure, the BAT requirements for beef would apply to any operation with more than 1,000 head of cattle and any operation with 300 to 1,000 head which meets the conditions identified in section VII.B.2 and 3 of this preamble.

EPA proposes to establish BAT requirements for dairy operations which meet the following definitions: under the two-tier structure, all dairy with 350 head of mature dairy cows or more would be subject to today's proposed BAT requirements. Under the three-tier approach any dairy with more than 700 head of mature dairy cows or 250 to 700 head of mature dairy cows which meets the conditions identified in section VII of this preamble would be subject to today's proposed BAT requirements.

EPA proposes to establish BAT requirements for the beef and dairy subcategories based on Option 3. BAT would require all beef and dairy CAFOs to monitor the ground water beneath the production area by drilling wells up gradient and down gradient to measure for a plume of pollutants discharged to ground water at the production area. A beef or dairy CAFO can avoid this ground water monitoring by demonstrating, to the permit writer's satisfaction, that it does not have a direct hydrological connection between the ground water beneath the production area and surface waters.

EPA proposes to require CAFOs in the beef and dairy subcategories to monitor their ground water unless they determine that the production area is located above ground water which has a direct hydrological connection to surface water. CAFOs would have to monitor for ammonia, nitrate, fecal coliform, total coliform, total chlorides and TDS. EPA selected these pollutants because they may be indicators of livestock waste and are pollutants of concern to ground water sources. If the down gradient concentrations are higher than the up gradient concentration this indicates a discharge which must be controlled. As discussed above, EPA requests comment on the inclusion of total and fecal coliforms among the required analytes. For operations that do not demonstrate that they do not have a direct hydrologic connection, EPA based the BAT zero discharge requirement on the installation of liners in liquid storage structures such as lagoons and storm water retention ponds and concrete pads for the storage of dry manure stockpiles.

Beef and dairy CAFOs must also develop and implement a PNP that is based on application of manure and wastewater to crop land either at a crop removal rate for phosphorus where soil conditions require it, or on the nitrogen requirements of the crop. EPA believes the land application rates established in accordance with one of the three methods described in today's proposed regulation, along with the prohibition of manure application within 100 feet of that surface water will ensure manure and wastewater are applied in a manner consistent with proper agricultural use. See EPA's document entitled "Managing Manure Nutrients at Concentrated Animal Feeding Operations" for the detailed discussion of how a PNP is developed.

EPA believes that technology option 3 is economically achievable and represents the best available technology for the beef and dairy subcategories, and is therefore proposing this option as BAT for these subcategories. The incremental annual cost of Option 3 relative to Option 2 for these subcategories is $170 million pre-tax under the two-tier structure, and $1205 million pre-tax under the three tier structure. EPA estimated annual ground water protection benefits from the proposed requirements of $70–80 million. EPA estimates Option 3 for the beef and dairy subcategories will reduce loadings to surface waters from hydrologically connected ground water by 3 million pounds of nitrogen. To determine economic achievability, EPA analyzed how many facilities would experience financial stress severe enough to make them vulnerable to closure under each regulatory option. As explained in more detail in the *Economic Analysis*, the number of facilities experiencing stress may indicate that an option might not be economically achievable, subject to additional considerations. Under Option 2, no facilities in either the beef or dairy sectors were found to experience stress, while under Option 3, the analysis projects 10 beef and 329 dairy CAFOs would experience stress under the two-tier structure, and 40 beef and 610 dairy CAFOs would experience stress under the three-tier structure. Of these, EPA has determined that 40 beef operations are considered small businesses based on size standards established by the Small Business Administration. This analysis assumes that 76% of affected operations would be able to demonstrate that their ground water does not have a hydrological connection to surface water and would therefore not be subject to the proposed requirements. EPA projects the cost of making this demonstration to the average CAFO would be $3,000. EPA is aware that concerns have been raised about these cost estimates, and about its estimates of how many facilities would be able to avoid the groundwater monitoring and protection requirements on this basis. EPA requests comment on this analysis and on its proposed determination that Option 3 is economically achievable for the beef and dairy sectors.

EPA is not proposing to base BAT requirements for the beef and dairy subcategories on Option 2 because it does not as comprehensively control discharges of pollutants through ground water which has a direct hydrological connection with surface water. However, EPA is requesting comment on Option 2 as a possible basis for BAT in the beef and dairy subcategories. EPA notes that even under Option 2, permit writers would be required to consider whether a facility is located in an area where its hydrogeology makes it likely that the ground water underlying the facility is hydrologically connected to surface water and whether a discharge to surface water from the facility through such hydrologically connected ground water may cause or contribute to a violation of State water quality standards. In cases where such a determination was made by the permit writer, he or she would impose appropriate conditions to prevent discharge via a hydrologic connection would be included in the permit. The main difference between Option 2 and Option 3 is thus that under Option 3, the burden of proof would be on the facility to demonstrate that it does not discharge to ground water that is hydrologically connected to surface water, while under Option 2, ground water protection and monitoring requirements would only be included in the permit if there were an affirmative determination by the permitting authority that such requirements were necessary to prevent a discharge of pollutants to surface waters via hydrologically connected ground water that may be sufficient to cause a violation of State water quality standards. Under today's proposal, the Option 2 approach to preventing discharges via hydrologically connected ground water would be used for the veal, swine and poultry subcategories. EPA requests comment on applying this approach to the beef and dairy subcategories as well.

EPA is not proposing to establish BAT requirements for the beef and dairy subcategories on the basis of Option 4 due to the additional cost associated with ambient stream monitoring and because the addition of in-stream monitoring does not by itself achieve any better controls on the discharges from CAFOs as compared to the other options. In-stream monitoring could be an indicator of discharges occurring from the CAFO; however, it is equally likely that in-stream monitoring will measure discharges that may be occurring from adjacent non-CAFO agricultural sources. Through the use of commercial fertilizers these non-CAFO sources would likely be contributing the same pollutants being analyzed under Option 4. EPA has not identified a better indicator parameter which would isolate constituents from CAFO manure and wastewater from other possible sources contributing pollutants to a stream. Pathogen analysis could be an indicator if adjacent operations do not also have livestock or are not using manure or biosolids as fertilizer sources. However, as described earlier, EPA has concerns about the ability of CAFOs to collect and analyze samples for these pollutants because of the holding time constraints associated with the analytical methods for these parameters. Accordingly, EPA does not believe that specifying these additional in-stream monitoring BMP requirements would be appropriate; and would not be useful in ensuring compliance with the Clean Water Act. Moreover, in-stream monitoring would be a very costly requirement for CAFOs to comply with.

EPA is not proposing to establish BAT requirements for the beef and dairy subcategories on the basis of Option 5. Option 5 would require zero discharge with no overflow from the production area. Most beef feedlots are open lots which have large areas from which storm water must be collected; thus, it is not possible to assume that the operation can design a storm water impoundment that will never experience an overflow even under the most extreme storm. Stand alone heifer operations (other than those that are pasture-based) are configured and operated in a manner very similar to beef feedlots. Unlike the hog, veal and poultry subcategories, EPA is not aware of any beef operations that keep all cattle confined under roof at all times.

Dairies also frequently keep animals in open areas for some period of time, whether it is simply the pathway from the barn to the milk house or an open exercise lot. Storm water from these open areas must be collected in addition to any storm water that contacts food or silage. As is the case for beef feedlots, the runoff volume from the exposed areas is a function of the size of the area where the cattle are maintained, and the amount of precipitation. Since the CAFO operator cannot control the amount of precipitation, there always remains the possibility that an extreme storm event can produce enough rainfall that the resulting runoff would exceed the capacity of the lagoon.

EPA did consider a new source option for new dairies that would enforce total confinement of all cattle at the dairy. This new source option poses a barrier to entry for new sources, therefore, EPA assumes that this option if applied to existing sources would be economically unachievable. Furthermore, EPA did evaluate a variation of Option 5 that would apply to existing beef and dairy operations and would require the use of technologies which achieve a less wet manure. These technologies include solid-liquid separation and composting the solids. EPA is not proposing to establish BAT on the use of these technologies, but does believe these technologies may result in cost savings at some operations. Additionally, composting will achieve pathogen reductions. As described in section VIII.C.9., EPA is continuing to examine pathogen controls and may promulgate requirements on the discharge of pathogens. If EPA set limitations on pathogens, composting technology would likely become a basis for achieving BAT limits. EPA invites comment on composting and its application to dry beef and dairy manure.

For any operation that has inadequate crop land on which to apply its manure and wastewater, solid-liquid separation and composting could benefit the CAFO, as these technologies will make the manure more transportable. Drier manure is easier to transport; and therefore, EPA believes solid liquid separation and composting will be used in some situations to reduce the transportation cost of excess manure. In addition, composting is a value-added process that improves the physical characteristics (e.g., reduces odor and creates a more homogenous product) of the manure. It can also make the manure a more marketable product. As a result, a CAFO with excess manure may find it easier to give away, or even sell, its excess manure. EPA encourages all CAFOs to consider technologies that will reduce the volume of manure requiring storage and make the manure easier to transport.

Option 6, which requires anaerobic digestion treatment with methane capture, was not considered for the beef subcategory, but was considered for the dairy subcategory for treatment of liquid manure. Anaerobic digestion can only be applied to liquid waste. As described previously in Section VI, beef feedlots maintain a dry manure, yet they capture storm water runoff from the dry lot and manure stockpile. The storm water runoff is generally too dilute to apply digestion technology.

Most dairies, however, handle manure as a liquid or slurry which is suited to treatment through anaerobic digestion. EPA concluded that application of anaerobic digesters at dairies will not necessarily lead to significant reductions in the pollutants discharges to surface waters from CAFOs. An anaerobic digester does not eliminate the need for liquid impoundments to store dairy parlor water and barn flush water and to capture storm water runoff from the open areas at the dairy. Neither do digesters reduce the nutrients, nitrogen or phosphorus. Thus, basing BAT on digester technology would not change the performance standard that a production area at a CAFO would achieve and would not reduce or eliminate the need for proper land application of manure. Digesters were considered because they achieve some degree of waste stabilization and more importantly they capture air emissions generated during manure storage. The emission of ammonia from manure storage structures is a potentially significant contributor of nitrogen to surface waters. Covered anaerobic digesters will prevent these emissions while the waste is in the digester, but the digester does not convert the ammonia into another form of nitrogen, such as nitrate, which is not as volatile. Thus as soon as the manure is exposed to air the ammonia will be lost. Operations may consider additional management strategies for land application such as incorporation in order to maintain the nitrogen value as fertilizer and to reduce emissions.

As mentioned above, the application of ambient temperature or mesophilic anaerobic digesters would not change the performance standard that a CAFO would achieve. EPA considered anaerobic digestion as a means to control pathogens. Thermophilic digestion which applies heat to the waste will reduce pathogens. As described in Section VIII.C.9. EPA is still evaluating effective controls for pathogens.

EPA is not proposing to base BAT requirements on Option 7 for the beef and dairy subcategories. Option 7 would prohibit manure application on saturated, snow covered or frozen ground. Pollutant runoff associated with application of manure or wastewater to saturated, snow covered or frozen ground is a site specific consideration, and depends on a number of site specific variables, including distance to surface water and slope of the land. EPA believes that establishing a national standard that prohibits manure or wastewater application is inappropriate because of the site specific nature of these requirements and the regional variability across the nation. This is described in Section VII.E.5.b, above. However, Section VII also explains that EPA is proposing to revise 40 CFR Part 122 to require the permit authority to include, on a case-by-case basis, restrictions on the application of CAFO waste to frozen, snow covered or saturated ground in CAFO permits. This permit condition should account for topographic and climatic conditions found in the state.

Requirements for the beef and dairy subcategories would still allow for an overflow in the event of a chronic or catastrophic storm that exceeds the 25-year, 24-hour storm. EPA believes this standard reflects the best available technology. Under the proposed revisions to Part 122, permits will require that any discharge from the feedlot or confinement area be reported to the permitting authority within 24 hours of the discharge event. The CAFO operator must also report the amount of rainfall and the approximate duration of the storm event.

BAT Requirements for the Swine, Veal and Poultry Subcategories. EPA is proposing to establish BAT requirements for the swine, veal and poultry subcategories based on Option 5. For the purpose of simplifying this discussion, the term poultry is used to include chickens and turkeys. Option 5 requires zero discharge of manure and process wastewater and provides no overflow allowance for manure and wastewater storage. Land application requirements for these operations would be the same as the requirements under Option 2.

EPA is proposing Option 5 because swine, veal and poultry operations can house the animals under roof and feed is also not exposed to the weather. Thus, there is no opportunity for storm water contamination. Broiler and turkey operations generate a dry manure which can be kept covered either under a shed or with tarps. Laying hens with dry manure handling usually store manure below the birds' cages and inside the confinement building. Veal and poultry operations confine the animals under roof, thus there are no open animal confinement areas to generate contaminated storm water. Those operations with liquid manure storage can comply with the restrictions proposed under this option by diverting uncontaminated storm water away from the structure, and covering the lagoons or impoundments.

The technology basis for the poultry BAT requirements at the production area are litter sheds for broiler and turkey CAFOs, and nnderhouse storage for laying hens with dry manure handling systems. For laying hen CAFOs with liquid manure handling systems, EPA's technology basis is solid separation end covered storege for the solids and covered lagoons.

Laying hen farms may also have egg wesh water from in-line or off-line processing areas. Only 10% of laying hen operations with fewer than 100,000 birds have on farm egg processing, while 35% of laying hen operations with more than 100,000 birds have on farm egg processing. The wash water is often passed through a settling system to remove calcium, then stored in above ground tanks, below ground tanks, or lagoons. Today's proposal is based on covered storage of the egg wash water from on-farm processing, to prevent contact with precipitation. The ultimate disposal of egg wash water is through land application which must be done in accordance with the land epplication rates established in the PNP. EPA believes the low nutrient value of egg washwater is unlikely to cause additional incremental costs to laying hen facilities to comply with the proposed land application requirements.

EPA assumes large swine operations (e.g., operations with more than 1,250 hogs weighing 55 pounds or greater) operate using total confinement practices. EPA based BAT Option 5 on the same approach described above of covering liquid manure storage. CAFOs can operate covered lagoons as anaerobic digesters which is an effective technology for achieving zero discharge and will provide the added benefits of waste stabilization, odor reduction and control of air emissions from manure storage structures. Anaerobic digesters also can be operated to generate electricity which can be used by the CAFO to offset operating costs.

Although Option 5 is the most expensive option for the hog subcategory, as shown on Table X.E.2(a), EPA believes this option reflects best available technology economically achievable because it prevents discharges resulting from liquid manure overflows that occur in open lagoons and pond. Similarly, the technology basis of covered treatment lagoons and drier manure storage is believed to reduce the likelihood of those catastrophic lagoon failures associated with heavy rainfalls. Option 5 also achieves the greatest level of pollutant reductions from runoff reaching the edge of the field. Non-water quality environmental impacts inclnde redneed emissions and odor, with a concurrent increase in nitrogen value of the manure, however as mentioned previously, the ammonia concentration is not reduced and once the mannre is exposed to air the ammonia will volatilize. Water conservation and recycling practices associated with Option 5 will promote increased nutrient valne of the manure, reduced hauling costs via reduced water content, and less fresh water use.

The technology basis of Option 5, solid-liquid separation end storage of the solids, hes the advantage of creating a solid fraction which is more transportable, thus hog CAFOs that have excess manure can nse this technology to reduce the transportation costs.

EPA is aware of three open lot hog operations that have more than 1,250 hogs and there may be a small number of others, but the predominant practice is to house the animals in roofed buildings with total confinement. For open lot hog CAFOs, EPA is proposing to base BAT the application of hoop structures as described above.

Veal operations use liquid manure management and store manure in lagoons. EPA has based BAT on covered manure and feed storage. The animals are housed in buildings with no outside access. Thus, by covering feed and waste storage the need to capture contaminated storm water is avoided.

In evaluating the economic achievability of Option 5 for the swine, veal and poultry subcategories, EPA evalnated the costs and impacts of this option relative to Optiou 2. For these subcategories, the incremental annual cost of Option 5 over Option 2 would be $110 million pre-tax under the two-tier structure, and $140 million pre-tax under the three-tier structure. Almost all of these incremental costs are projected to be in the swine sector. Since the majority of the costs are borne by the swine subcategory, EPA solicits comment on establishing BAT on the basis Option 5 for the only the veal and poultry subcategories, and establishing BAT on the basis of Option 2 that the swine subcategory. EPA projects that tbere would be no additional costs nnder the two-tier strncture, and only very small additional costs under the three-tier strncture for the veal and poultry subcategories to move from Option 2 to Option 5. Under Option 2, EPA estimates 300 swine operations and 150 broiler operations would experience stress nnder the two-tier structnre, and 300 swine operations and 330 broiler operations would experience stress under the three-tier structure. Under Option 5 an additional 1,120 swine operations would experience stress under both the two-tier and three-tier structures. All affected hog operations have more than 1000 AU. None of these affected hog operations are small businesses based on the Small Business Administration's size standards. There would be no additional broiler operatious experiencing stress nnder Option 5, and no veel, layer, or turkey operations are projected to experience stress under either Option 2 or Option 5. EPA did not analyze the benefits of Option 5 relative to Option 2. Under Optiou 2 operations are required to be designed, constructed and operated to contain all process generated waste waters, plns the runoff from e 25-year, 24-hour rainfall event for the location of the point source. Thus, the benefit of Option 5 over Option 2 would be the value of eliminating discharges during chronic or catastrophic rainfall events of a magnitude of the 25-year, 24-hour rainfall event or greater. Further benefit would be realized as a resnlt of increased flexibility on the timing of manure application to land. By preventing the rainfall and run-off from mixing with wastewater, CAFOs would not need to operate such that land application dnring storm events was necessary.

EPA is not proposing Option 2 for these sectors. However, EPA notes that at the time of the SBREFA outreach process, removing the 25-year, 24-honr design standard for any sector was not considered largely due to concern that a different design standard would lead to larger lagoons or impoundments. EPA staff explicitly stated this to the SERs and other member of the Panel. Although not extensively discussed, since it did not appear at that time to be an issue, retention of this standard was supported by both the SERs and the Panel. At that time, EPA was not planning to evalnate such an option because of the concern that this would encourage larger lagoons. Since the Panel concluded it outreach, EPA decided to evalnate, and ultimately propose removing this design standard for the veal, swine and poultry subcategories because of reports of lagoon failures resulting from rainfall and poor management. As mentioned praviously, all of these sectors maintain their animals under roof eliminating the need to capture contaminated storm water from the animal confinement area. In addition, most poultry operations generate a dry mannre, which when properly stored, under some type of cover, eliminates any possibility of an overflow in the event of a large storm. Therefore EPA believes that Optioo 5 technology which prevents the introduction of storm water into manure storage is achievable and represents Best Available Technology, without redesigning the capacity of existing manure storage units. However, EPA requests comment on retaining te 25-year, 24-hour storm design standard (and thus basing BAT on Option 2) for these sectors, consistent with its intention at the time of the SBREFA outreach process.

EPA is not proposing to base BAT for the swine, poultry and veal subcategories on Option 3, because EPA believes Option 5 is more protective of the environment. If operators move towards dry manure handling technologies and practices to comply with Option 5, there should be less opportunity for ground water contamination and surface water contamination through a direct hydrological connection. EPA strongly encourages any newly constructed lagoons or anaerobic digesters to be done in such a manner as to minimize pollutant losses to ground water. A treatment lagoon should be lined with clay or synthetic liner or both and solid storage should be on a concrete pad or preferably a glass-lined steel tank as EPA has included in its estimates of BAT costs. Additionally, Option 5 provides the additional non-water quality benefit of achieving reductions in air emissions from liquid storage systems. EPA estimates that the cost of complying with both Option 3 and 5 at existing facilities would be economically unachievable.

EPA believes the proposed technology basis for broilers, turkeys and laying hens with dry manure management will avoid discharges to ground water since the manure is dry and stored in such a way as to prevent storm water from reaching it. Without some liquid to provide a transport mechanism, pollutants cannot move through the soil profile and reach the ground water and surface water through a direct hydrological connection.

EPA is not proposing to base BAT on Option 4 for the same reasons described above for the beef and dairy subcategories.

EPA is not proposing to base BAT on Option 6, because EPA believes that the zero discharge aspect of the selected option will encourage operations to consider and install anaerobic digestion in situations where it will be cost effective.

As with beef and dairy, EPA is not proposing to base BAT for swine, veal and poultry on Option 7, but believes that permit authorities should establish restrictions as necessary in permits issued to CAFOs. Swine, veal and poultry operations should take the timing of manure application into account when developing the PNP. Any areas that could result in pollutant discharge from application of manure to frozen, snow covered or saturated ground should be identified in the plan and manure or wastewater should not be applied to those areas when there is a risk of discharge.

EPA solicits comment on the use of remote liquid level monitoring at livestock operations. As described above in Section VIII.C.3, this technology could provide advanced notification that levels are reaching a critical point, and corrective actions could then be taken. This technology does not prevent precipitation from entering the lagoon and does not prevent overflows, therefore EPA chose not to propose this technology as BAT for swine or veal operations. However, EPA solicits comments on applicability of this technology to livestock operations, especially at swine and veal as an alternative to covers on lagoons.

PNP Requirements

There are a number of elements that are addressed by both USDA's "Guidance for Comprehensive Nutrient Management Plans (CNMPs)" and EPA's PNP which would be required by the effluent guidelines and NPDES proposed rules and is detailed in the guidance document "Managing Manure Nutrients at Concentrated Animal Feeding Operations." EPA's proposed PNP would establish requirements for CAFOs that are consistent with the technical guidance published by USDA experts, but go beyond that guidance by identifying specific management practices that must be implemented. What follows is a brief description of what must be included in a PNP.

General Information. The PNP must have a Cover Sheet which contains the name and location of the operation, the name and title of the owner or operator and the name and title of the person who prepared the plan. The date (month, day, year) the plan was developed and amended must be clearly indicated on the Cover Sheet. The Executive Summary would briefly describe the operation in terms of herd or flock size, total animal waste produced annually, crop identity for the full 5 year period including a description of the expected crop rotation and, realistic yield goal. The Executive Summary must include indication of the field conditions for each field unit resulting from the phosphorus method used (e.g., phosphorus index), animal waste application rates, the total number of acres that will receive manure, nutrient content of manure and amount of manure that will be shipped off-site. It should also identify the manure collection, handling, storage, and treatment practices, for example animals kept on bedding which is stored in a shed after removal from confinement house, or animals on slatted floors over a shallow pull plug pit that is drained to an outdoor in-ground slurry storage impoundment. Finally, the Executive Summary would have to identify the watershed(s) in which the fields receiving manure are located or the nearest surface water body. While the General Information section of a PNP would give a general overview of the CAFO and its nutrient management plan, subsequent sections would provide further detail.

Animal Waste Production. This subsection details types and quantities of animal waste produced along with manure nutrient sampling techniques and results. Information would be included on the maximum number of livestock ever confined and the maximum livestock capacity of the CAFO, in addition to the annual livestock production. This section would provide an estimate of the amount of animal waste collected each year. Each different animal waste source should be sampled annually and tested by an accredited laboratory for nitrogen, phosphorous, potassium, and pH.

Animal Waste Handling, Collection, Storage, and Treatment. This subsection details best menagement practices to protect surface and groundwater from contamination during the handling, collection, storage, and treatment of animal waste. A review would have to be conducted of potential weter contamination sources from existing animal waste handling, collection, storage, and treatment practices. The capacity needed for storage would be calculated.

Feedlot runoff would have to be contained and adequately managed. Runoff diversion structures and animal waste storage structures would have to be visually inspected for: seepage, erosion, vegetation, animal access, reduced freeboard, and functioning rain gauges and irrigation equipment, on a weekly basis. Deficiencies based on visual inspections would have to be identified and corrected within a reasonable time frame. Depth markers would have to be permanently installed in all lagoons, ponds, and tanks. Lagoons, ponds, and tanks would have to be maintained to retain capacity for the 25-year, 24-hour storm event. Dead animals, required to be kept out of lagoons, would have to be properly handled and disposed of in a timely manner. Finally, an emergency response plan for animal waste spills and releases would have to be developed.

Land Application Sites. This subsection details field identification and soil sampling. County(ies) and watershed code(s) where feedlot and land receiving animal waste applications are located would be identified. Total acres of operation under the control of the CAFO (owned and rented) and total acres where animal waste will be applied would be included. A detailed farm map or aerial photo, to be included, would have to indicate: location and boundaries of the operation, individual field boundaries, field identification and acreage, soil types and slopes, and the location of nearby surface waters and other environmentally sensitive areas (e.g., wetlands, sinkholes, agricultural drainage wells, and aboveground tile drain intakes) where animal waste application is restricted.

Separate soil sampling, using an approved method, would have to be conducted every 3 years on each field receiving animal waste. The samples shall be analyzed at an accredited laboratory for total phosphorous. Finally, the phosphorous site rating for each field would have to be recorded according to the selected assessment tool.

Land Application. This subsection details crop production and animal waste application to crop production areas. Details of crop production would have to include: Identification of all planned crops, expected crop yields and the basis for yield estimates, crop planting and harvesting dates, crop residue management practices, and nutrient requirements of the crops to be grown. Calculations used to develop the application rate, including nitrogen credits from legume crops, available nutrients from past animal waste applications, and nutrient credits from other fertilizer and/or biosolids applications would have to be included.

Animal waste application rates cannot exceed nitrogen requirements of the crops. However, animal waste application rates would be limited to the agronomic requirements for phosphorous if the soil phosphorous tests are rated "high", the soil phosphorous tests are equal to ¾, but not greater than twice the soil phosphorous threshold value, or the Phosphorous Index rating is "high." Finally, animal waste could not be applied to land if the soil phosphorous tests are rated "very high", the soil phosphorous tests are greater than twice the soil phosphorous threshold value, or the Phosphorous Index rating is "very high." In some cases, operators may choose to further restrict application rates to account for other limiting factors such as salinity or pH.

Animal wastes cannot be applied to wetlands or surface waters, within 100 feet of a sinkhole, or within 100 feet of water sources such as rivers, streams, lakes, ponds, and intakes to agricultural drainage systems (e.g., aboveground tile drain intakes, agricultural drainage wells, pipe outlet terraces). EPA requests comment on how serious would be the limitations imposed by these requirements. Manure spreader and irrigation equipment would have to be calibrated at a minimum once each year, but preferably before each application period. Finally, the date of animal waste application and calibration application equipment, and rainfall amounts 24-hours before and after application would be recorded.

Other Uses/Off-Site Transfer. The final required subsection for a PNP details any alternative uses and off-site transport of animal wastes. If used, a complete description of alternative uses of animal waste would have to be included. If animal wastes are transported off-site the following would have to be recorded: date (day, month, year), quantity, and name and location of the recipient of the animal waste.

Voluntary Measures. Many voluntary best management practices can be included within various subsections of a PNP. These voluntary best management plans are referenced in EPA's guidance document for PNP "Managing Manure Nutrients at Concentrated Animal Feeding Operations."

Annual Review and Revision. While a PNP is required to be renewed every 5 years (coinciding with NPDES permitting), an annual review of the PNP would have to occur and the PNP would be revised or amended as necessary.

The most likely factor which would necessitate an amendment or revision to a PNP is a change in the number of animals at the CAFO. A substantial increase in animal numbers (for example an increase of greater than 20%) would significantly increase the volume of manure and total nitrogen and phosphorous produced on the CAFO. Because of this, the CAFO will need to re-evaluate animal waste storage facilities to ensure adequate capacity, and may need to re-examine the land application sites and rates.

A second reason which would require an amendment or revision to a PNP is a change in the cropping program which would significantly alter land application of animal waste. Changes in crop rotation or crop acreage could significantly alter land application rates for fields receiving animal waste. Also the elimination or addition of fields receiving animal waste application would require a change in the PNP.

Changes in animal waste collection, storage facilities, treatment, or land application method would require an amendment or revision to a PNP. For example, the addition of a solid-liquid separator would change the nutrient content of the various animal waste fractions and the method of land application thereby necessitating a revision in a PNP. Changing from surface application to soil injection would alter ammonia volatilization subsequently altering animal waste nutrient composition requiring a revision of land application rates.

When CAFOs Must Have PNPs. EPA proposes to allow two groups of CAFOs up to 90 days to obtain a PNP:

3. Existing CAFOs which are being covered by a NPDES permit for the first time; or

4. Existing CAFOs that are already covered under an existing permit which is reissued within 3 years from the date of promulgation of these regulations.

EPA proposes that all other existing CAFOs must have a PNP at the time permits are issued or renewed.

7. New Source Performance Standards

For purposes of applying the new source performance standards (NSPS) being proposed today, a source would be a new source if it commences construction after the effective date of the forthcoming final rule. (EPA expects to take final action on this proposal in December 2002, which is more than 120 days after the date of proposal—see 40 CFR 122.2). Each source that meets this definition would be required to achieve any newly promulgated NSPS upon commencing discharge.

In addition, EPA is proposing additional criteria to define "new source" that would apply specifically to CAFOs under Part 412. EPA intends that permit writers will consult the specific "new source" criteria in Part 412 rather than the more general criteria set forth in 40 CFR 122.29(b)(1). The other provisions of 40 CFR 122.29 continue to apply. EPA proposes to consider an operation as a new source if any of the following three criteria apply.

The definition of new source being proposed for Part 412 states three criteria that determine whether a source is a "new source."

First, a facility would be a new source if it is constructed at a site at which no other source is located. These new sources have the advantage of not having to retrofit the operation to comply with BAT requirements, and thus can design to comply with more stringent and protective reqnirements.

The second criterion for defining a new source would be where new construction at the facility "replaces tho housing, waste handling system, prodnction process, or production eqnipment that causes the discharge or potential to discharge pollutants at an existing source." Confinement housing and barns are periodically replaced, allowing the opportunity to iustall improved systems that provide increased environmental protection. The modern confinement honsing used at many swine, dairy, veal, and poultry farms allows for waste handling and storage in a fashion that generates little or no process water. Such systems negate the need for traditional flush systems and storage lagoons, reduce the risks of nncontrollable spills, and decrease the costs of transporting manure.

Third, a source would be a new source if constructiou is begun after the date this rule is promulgated and its production area and processes are substantially independent of an existing source at the same site. Facilities may construct additional production areas that are located on one contiguous property, without sharing waste management systems or commingling waste streams. Separate production areas may also be constructed to help coutrol biosecurity. New production areas may also he constructed for entirely different animal types, in which case the more stringent NSPS requirements for that subcategory would apply to the separate and newly constructed production area. Iu determining whether production and processes are suhstantially indopendent, the permit authority is directed to consider such factors as the extent to which the new production areas are integrated with the existing production areas, and the extent to which the new operation is engaging in the same general type of activity as the existing source.

EPA also considered whether a certain level of facility expansion, measured as an increase in animal production, should cause an operation to be subject to new source performance standards. If so, upon facility expansion, the CAFO would need to go beyond compliance with BAT requirements to meet the more stringent standards represented by NSPS. In today's proposal, that increment of additional control, for the swine, poultry and veal snbcategories, would amount to the need to monitor ground water and install liners in lagoons and impoundments to prevent discharges to ground water that has a direct hydrological connection to surface water; unless tho CAFO could demonstrate that no such direct hydrological link existed. In the beef and dairy subcategories, the NSPS proposed today are the same as the BAT standards.

The Agency, however, decided against proposing to identify facility expansion as a trigger for the application of NSPS. Many CAFOs oversize or over-engineer their waste handling systems to accommodate future increases in production. Thus, in many cases, the actual increases in production may not preseut a new opportunity for the CAFO to install the additional NSPS technologies—e.g. liners. To install liners, these operations would need to retrofit their facilities the same as existing sources would. EPA has explained above that such retrofitting would not be economically achievable in these animal sectors. Similarly, the costs associated with these requirements wonld represent a barrier to the expansion. Therefore, it would not be appropriate to require these operations, upon facility expansion, to meet the additional ground water-related requirements that are a part of today's proposed NSPS.

EPA considered the same seven options for new source performance standards (NSPS) as it considered for BAT. EPA also considered an additional option for new dairies, which if selected, would prohibit dairies from discharging any manure or process wastewater from animal confinement and manure storage areas (i.e., eliminating the allowance for discharging overflows associated with a storm event). New sources have the advantage of not having to retrofit the operation to comply with the requirements and thus can design the operation to comply with more stringent requirements. In selecting new sourca performance standards, EPA evaluates whether the requirements under consideration would impose a barrier to entry to new operations.

EPA is proposing to select Option 3 as the basis for NSPS for the beef and dairy subcategories. Option 3 includes all the requirements proposed for existing sources including complying with zero discharge from the production area except in the event of a 25-year, 24-hour storm and the requirement to develop a PNP which establishes the rate at which manure and wastewater can be applied to crop or pasture land owned or controlled by the CAFO. The application of manure and wastewater would be restricted to a phosphorus based rate where necessary depending on the specific soil conditions at the CAFO. Additionally, other best management practice requirements would apply, including the prohibition of manure and wastewater application within 100 feet of surface water. The proposed new source standard for the beef and dairy subcategories includes a requirement for assessing whether the ground water beneath the production area has a direct hydrological connection to surface water. If a direct hydrological connection exists, the operation must conduct additional monitoring of ground water np gradient and down gradient from the production area, and implement any necessary controls based on the monitoring resnlts to ensure that zero discharge to surface water via the ground water route is achieved for manure stockpiles and liquid impoundments or lagoons. For the purpose of estimating compliance costs, EPA has assumed that operations located in areas with a direct hydrological connection will install synthetic material or compacted clay liners beneath any liquid manure storage and construct impervious pads for any dry manure storage areas. The operator wonld be required to collect and analyze ground water samples twice per year for total dissolved solids, chlorides, uitrate, ammonia, total coliforms and fecal coliform. EPA believes that Option 3 is economically achievable for existing sonrces. Since new sources are able to install impermeable liners at the time the lagoon or impoundment is being constructed, rather than retrofitting impoundments at existing source, costs associated with this requirement shonld be less for new sources in comparison to existing sources. EPA has concluded that Option 3 requirements will not pose a barrier to entry for new sources.

EPA is proposing to establish NSPS for all swine and poultry operations based on Option 5 and Option 3 combined. In addition the BAT requirements described in Section VIII.C.6, the proposed new source standards would require no discharge via any ground water that has a direct hydrological link to surface water. As described above, Option 3 requires all CAFOs to monitor the ground water and impose appropriate coutrols to ensure compliance with the zero discharge standard, nnless the CAFO has demonstrated that there is no direct hydrological link between the ground water and any surface waters. The proposed new source standard also restricts land application of manure and wastewater to a phosphorus based rate where necessary depending on the specific soil conditions at the CAFO. Additionally, other best management practice requirements would apply, including that application of manure and wastewater would be prohibited within 100 feet of surface water.

EPA encourages new swine and poultry facilities to be constructed to use dry manure handling. Dry manure handling is currently the standard practice at broiler and turkey operations. As described previously, some existing laying hen operations and most hog operations use liquid manure handling systems. The proposed new source performance standard would not require the use of dry manure handling technologies, bnt EPA believes this is the most efficient technology to comply with its requirements.

EPA has analyzed costs of installing dry manure handling at new laying hen and swine operations. Both sectors have operations which demonstrate dry manure handling can be used as an effective manure management system. The dry manure handling systems considered for both sectors require that the housing for the animals be constructed in a certain fashion, thus making this practice less practical for existing sources. Both sectors have developed a high rise housing system, which houses the animals on the second floor of the building allowing the manure to drop to the first floor or pit. In the laying hen sector this is currently a common practice and with aggressive ventilation, the manure can be maintained as a dry product. Hog manure has a lower solids content, thns the manure must be mixed with a bedding material (*e.g.*, wood chips, rice or peanut hulls and other types of bedding) which will absorb the liquid. To further aid in drying the hog manure, air is forced up through pipes installed in the concrete floor of the pit. With some management on the part of the CAFO operator, involving mixing and turning the hog mauure in the pit periodically, the manure can be composted while it is being stored. The advantages of the high rise system for hogs and laying hens include a more transportable manure, which, in the case of the hog high rise system, has also achieved a fairly thorough decomposition. The air quality inside the high rise house is greatly improved, and the potential for leaching pollutants into the groundwater is greatly reduced. The design standard of these high rise houses include concrete floors and also assume that the manure would be retained in the building until it will be land applied, thus there is no opportunity for storm water to reach the manure storage and virtually no opportunity for pollutants to leach to groundwater beneath the confinement house. EPA believes that the cost savings associated with ease of manure transportation, as well as improved animal health and performance, with the dry manure handling system for hogs will off-set the increased cost of operation and maintenance associated with the high rise hog system. Thus, EPA concludes the high-rise house does not pose a barrier to entry and is the basis for NSPS in both the laying hen and hog sectors. Although the high rise house is the basis of the new source standards for the swine and laying hen sectors, operations are not prevented from constructing a liqnid manure handling system. If new sources in these sectors choose to construct a liquid manure handling system, they would be required to line the lagoons if the operation is located in an area that has a direct hydrologic connection, but the cost associated with lining a lagoon at the time it is being constructed is much less than the cost to retrofit lagoon liners.

EPA proposes to establish new source requirements for the veal snbcategory on the basis of Option 5 which requires zero discharge with no overflow from the production area aud Option 3 which requires zero discharge of pollutants to groundwater which has a direct hydrological connection to surface water, with the ground water mouitoring or hydrological assessment requirements described above. EPA believes that a zero discharge standard without any overflow will promote the use of covered lagoons, anaerobic digesters or other types of manure treatment systems. Additionally, this will minimize the use of open air manure storage systems, thus reducing emission of pollutants from CAFOs.

New veal CAFOs would not be expected to modify existing housing conditions since EPA is not aware of any existing veal operations that use dry manure handling systems. New veal CAFOs would be expected to also use covered lagoons, or anaerobic digesters to comply with the zero discharge standard. New veal CAFOs would be required to line their liquid manure treatment or storage structures with either synthetic material or compacted clay to prevent the discharge of pollutants to ground water which has a direct hydrological connection to surface water. In addition, the CAFO would have to monitor the groundwater beneath the production area to ensure compliance with the zero discharge requirement. Tbe CAFO wonld not need to install liners or monitor ground water if it demonstrates that there is no direct hydrologic link between the ground water and any surface waters.

In addition to the seven options considered for both existing and new sources, EPA also investigated a new source option for dairies that would prohibit all discharges of manure and process wastewater to surface waters, eliminating the current allowance for the discharge of the overflow of runoff from the production area. To comply with a zero discharge requirement, dairies would need to transform the operation so they could have full control over the amount of manure and wastewater, including any runoff, entering impoundments. Many dairies have drylut areas where calves, heifers, and bulls are confined, as well as similar drylot areas where the mature cows are allowed access. EPA estimated compliance costs for a zero discharge requirements assuming that the following changes would occur at new dairies:

(1) Freestall barns for matnre cows would be constructed with six months underpit manure storage, rather than typical flush systems with lagoon storage;

(2) Freestall barns with six months underpit manure storage would be constructed to house heifers;

(3) Calf barns with a scrape system would be constructed with a scrape system aud six months of adjacent manure storage; and

(4) New dairies would include covered walkways, exercise areas, parlor holding, and handling areas.

Drylot areas are continually exposed to precipitation. The amount of contamiuated runoff from such areas that must be captured is directly related to the size of the exposed area and the amount of precipitation. Under the current regulations, dairies use the 25-year, 24-hour rainfall event (in addition to other considerations) when determining the necessary storage capacity for a facility. Imposing a zero discharge requirement that prevents any discharge from impoundments would force dairies to reconfigure in a way that provides complete control over all sonrces of wastewater. EPA considered the structural changes in dairy design described here to create a facility that eliminates the potential for contaminated runoff.

While EPA believes that confining all mature and immature dairy cattle is technically feasible, tha costs of zero discharge relative to the costs for Option 3 are very high. Capital costs to comply with zero discbarge increase by two orders of magnitude. EPA estimates annual operating and mainteuance costs would rise between one to two orders of magnitude above the costs for Option 3. These costs may create a barrier to entry for new sonrces. In addition, EPA believes selecting this option could have the unintended consequence of enconraging dairies to shift calves and heifers offsite to standalone heifer raising operations (either on land owned by the dairy or at contract operations) to avoid building calf and heifer barns. If these offsite calf/heifer operations are of a size that they avoid being defined as a CAFO, the manure from the immature auimals would not be subject to the effluent guidelines.

EPA is not basing requirements for new dairies on the zero discharge option for the reasons discussed above. EPA solicits comment on the approach used to estimate the costs for new dairies to comply with a zero discharge requirement. Comments are particularly solicitod on aspects such es: converting from flnsh systems to underpit manure stnrage; types of housing for calves and heifers; and whether the potential for nncontrollable amounts of precipitation runoff have been sufficiently eliminated (including from silage). EPA also solicits comment on a regulatory scenario that wonld establish a zero discharge requirement for manure and process wastewater from barns (housing either mature or immature dairy cattle) and the milking parlor, but would maintain the current allowance for overflow of runoff from drylot arees.

As an alternative to underpit manure storage, dairies could achieve zero discharge for parlor wastes and barn flush water by constructing systems such as anaerobic digesters and covered lagoons. These covered systems, if properly nperated, can facilitate treatment of the menure and offer opportunities to reduce air emissions. The resulting liqnid and solid wastes would be more steble than untreated manure. EPA solicits comment ou the nsefulness of applying stabilization or treatment standards to liquid and slurry manures prior to land application. Commenters encouraging the use of such standards should recommend appropriate measurement parameters such as volatile solids, BOD, COD, and indicator organism reduction(s) to establish stability or treatment levels.

EPA has not identified any basis for rejecting the zero discharge option for dairies solely due to animal health reasons. EPA solicits comment on the technical feasibility of confining mature and/or immature dairy cettle in barns at all times.

Ten-year protection period. The NSPS that are currently codified in part 412 will continue to have force and effect for a limited universe of CAFOs. For this reason, EPA is proposing to retaiu the NSPS promulgated in 1974 for part 412. Specifically, following promulgation of the final rule that revises part 412, the 1974 NSPS would continue to apply for a limited period of time to certain new sources and new dischargers. See CWA section 306(d) and 40 CFR 122.29(d). Thus, if EPA promulgates revised NSPS for part 412 in December 2002, and those regulations take effect in January 2003, qualified new sources and new dischargers that commeuced discharge after January 1993 but before January 2003 would be snbject to the currently codified NSPS for ten years from the date they commenced discharge or until the end of the period of depreciation or amortization of their facility, whichever comes first. See CWA section 306(d) and 40 CFR 122.29(d). After that ten year period expires, any new or revised BAT limitations would apply with respect to toxic and nonconventional pollutants. Limitetions on conventional pollutants would be based on the1974 NSPS unless EPA promnlgates revisions to BPT/BCT for conventional pollutants that arc more stringent then the 1974 NSPS.

Rather than reproduce the 1974 NSPS in the proposed rule, EPA proposes to refer permitting authorities to tho NSPS codified in the 2000 edition of the Code of Federal Regulations for use during the applicable ten-year period.

8. Pretreatment Standards for New or Existing Sources (PSES AND PSNS)

EPA is not proposing to establish Pretreetment Standards for either new or existing sources. Fnrther, EPA is withdrawing the existing provisions entitled "Pretreatment standards for existing sources" at §§ 412.14, 412.16, 412.24, 412.26. Those existing provisions establish no limitations. The vest majority of CAFOs are located in rural areas that do not heve access to municipal treatment systems. EPA is not aware of any existing CAFOs that discharge wastewater to POTWs at present and does not expoct new sources to be constructed in areas where POTW access will he available. For those reasons, EPA is not establishing nationel pretreatment standards. However, EPA also wants to make it clear that if a CAFO discharged wastewater to a POTW, local pretreatment limitations could be established by the Control Authority. These local limits are similar to BPJ requirements in en NPDES permit.

9. Effluent Guidelines Controls for Pathogens

The third most common reason for waterbodies being listed on State § 303(d) lists as an impaired watershed is pathogens. Degradation of surface waters by excessive levels of pathogens has been attributed to several sources, including natural wildlife, faulty septic systems, and animal agriculture. As described in Section 5, stream water quality may be impacted by animal feeding operations due to feedlot surface runoff, spills from liqnid impoundments, tile drain effluent, leaching and runoff from land receiving manure, and seepage from waste storage. Degradation of aquatic and riparian habitat also occurs when animal grazing operations are poorly managed.

In today's notice, EPA is not setting specific requirements for the control of pathogens. The proposed BAT is expected tn reduce pathogens to surface weters through the implementation of the zero discharge requirements at the productiou area, and through the implementation of the PNP at the land application area. Even without explicit reqnirements or limits for pathogen controls, EPA expects considerable reduction in the discharge of pathogens for reasons described below. Runoff simulations and loadings analysis predict a 50% reduction in fecal coliforms and a 60% reduction in fecal streptococci under the regulatory scenario proposed today. Following this proposal, EPA intends to further analyze technologies for the treatment or reduction of pathogens in manure, and solicits comment on other approaches to control pathogens.

One mechauism for pathogen discharge to surface waters is catastrophic spills, whether caused by intentional discharges or through overflow following major storms. EPA expects the requirements for no discharge from the prodnction area, as well as routine inspection and mandatory menagement practices for the control of liquid impoundmeut levels, will reduce catastrophic spills. For the swine and ponltry sectors EPA believes the elimination of the storm event et which an overflow is allowed will also reduce discharge of pathogens. At the production area, operators wonld be required to handle enimal mortalities in a manner so as to prevent contamination of surface water. The proper use of manure as a fertilizer, as specified in the proposed regulations, may resnlt in increased storage capacity and longer retention times of both liquid and solid manure storage, allowing increased opportunity for natural die-off of pathogens. For example, runoff from fields receiving poultry litter that had been stored prior to application showed no significant difference in pathogen content in runoff from control fields (GEIS, 1999), supporting the conclusion that pathogen reductions will occur from increased storage times.

Application rate has been identified as the single most important manure management practice affecting pollution of surface waters from fields receiving manure. Other practices affecting pathogen content in the runoff include amount of application, incorporation methods, tillage, saturation of the receiving field, and elapsed time following application before a rainfall. In one case study, swine lagoon effluent applied to tile drained fields at 1.1 inches showed no difference in runoff quality than the control fields, but application at three times the rate showed high levels of fecal coliform in the surface water. Fecal bacteria in runoff from land receiving fresh manure may often be a significant proportion of the fecal contamination measured in the surface waters. Vegetated filter strips are useful in removing pollutants from runoff on manured fields, particularly nutrients and sediment, but have not been identified as generally effective in reducing bacterial concentrations in the runoff. Surface applications of manure are more likely to result in fecal coliform transport when the soil is saturated, particularly in fine sandy loam soils.

EPA believes nutrient management practices and rates established in the PNP would limit the quantity of nutrients that may be applied to fields and will reduce the occurrence of manure application to saturated soils, or when a heavy storm event is predicted. Nutrient loss to surface water under these conditions would result in reduced crop yields and would be reflected in revisions made to the PNP in subsequent years translating to a lower manure application rate.

EPA has collected data on technologies useful in treating manure and wastes for pathogens. Anaerobic digesters and even simple manure storage for an extended period of time promote pathogen reductions through selective growth conditions and natural die-off over time. The addition of heat, such as is used in thermophilic digesters, further reduces pathogens. Proper composting processes also involve high temperatures—achieving temperatures approaching 140 degrees F in the pile. Heat treatment over several days is likely to kill protozoans such as Giardia and Cryptosporidium. The addition of lime to achieve high alkaline conditions, e.g., achieving a $pH \geq 12$, also is effective at killing many pathogens by disrupting the cell membrane or disrupting virus viability.

EPA will continue to analyze the performance and applicability of treatments to reduce pathogens in CAFO waste, and will analyze the costs of these processes. The processes described above and others used to significantly reduce pathogens in biosolids or sewage sludge such as heat treatment, drying, thermophilic aerobic digestion, pasteurization, disinfection, and extended storage will be analyzed for their applicability to animal manures. EPA will give consideration to establishing the same performance standards as required for Class A sludge in Part 503. If supported by appropriate data, the final rule could establish these or other appropriate standards as performance standards that the wastes would be required to meet prior to land application. The CAFO would need to demonstrate achievement of these standards prior to land application because of the impracticability of measuring the pollutant loadings in any eventual runoff from the land application areas to the waters. EPA solicits comment on this possible approach and specifically requests data relating to pathogen treatment and reductions that are demonstrated to be effective on CAFO waste. EPA also solicits data on management practices that can be applied to the land application of manure, which may reduce pathogens in runoff.

10. Antibiotics

Related to concerns over pathogens in animal manures are concerns over antibiotics and other pharmaceuticals that may be present in the manure. As discussed in Section V, an estimated 60–80% of all livestock receive antibiotics. Some antibiotics are metabolized, and some are excreted with the manure. In cases where antimicrobials are administered to animals through the feed, spilt feed and wastelage may contribute to antibiotic content of the waste storage. The presence of antibiotics in manure and the environment has been shown to result in antibiotic resistant pathogens. EPA solicits comments on the direct effects of antibiotic residues and antimicrobial resistance, specifically on how manure management may contribute to the problem of antibiotics reaching the environment and contributing to pathogen resistance. EPA also solicits data and information on effective treatment or practices that may be implemented by CAFOs to reduce these releases.

IX. Implementation of Revised Regulations

A. How Do the Proposed Changes Affect State CAFO Programs?

EPA is proposing a number of changes to the effluent guidelines and the NPDES permit regulations for CAFOs in today's proposed rule. Under 40 CFR 123.25, authorized NPDES State programs must administer their permit programs in conformance with NPDES requirements, including the requirements that address concentrated animal feeding operations (§ 122.23) and the incorporation of technology-based effluent limitation guidelines and standards in permits (§ 122.44). Thus, today's proposed rule would require the 43 States [note that State is defined in § 122.2] with authorized NPDES permit programs for CAFOs to revise their programs as necessary to be consistent with the revised federal requirements. Current NPDES regulations note that authorized NPDES State permit programs are not required to be identical to the federal requirements; however, they must be at least as stringent as the federal program. States are not precluded from imposing requirements that are more stringent than those required under federal regulations.

Any State with an existing approved NPDES permitting program under section 402 must be revised to be consistent with changes to federal requirements within one year of the date of promulgation of final changes to the federal CAFO regulations [40 CFR 123.62(e)]. In cases where a State must amend or enact a statute to conform with the revised CAFO requirements, such revisions must take place within two years of final changes to the federal CAFO regulations. States that do not have an existing approved NPDES permitting program but who seek NPDES authorization after these CAFO regulatory provisions are promulgated must have authorities that meet or exceed the revised federal CAFO regulations at the time authorization is requested.

In States not authorized to administer the NPDES program, EPA will implement the revised requirements. Such States may still participate in water quality protection through participation in the CWA section 401 certification process (for any permits) as well as through other means (e.g., development of water quality standards, development of TMDLs, and coordination with EPA).

EPA is aware that the majority of States authorized to implement the NPDES program supplement the NPDES CAFO requirements with additional State requirements, and some States currently regulate or manage CAFOs predominantly under State non-NPDES programs. It has been snggested that EPA provide a mechanism through which State non-NPDES CAFO programs can be racognized alternatives that would be authorized nnder the CWA.

No permit issued by a non-NPDES program will satisfy the NPDES permit requirement. Facilitias required to be covered by a NPDES permit must obtain a permit from an agency authorized to issne a NPDES permit. However, EPA believes that the current NPDES program provides a reasonable degree of flexibility consistent with CWA requirements, and that the proposed CAFO regnlation provides opportunities to incorporate State programs in several ways.

It is possible for non-NPDES State programs that cnrrently regulate AFOs to gain EPA's approval as NPDES-authorized programs. Such a change would require a formal modification of the State's approved NPDES program, and the State wonld have to demonstrate that its program meets all of the minimum criteria specified in 40 CFR Part 123, Subpart B for substantive and procedural regulations. Among other things, these criteria include the restriction that permit terms may not exceed 5 years, and include provisions on public participation in permit development and enforcement, and EPA enforcement authority.

In addition, today's proposal provides specific flexibility on particular issues. First, with regard to the off-site transfer of manure, EPA is requiring under one co-proposed option that the CAFO operator obtain a certification from recipients that, if they intend to land apply the manure, it will be done according to appropriate agricultural practices. EPA is proposing to waive this reqnirement in a State that is implementing an effective program for addressing excess manure generated by CAFOs. Second, EPA is proposing to require that processors be permitted, or co-permitted, along with their contract producers. EPA is requesting comment on an option that would waive this requirement in certain instances in States with effective programs for managing excess manure. EPA is also soliciting comment on oue particnlar type of program, an Environmental Management System developed by the processor, as sufficient to waive co-permitting reqnirements. EPA is interested in comments on other specific requirements of today's proposal that might be satisfied in whole or in part by State program requirements. This could inclnde ways to ensnre that states with unique programs that meet or exceed the provisions of the revised regulations and the CWA reqnirements could utilize their own programs that include similar objectives such as enhanced water quality protection, public participation and accountability.

A third possible means of providing flexibility for States would be available if the three-tier regulatory structure is adopted in the final regulation. In the three-tier structure, all facilities over 1,000 AU would be considered CAFOs by definition, and those between 300 AU and 1,000 AU would be CAFOs only if they meet one of several conditions, described in detail in Section VII.B.3, or if designated by the permit authority as a significant contributor of pollution to waters of the U.S. Those with fewer that 300 AU would become CAFOs only if designated by the permit authority. A State with an effective non-NPDES program could succeed in helping many operations avoid permits by ensuring they do not meet any of the conditions that would define them as CAFOs.

EPA is also soliciting comment on whether or not to adopt both the two-tier and the three-tier structures, and to provide a mechanism to allow States to select which of the two alternative proposed structnres to adopt in their State NPDES program. Under this option, a State could adopt the structure that best fits with the administrative strncture of their program, and that best serves the character of the industries located in their State and the associated environmental problems. This option is viable only if the Agency is able to determine that the two structnres provide substantially similar environmental benefits by regulating equivalent numbers of facilities and amounts of manure. Otherwise, States would be in a position to choose a less stringent regulation, contrary to the requirements of the Clean Water Act. A discussion of this option can be found in Section VII.B.4.

The requirements for State NPDES program authorization are specified under § 402(b) of the CWA and within the broad NPDES regulations (40 CFR Part 123). These provisions set out specific requirements for State authorization applicable to the entire NPDES program and the Agency does not believe that broad changes to these requirements are appropriate in this proposed rulemaking.

B. How Would EPA's Proposal to Designate CAFOs Affect NPDES Authorized States?

Today's proposal would provide explicit authority, even in States with approved NPDES programs, for the EPA Regional Administrator to designate an AFO as a CAFO if it meets the designation criteria in the regulations. EPA's authority to designate AFOs as CAFOs would be subject to the same criteria and limitations to which State designation authority is subject. However, EPA does not propose to assume authority or jurisdiction to issue permits to the CAFOs that the Agency designates in approved NPDES Stetes. That authority would remain with the approved State. EPA requests comment on this prosed new designation authority.

C. How und When Will the Revised Regulations be Implemented?

EPA anticipates that this these proposed regulations will be promulgated as final regulations in December, 2002, and published in the **Federal Register** shortly thereafter (approximately Jannary, 2003). As mentioned, authorized States programs will need up to two years after that date to revise their programs to reflect the new regulations. Following a State's revision of its program and approval of the revisions by EPA, we expect many States to want additional time to develop new or revised CAFO general permits. EPA believes it is reasonable to allow States one additional year to develop these new or revised general permits. To summarize, some States will need until approximately January 2006—i.e., three years after the final rule is published—before they can make CAFO general permits available that reflect the new regulations in the State.

At the same time, once these regulations are finalized, we estimate that there will be a large number of operations that will need to apply for a permit, described in Section VII.B.4. It is important to take into account that some States will not be making CAFO general permits available to these facilities until three years after the final rule. If EPA were to make the new Part 122 regnlations effective shortly after we issue the final rule (January 2003), there would be large numbers of facilities that would be newly defined as CAFOs at that time. They would be required to apply for a permit right away, bnt States would not be able to issue general permits at that time or a large nnmber of individual permits all at once. This would leave the facilities potentially in the detrimental position of being unpermitted dischargers.

To avoid this situation, EPA proposes that the revisions to the CAFO definition in part 122 (including, for example, changes to the threshold number of animals to qualify as a CAFO and other changes such as the elimination of the 25-year, 24-hour storm exemption) would not take effect until three years after publication of the final rules. See proposed section 122.23(f). We expect, therefore, that these changes would not take effect until approximately January, 2006. Operations that are brought within the regulatory definition of a CAFO for the first time under these regulatory revisions would not be defined as CAFOs under final and effective regulations until that date.

EPA also considered an alternate approach in which the effective date for the part 122 revisions would be different in each State, depending on when the State actually adopted and got approval for the changes and issued general permits. An advantage of this approach would be that the new regulations would potentially be effective at an earlier date, i.e., before January 2006, in some States. EPA is not proposing this approach, however. We decided that it would be preferable to provide one uniform effective date for these particular revisions, which would provide necessary clarity and consistency to the national NPDES program for CAFOs. EPA does seek comment, however, on which approach would be preferable to adopt in the final regulations. States, however, are free to implement more stringent requirements, and may choose to implement the revised CAFO definition at an earlier date.

It should be noted that EPA is proposing this delayed effective date only for the proposed regulatory changes that affect which operations would be defined as CAFOs. There is no need to delay the effective date of any of the other revisions EPA is proposing to the CAFO regulations at 40 CFR part 122, such as those that specify land application requirements and other requirements. These other revisions to the part 122 regulations would become effective 60 days after publication of the final regulations (January 2003). For any operation that is a CAFO according to the current definition and that is being permitted after that date, or having its permit renewed, the permit would be developed under these new part 122 provisions.

EPA is proposing that the revised effluent guidelines, once promulgated as final regulations, would be effective 60 days after promulgation. The 1989 statutory deadline for meeting BAT has long passed, and we do not believe there is any reason why permit writers could not begin incorporating the revised effluent guidelines into permits beginning 60 days after promulgation.

If a CAFO submits a timely application for a permit renewal, but has not received a decision on that application prior to the expiration date of the original permit, then the original permit would be administratively "continued" until there is a decision from the permit authority on the new application (in EPA-administered States and States with comparable administrative procedure laws). If that continuance lasts beyond the date that is the effective date of the revised NPDES regulations and effluent guidelines, then the CAFO's new permit would reflect both sets of new regulations.

EPA also proposes to adopt specific timing requirements in the permit with respect to the CAFO's development of PNPs. As described in Section VIII, EPA proposes to establish BAT as encompassing the following timing requirements: (1) for all new permittees and for applicants who hold existing individual permits, compliance with the PNP would be an immediate requirement of the permit. Therefore, the draft PNP must be submitted to the permit authority along with the permit application or NOI; the final PNP must be adopted by the permittee within 90 days of being permitted; (2) for applicants who are authorized under an existing general permit, the permittee must develop a Permit Nutrient Plan within 90 days of submittal of the NOI; and (3) the PNP for all CAFOs would need to include milestones for implementation. This time is necessary because, while operators can begin preparing necessary data, it would be difficult to develop a PNP before the permit authority issues a final permit that specifies the terms and conditions of the permit. (Operators of existing CAFOs with individual NPDES permits, who must submit their draft PNP with the permit application, are expected to reapply for coverage under the revised regulation early enough to provide time to develop its PNP without causing a lapse in coverage.) For facilities that have been designated as CAFOs, the permit writer will develop the implementation schedule in order to provide reasonable time to prepare the PNP.

Prior to the effective date of the revised regulations, State and EPA permit authorities will be issuing permits to facilities that currently meet the definition of a CAFO under the existing regulations or that have been designated as CAFOs. Consistent with the AFO Strategy, discussed in section III.B., during 2000 to 2005 States with authorized NPDES programs are to focus on issuing permits to the largest CAFOs, those with 1,000 AU or greater. In States where EPA is the permit authority, EPA will issue permits to operations defined as CAFOs that are over 300 AU. The permits are valid for a maximum of five years, at which time these facilities would obtain new permits under the revised regulation.

One of the significant changes to the NPDES and ELG regulation for CAFOs will be the requirement to develop and implement Permit Nutrient Plans that are developed, or reviewed and approved, by certified planners. Concern has been raised about the availability of the necessary expertise to develop and certify the plans. EPA believes that there will be sufficient lead time before this regulation is implemented to expect the market to have developed the CNMP and PNP planning expertise and infrastructure because, during this period, CNMPs will be developed under both the USDA voluntary program and EPA's Round I permitting.

For facilities subject to the requirements of the revised regulation, EPA anticipates that during the period between the time this regulation is promulgated and the time it is effective, operators will be able to anticipate the status of their facilities, and therefore can begin gathering data that will be needed for the Permit Nutrient Plan and other requirements, such as soil type, manure sampling, cropping information, and other data needed to calculate the allowable manure application rate. (Note: States are supposed to have adopted their NRCS 590 standard by May 2001.)

EPA also proposes that CAFOs that are new sources may not receive permit coverage until the PNP is developed. In this case, a complete application must include the PNP. The owner or operator of a new facility is expected to design and construct the new facility in a manner that anticipates the ELG and NPDES requirements for manure management, rather than incurring the costs of retrofitting an already constructed facility.

EPA recognizes that some practices such as liners and groundwater wells for beef and dairy operations may take time to implement. The PNP will include a schedule for implementing the provisions of the PNP, including milestones with dates.

Facilities Constructed After the Proposed Regulation is Published. EPA is soliciting comment on whether the revised regulations should apply 60 days after publication of the final rule to facilities that commence operation after that date, even if they would not be defined as a CAFO under the existing rules. Although EPA is proposing to delay for three years the effective date of the proposed regulations for existing facilities that are not currently defined as CAFOs, it is considering whether to require all facilities defined as CAFOs under the final rule that commence operation after the final rule is published to obtain an NPDES permit and comply with the other requirements of the final rule. For example, a dry poultry operation or an animal feeding operation of 501 cattle that is constructed during the three year period after publication of the final rule might be required to comply immediately with the revised regulations rather than remaining outside the scope of the NPDES program until three years after publication of the final rule.

Requiring newly constructed facilities to obtain permits does not pose the same problem as requiring all existing AFOs which are not defined as CAFOs under the current rule to obtain permits immediately after promulgation of the final rule. Once a new definition of a CAFO becomes effective, a large number of existing facilities would need a permit on the same date. EPA expects that most existing facilities will seek coverage under a general permit. However, EPA and authorized States will need some time after the final rule is promulgated to develop those general permits. An existing facility would face the dilemma of either ceasing operations or discharging without a permit if it was required to obtain a permit but none was available. By contrast, new facilities would commence operation over a period of time and present less of a burden on permit authorities. If a general permit was not available, issuing individual permits to the smaller number of newly constructed facilities would present less of a burden. If all else fails, a newly constructed facility could not commence operation until it had a permit. This approach would be consistent with EPA's general approach for regulation of new sources and new dischargers, who are required to obtain an NPDES permit (and comply with any applicable NSPS) prior to commencing operation. See 40 CFR 122.29, 124.60(a). Finally, unlike an existing facility, a newly constructed facility is in a better position to plan its facility to comply with the revised regulations.

If EPA did not delay the effective date for facilities that are constructed after the final rule is published, the rule would address additional sources sooner. On the other hand it would further complicate the regulatory structure because it would temporarily create another category of facilities. EPA solicits comments on whether all provisions of the rule should be effective 60 days after the final rule is published for facilities that are constructed after that date.

D. How Many CAFOs are Likely to be Permitted in Each State and EPA Region?

Tables 9–1 and 9–2 delineate the number of facilities, in each State and EPA Region, that are expected to be affected by either of today's proposed two-tier and three-tier structures, respectively. In both proposed structures, all CAFOs with more than 1,000 AU would be required to apply for a NPDES permit. The differences lie primarily in how the middle-sized operations are affected.

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Table 9-1. Projected Estimated Number of Potential CAFOs Potentially Regulated Under the Three-Tier Structure by Region, State and Size

EPA Region	State	<300 AU		300-1,000 AU		>1,000 AU		Total	
			Regional Subtotal		Regional Subtotal		Regional Subtotal		Regional Subtotal
Region 1	Connecticut	0		39		9		48	
	Maine	0		60		8		68	
	Massachusetts	0		41		7		48	
	New Hampshire	0		29		4		33	
	Rhode Island	0		5		0		5	
	Vermont	0		129		15		144	
			0		**303**		**43**		**346**
Region 2	New Jersey	0		27		6		33	
	New York	0		514		79		593	
			0		**542**		**85**		**627**
Region 3	Delaware	0		332		97		429	
	Maryland	0		437		137		573	
	Pennsylvania	0		628		321		949	
	Virginia	0		551		216		767	
	West Virginia	0		135		75		210	
			0		**2,084**		**845**		**2,929**
Region 4	Alabama	0		1,224		557		1,782	
	Florida	0		247		169		416	
	Georgia	0		1,360		834		2,193	
	Kentucky	0		233		179		412	
	Mississippi	0		766		433		1,199	
	N. Carolina	0		1,454		1,218		2,672	
	S. Carolina	0		306		201		508	
	Tennessee	0		265		114		378	
			0		**5,854**		**3,706**		**9,560**
Region 5	Illinois	1		461		377		839	
	Indiana	1		455		328		784	
	Michigan	1		345		144		490	
	Minnesota	2		785		496		1,283	
	Ohio	0		369		217		586	
	Wisconsin	3		574		141		718	
			8		**2,988**		**1,704**		**4,700**

EPA Region	State	<300 AU		300-1,000 AU		>1,000 AU		Total	
			Regional Subtotal		Regional Subtotal		Regional Subtotal		Regional Subtotal
Region 6	Arkansas	0		1,418		580		1,999	
	Louisiana	0		211		86		297	
	New Mexico	0		30		112		141	
	Oklahoma	0		289		175		464	
	Texas	0		841		675		1,516	
			0		**2,789**		**1,629**		**4,418**
Region 7	Iowa	2		1,440		1,318		2,760	
	Kansas	0		188		277		465	
	Missouri	0		449		321		770	
	Nebraska	0		442		641		1,083	
			2		**2,519**		**2,557**		**5,078**
Region 8	Colorado	0		121		210		331	
	Montana	0		32		55		87	
	North Dakota	0		35		28		63	
	South Dakota	0		181		177		358	
	Utah	0		123		53		176	
	Wyoming	0		18		24		42	
			0		**509**		**548**		**1,057**
Region 9	Arizona	0		30		83		113	
	California	0		956		1,031		1,988	
	Hawaii	0		16		16		33	
	Nevada	0		15		20		35	
			0		**1,017**		**1,151**		**2,168**
Region10	Alaska	0		3		1		4	
	Idaho	0		176		151		328	
	Oregon	0		156		72		228	
	Washington	0		320		168		488	
			0		**655**		**392**		**1,047**
Total Potential Permittees		**10**		**19,260**		**12,660**		**31,930**	

Note: An additional 7,000 facilities in the 300 AU to 1,000 AU size category would potentially be subject to the rule, but are projected to file a certification indicating that they do not need to apply for a permit.

Table 9-2. Projected Estimated Number of Potential CAFOs Potentially Regulated Under the Two-Tier Structure by Region, State and Size

EPA Region	State	<500 AU		500-1,000 AU		>1,000 AU		Grand Total	
			Regional Subtotal		Regional Subtotal		Regional Subtotal		Regional Subtotal
Region 1	**Connecticut**	1		22		9		32	
	Maine	1		30		8		39	
	Massachusetts	1		21		7		29	
	New Hampshire	1		15		4		20	
	Rhode Island	0		2		0		3	
	Vermont	3		64		15		82	
			7		**153**		**43**		**204**
Region 2	**New Jersey**	1		15		6		22	
	New York	21		259		79		359	
			22		**274**		**85**		**380**
Region 3	**Delaware**	3		169		97		268	
	Maryland	5		229		137		371	
	Pennsylvania	15		380		320		715	
	Virginia	10		325		216		552	
	West Virginia	1		94		75		170	
			34		**1,197**		**846**		**2,076**
Region 4	**Alabama**	1		719		557		1,278	
	Florida	1		178		170		349	
	Georgia	5		936		833		1,774	
	Kentucky	7		165		179		351	
	Mississippi	1		488		433		922	
	N. Carolina	0		911		1,221		2,133	
	S. Carolina	1		231		202		434	
	Tennessee	0		148		114		261	
			16		**3,776**		**3,710**		**7,502**
Region 5	**Illinois**	14		420		377		811	

EPA Region	State	<500 AU		500-1,000 AU		>1,000 AU		Grand Total	
			Regional Subtotal		Regional Subtotal		Regional Subtotal		Regional Subtotal
	Indiana	6		396		328		730	
	Michigan	9		222		144		375	
	Minnesota	30		621		496		1,147	
	Ohio	3		269		217		489	
	Wisconsin	25		309		141		475	
			87		**2,237**		**1,703**		**4,027**
Region 6	**Arkansas**	1		777		579		1,357	
	Louisiana	0		120		86		206	
	New Mexico	0		26		112		138	
	Oklahoma	0		165		175		340	
	Texas	0		532		676		1,208	
			1		**1,620**		**1,628**		**3,249**
Region 7	**Iowa**	58		1,374		1,318		2,750	
	Kansas	5		182		277		464	
	Missouri	9		323		321		652	
	Nebraska	11		437		640		1,087	
			83		**2,315**		**2,556**		**4,953**
Region 8	**Colorado**	0		81		210		291	
	Montana	0		25		55		80	
	North Dakota	0		27		28		54	
	South Dakota	0		149		177		326	
	Utah	0		65		53		118	
	Wyoming	0		9		24		33	
			0		**355**		**548**		**902**
Region 9	**Arizona**	0		23		83		106	
	California	0		545		1,029		1,574	
	Hawaii	0		10		16		26	
	Nevada	0		8		21		29	
			0		**586**		**1,149**		**1,735**
Region10	**Alaska**	0		2		1		3	
	Idaho	0		97		151		248	
	Oregon	0		82		72		153	
	Washington	0		167		169		336	
			0		**348**		**393**		**741**
Total Potential Permittees		**250**	**250**	**12,860**	**12,860**	**12,660**	**12,660**	**25,770**	**25,770**

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As described in today's preamble, the three-tier structure would affect more facilities because all AFOs with 300 AU or more would be required to do something. However, not all would be required to apply for a permit, and, depending on the vigor with which States and AFOs seek to avoid the conditions defining these facilities as CAFOs, the actual number of permittees could be smaller. EPA projects that a minimum of 4,000 middle-sized facilities and a maximum of 19,000 would apply for a permit under the three-tier structure. By contrast, the proposed two-tier structure would require all 13,000 facilities between 500 AU and 1,000 AU to apply for a permit.

Further, the number of small facilities likely to be designated differs between the two proposed structures. Under the three-tier structure, EPA expects very few AFOs to be designated, potentially 10 per year nationally. Under the two-tier structure, however, this number is likely to rise to 50 per year, given that AFOs from 300 AU to 499 AU have the potential to generate significant quantities of manure that, if not properly managed, may lead the facility to be a significant contributor of pollution to the waters.

E. Funding Issues

While most CAFO owners and operators are interested in taking appropriate measures to protect and preserve the environment, there are legitimate concerns over the costs of doing so. While EPA's cost analysis indicates that this rule is affordable, some businesses in some locales may experience economic stress. (See Section X). Further, concern has been expressed as to whether facilities below 1,000 AU that become CAFOs due to the changes in this proposed rulemaking may potentially cause operations to lose cost-share money available under EPA's Section 319 Nonpoint Source Program and USDA's Environmental Quality Incentive Program (EQIP). Once a facility is considered a point source under NPDES, the operation is not eligible for cost sharing under the Section 319 nonpoint source program. However, the USDA EQIP program is in fact available to most facilities, and being a permitted CAFO is not a reason for exclusion from the EQIP program. EQIP funds may not be used to pay for construction of storage facilities at operations with greater than 1,000 USDA animal units; however, EQIP is available to these facilities for technical assistance and financial assistance for other practices. One USDA animal unit equals 1,000 pounds of live weight of any given livestock species or any combination of livestock species. (The approximate number of animal equivalents would be: 1,000 head of beef; 741 dairy cows; 5,000 swine, 250,000 layers; and 500,000 broilers).

To this end, EPA anticipates that State and Federal Agencies will facilitate compliance with this rule by providing technical assistance and funding for smaller CAFOs, as available.

F. What Provisions are Made for Upset and Bypass?

A recurring issue of concern has been whether industry guidelines should include provisions authorizing noncompliance with effluent limitations during periods of "upsets" or "bypasses". An upset, sometimes called an "excursion," is an unintentional noncompliance occurring for reasons beyond the reasonable control of the permittee. It has been argued that an upset provision is necessary in EPA's effluent limitations because such upsets will inevitably occur even in properly operated control equipment. Because technology based limitations require only what the technology can achieve, it is claimed that liability for such situations is improper. When confronted with this issue, courts have disagreed on whether en explicit upset exemption is necessary, or whether upset incidents may be handled through EPA's exercise of enforcement discretion. Compare *Marathon Oil Co.* v. *EPA*, 564 F.2d 1253 (9th Cir.1977), with *Weyerhaeuser* v. *Costle*, 594 F.2d 1223 (8th Cir. 1979). See also *Sierra Club* v. *Union Oil Co.*, 813 F.2d 1480 (9th Cir. 1987), *American Petroleum Institute* v. *EPA*, 540 F.2d 1023 (10th Cir. 1976), *CPC International, Inc.* v. *Train*, 540 F.2d 1320 (8th Cir. 1976), and *FMC Corp.* v. *Train*, 539 F.2d 973 (4th Cir. 1976).

A bypass, on the other hand, is an act of intentional noncompliance during which waste treatment facilities are circumvented because of an emergency situation. EPA has in the past included bypass provisions in NPDES permits. EPA has determined that both upset and bypass provisions should be included in NPDES permits and has promulgated permit regulations that include upset and bypass permit provisions. See 40 CFR 122.41. The upset provision establishes an upset as an affirmative defense to prosecution for violation of, among other requirements, technology-based effluent limitations. The bypass provision authorizes bypassing to prevent loss of life, personal injury, or severe property damage. Consequently, although permittees in the offshore oil and gas industry will be entitled to upset and bypass provisions in NPDES permits, this regulation does not address these issues.

G. How Would an Applicant Apply for Variances and Modifications to Today's Proposed Regulation?

Once this regulation is in effect, the effluent limitations must be applied in all NPDES permits thereafter issued to discharges covered under this effluent limitations guideline subcategory. The CWA, however, provides certain variances from BAT and BCT limitations. Under 301(l), the only variance available for discharges from the production area is an FDF variance under 301(m). For the land application area, 301(g) variances don't apply because EPA is not setting BAT effluent limitations for the five pollutants to which that provision applies. 301(c) and FDF variances are available for effluent limitations covering the land application area.

The Fundamentally Different Factors (FDF) variance considers those facility specific factors which a permittee may consider to be uniquely different from those considered in the formulation of an effluent guideline as to make the limitations inapplicable. *An FDF variance must be based only on information submitted to EPA during the rulemaking establishing the effluent limitations from which the variance is being requested, or on information the applicant did not have a reasonable opportunity to submit during the rulemaking process for these effluent limitations guidelines.* If fundamentally different factors are determined, by the permitting authority (or EPA), to exist, the alternative effluent limitations for the petitioner must be no less stringent than those justified by the fundamental difference from those facilities considered in the formulation of the specific effluent limitations guideline of concern. The alternative effluent limitation, if deemed appropriate, must not result in non-water quality environmental impacts significantly greater than those accepted by EPA in the promulgation of the effluent limitations guideline. FDF variance requests with all supporting information and data must be received by the permitting authority within 180 days of publication of the final effluent limitations guideline (Publication date here). The specific regulations covering the requirements for and the administration of FDF variances are found at 40 CFR 122.21(m)(1), and 40 CFR part 125, subpart D.

X. What Are the Costs and Economic Impacts of the Proposed Revisions?

A. Introduction and Overview

This section presents EPA's estimates of the costs and economic impacts that would occur as a result of today's proposed regulations. Costs and economic impacts are evaluated for each commodity sector, including the beef, veal, heifer, dairy, swine, broiler, turkey and egg laying sectors. A description of each of the ELG technology options and the NPDES scenarios considered by EPA, and the rationale for selecting the proposed BAT Option and NPDES Scenario, are provided in Sections VII and VIII of this document. Detailed information on estimated compliance costs are provided in the Development Document for the Proposed Revisious to the National Pollutaot Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations (referred to as the "Development Documeut"). EPA's detailed economic assessment cau be found in Economic Analysis of the Proposed Revisions to the Netional Pollutant Discharge Elimination System Regulation aud the Effluent Guidelines for Concentrated Animal Feeding Operations (referred to as "Economic Analysis"). EPA also prepared the Environmental and Economic Benefit Analysis of the Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations ("Benefits Analysis") in support of today's proposal. These documents are available et EPA's website at *http://www.epa.gov/owm/afo.htm.*

This section presents EPA's estimate of the total annual incremental costs and the economic impacts that would be incurred by the livestock and poultry industry as a result of today's proposed rule. This section also discusses EPA's estimated effects to small entities and presents the results of EPA's cost-effectiveness and cost-benefit analysis. All costs presented in this document are reported in 1999 pre-tax dollars (unless otherwise indicated).

B. Data Collection Activities

1. Sources of Data To Estimate Compliance Costs

As part of the expedited approach to this rulemaking, EPA has chosen not to conduct an industry-wide survey of all CAFOs using a Clean Water Act Section 308 questionnaire. Rather, EPA is relying on existing data sources and expertise provided by the U.S. Department of Agriculture (USDA), industry, State agriculture extension agencies, and several land grant universities. More detailed information on the data used for this analysis can be found in the Development Docnment and also the Economic Analysis.

EPA collected and evalnated data from a variety of sources. These sources include information compiled through EPA site visits to over 100 animal confinement operations and information from industry trade associations, government agencies, and other published literature. EPA also received information from environmental groups such as the Natural Resources Defense Council and the Clean Water Network. The Agency contacted university experts, state cooperatives and extension services, and state and EPA regional representetives to identify facilities for site visits. EPA elso attended USDA-sponsored farm tours and site visits arranged by other groups, as well es industry, academic, and government conferences.

EPA obteined data and information from several agencies in USDA, including the National Agricnltural Statistics Service (NASS), Natural Resources Conservation Service (NRCS), the Animal and Plant Health Inspection Service (APHIS), and the Economic Research Service (ERS). The collected data include statistical survey information and published reports.

EPA gathered information from a wide range of published NASS reports, including annuel data summaries for each commodity group. USDA's NASS is respousible for objectively providing importent, usable, and accurate statistical information and date support services on the structure and activities of agricultural production in the United States. Each year NASS conducts surveys and prepares reports covering virtuelly every facet of U.S. agricultural production. The primary sources of data are animal production facilities in the United States. NASS collects voluntary information using mail surveys, telephone and in-person interviews, end field observations. NASS is also responsible for conducting a Census of Agriculture.

EPA's main source of primary USDA data containing farm level descriptive information is USDA's Census of Agriculture (Census). USDA's Census is a complete accounting of United States agricultural productiou and is the only source of uniform, comprehensive agricultural data for every county in the nation. The Census is conducted every 5 years by NASS. The Census includes all farm operations from which $1,000 or more of agricultural products are produced and sold. The most recent Census reflects calendar year 1997 conditions. This database is maintained by USDA. Data used for this analysis were compiled with the assistance of staff at USDA's NASS. (USDA periodically publishes aggregated data from these databasas and also compiles customized analyses of the data to members of the public and other government agencies. In providing such analyses, USDA maintains a sufficient level of aggregation to ensure the confidentiality of any individual operation's activities or holdings.)

USDA's NRCS pnblishes the Agricultnral Waste Management Field Handbook, which is an agricultnral engineering guidence manual that explains general waste management principles and provides detailed design information for particular waste management systems. USDA's Handbook reports specific design information on a veriety of ferm production and waste management practices et different types of feedlots. The Handbook also reports runoff calculetions under normal and peak precipitetion as well as information on manure and bedding characteristics. EPA used this iuformation to develop its cost and environmental analyses. NRCS personnel also contributed technical expertise in the development of EPA's estimates of compliance costs and environmental assessmeut fremework by providing EPA with estimates of manure generation in excess of expected crop upteke. This information is provided iu the record that supports this rulemaking.

NRCS also compiled and performed analyses on Census data that EPA used for its analyses. These data identify the number of feedlots, their geographical distributions, and the amount of cropland aveilable to land apply auimal mauure generated from their confined feeding operetions (based on uitrogen aud phosphorus availability relative to crop need).

EPA gathered information from several reports on the livestock end poultry industries from the National Animal Health Monitoring System (NAHMS). USDA's APHIS provides leadership in eusuring the health and care of animals and plants, improving agricultural productivity and competitiveness, and contributing to the netional economy and public health. One of its main responsibilities is to enhance the care of animals. In 1983, APHIS iuitiated the NAHMS as an information-gathering program to collect, analyze, and disseminate data on animal health, management, and productivity. NAHMS conducts uational studies to gather data and generate descriptive statistics and information from data collected by other industry sources.

USDA's ERS provides economic analyses on efficiency, efficacy, and equity issues related to agriculture, food, the environment, and rural development to improve public and private decision-making. EPA's analysis of economic impacts at a model CAFO references a wide range of published ERS reports and available farm level statistical models. ERS also maintains farm level profiles of cost and returns compiled from NASS financial data.

Databases and reports containing the information and data used by EPA in support of this proposed rule are available in the rulemaking record.

2. Sources of Data To Estimate Economic Impacts

To estimate economic impacts, EPA used farm level data from USDA, industry, and land grant universities. The major source of primary USDA data on farm financial conditions is from the Agricultural Resources Management Study (ARMS). ARMS is USDA's primary vehicle for data collection on a broad range of issues about agricultural production practices and costs. These data provide a national perspective on the annual changes in the financial conditions of production agriculture.

USDA's ARMS data provide aggregate farm financial data, which EPA used for its cost impact analysis. The ARMS data provide complete income statement and balance sheet information for U.S. farms in each of the major commodity sectors, including those affected by the proposed regulations. The ARMS financial data span all types of farming operations within each sector, including full-time and part-time producers, independent owner operations and contract grower operations, and confinement and non-confinement production facilities.

ERS provided aggragated data for select representative farms through special tabulations of the ARMS data that differentiate the financial conditions among operations by commodity sector, facility size (based on number of animals on-site) and by major producing region for each sector. The 1997 ARMS data also provide corresponding farm level summary information that matches the reported average financial data to both the total number of farms and the total number of animals for each aggregated data category. As with the Census data, ERS aggregated the data provided to EPA to preserve both the statistical representativeness and confidentiality of the ARMS survey data. ARMS data used for this analysis are presented in the Economic Analysis and are available in the rulemaking record.

EPA obtained additional market data on the U.S. livestock and poultry industries as a whole from a wide variety of USDA publications and special reports. These include: Financial Performance of U.S. Commercial Farms, 1991–1994; USDA Baseline Projections 2000, Food Consumption, Prices and Expenditures, 1970–1997; Agricultural Prices Annual Summary; annual NASS statistical bulletins for these sectors; and data and information reported in Agricultural Outlook and ERS's Livestock, Dairy, and Poultry Situation and Outlook reports. Other source material is from ERS's cost of production series reports for some sectors and trade reports compiled by USDA's Foreign Agricultural Service (FAS). Information on the food processing segments of these industries is from the U.S. Department of Commerce's Census of Manufacturers data series. Industry information is also from USDA's Grain Inspection Packers and Stockyards Administration (GIPSA).

Industry and the associated trade groups also provided information for EPA's cost and market analyses. In particular, the National Cattlemen's Beef Association (NCBA) conducted a survey of its membership to obtain financial statistics specific to cattle feeding operations. EPA used those and other data to evaluate how well the ARMS data for beef operations represent conditions at cattle feedyards. EPA also obtained industry data from the National Milk Producers Federation (NMPF) and the National Pork Producers Council (NPPC).

EPA also used published research by various land grant universities and their affiliated research organizations, as well as information provided by environmental groups.

Databases and reports containing the information and data provided to and used by EPA in support of this proposed rule are available in the rulemaking record.

C. Method for Estimating Compliance Costs

1.Baseline Compliance

For the purpose of this analysis, EPA assumes that all CAFOs that would be subject to the proposed regulations are currently in compliance with the existing regulatory program (including the NPDES regulations and the effluent limitations guidelines and standards for feedlots) and existing state laws and regulations. As a practical matter, EPA recognizes that this is not true, since only 2,500 operations out of an estimated 12,700 CAFOs with more than 1,000 AU have actually obtained coverage under an NPDES permit and the remainder may in fact experience additional costs to comply with the existing requirements. EPA has not estimated these additional costs in the analysis that is presented in today's preamble because the Agency did not consider these costs part of the incremental costs of complying with today's proposed rule.

To assess the incremental costs attributable to the proposed rules, EPA evaluated current federal and state requirements for animal feeding operations and calculated compliance costs of the proposed requirements that exceed the current requirements. Operations located in states that currently have requirements that meet or exceed the proposed regulatory changes would already be in compliance with the proposed regulations and would not incur any additional cost. These operations are not included as part of the cost analysis. A review of current state waste management requirements for determining baseline conditions is included in the Development Document and also in other sections of the record (See State Compendium: Programs and Regulatory Activities Related to Animal Feeding Operations compiled by EPA and available at http://www.epa.gov/owm/afo.htm#Compendium).

EPA also accounted for current structures and practices that are assumed to be already in place at operations that may contribute to compliance with the proposed regulations. Additional information is also provided in the following section (X.C.2(a)). This information is also provided in the Development Document.

2. Method for Estimating Incremental CAFO Compliance Costs

a. *Compliance Costs to CAFO Operators.* For the purpose of estimating total costs and economic impacts, EPA calculated the costs of compliance for CAFOs to implement each of the regulatory options being considered (described in Section VIII of this preamble). EPA estimated costs associated with four broad cost components: nutrient management planning, facility upgrades, land application, and technologies for balancing on-farm nutrients. Nutrient management planning costs include manure and soil testing, record keeping, monitoring of surface water and groundwater, and plan development. Facility upgrades reflect costs for manure storage, mortality handling, storm water and field runoff controls, reduction of fresh water use, and additional farm management practices. Land application costs address agricnltural application of nutrients and reflect differences among operations based on cropland availability for manure application. Specific information on the capital costs, annual operating and maintenance cnsts, start-up or first year costs, and also recurring costs assumed by EPA to estimata costs and impacts of the proposed regulations is provided in the Development Document.

EPA evaluated compliance costs using a representative facility approach based on more than 170 farm level models that were developed to depict conditions aud to evaluate compliance costs for select representative CAFOs. The major factors used to differentiate individual model CAFOs include the commodity sector, the farm production region, and the facility size (based on herd or flock size or the number of animals on-site). EPA's model CAFOs primarily reflect the major animal sector gronps, including beef cattle, dairy, hog, broiler, turkey, and egg laying operations. Practices at other subsector operations are also reflected in the cost models, such as replacement heifer operations, veal operations, flushed caged layers, and hog grow- and farrow-finish facilities. EPA used model facilities with similar waste management and production practices to depict operations in regions that were not separately modeled.

Another key distinguishing factor incorporated into EPA's model CAFOs includes information on the availability of crop and pasture land for land application of manure nntrients. For this analysis, nitrogen and phosphorus rates of land application are evalnated for three categories nf cropland availability: Category 1 CAFOs are assumed to have sufficient cropland for all on-farm nntrients generated, Category 2 CAFOs are assumed to have insufficient cropland, and Category 3 CAFOs are assumed to have no cropland. EPA used 1997 information from USDA to determine the number of CAFOs within each category. This information takes into acconnt which nutrient (nitrogen or phosphorus) is used as the basis to assess land application end nutrient management costs.

For Category 2 and Category 3 CAFOs, EPA evaluated additional technologies that may be necessary to balance nutrients. EPA eveluated additional technologies that reduce off-site hanling costs associated with excess on-farm nutrients, as well as to address ammonia volatization, pathogens, trace metals, and antibiotic residuals. These technologies may include Best Management Practices (BMPs) and various farm production technologies, such as feed management strategies, solid-liquid separation, composting, anaerobic digestion, and other retrofits to existing technologies. EPA considered all these technologies for identification of "best available technnlogies" under the various options for BAT described in Section VIII.

EPA nsed soil sample information compiled by researchers at various land grant universities to determine areas of phosphoros and nitrngen saturation, as described in the Development Document. This information provides the basis for EPA's assumptions of which facilities would need to apply manure nutrients on a phosphorus- or nitrogen-based standard.

EPA's cost models also take into account other production factors, including climate and farmland geography, land application and waste management practices and other major prodoction practices typically found in the key producing regions of the country. Model facilities reflect major production practices used by larger confined animal farms, generally those with more than 300 AU. Therefore, the models do not reflect pasture and grazing type farms, nor do they reflect typicel costs to small farms. EPA's cost models also take into account practices required under existing state regnlations and reflect cost differences within sectors depending on manure composition, bedding nse, and process water volumes. More informatinn on the development of EPA's cost models is provided in the Development Document.

To estimate aggregate incremental costs to the CAFO industry from implementing a particular technology option, EPA first estimated the total cost to a mndel facility to employ a given technology, including the full range of necessary capital, annual, start-up, and recurriug costs. Additional detailed information on the baseline aud compliance costs attributed to model CAFOs across all sectors and across all the technology options considered by EPA is provided in the Development Document.

After estimating the total cnst to an individual facility to employ a given technology, EPA then weighted the average facility level cost to account for current use of the technology or management practice nationwide. This is done by mnltiplying the totel cost of a particular technology or practice by the percent of operations that are believed to use this particular technology or practice in order to derive the average expected cost that could be incurred by a model CAFO. EPA refers to this adjustment factor as the "frequency factor" and has developed such a factor for each individual cost (i.e. each technology) and cost component (i.e. capital and annual costs) in each of its CAFO models. The frequency factor reflects the percentage of facilities that are, technically, already in compliance with a given regulatory option since they already employ technolngies or practices that are protective of the environment. The frequency factor also accounts for compliance with existing federal and state regulatory requirements as well as the extent to which an animal sector has already adopted or established management practices to control discharges.

EPA developed its frequency factors based on data and information from USDA's NRCS and NAHMS, state agricultural extension agencies, industry trade groups and industry-sponsored surveys, academic literature, and EPA's farm site visits. More detailed information on how EPA developed and applied these weighting factors is provided in the Development Document. To identify where farm level costs may be masked by this weighting approach, EPA evaluated costs with and without frequency factors. The results of this sensitivity analysis indicate that the model CAFO costs used to estimate aggregate costs and impacts, as presented in this preamble, are stable across a rauge of possible frequency factor assumptions.

The data and information used to develop EPA's model CAFOs were compiled with the assistance of USDA, in combination with other information collected by EPA from extensive literature searches, more than 100 farm site visits, and numerous consultations with industry, universities, and agricultural extension agencies. Additional detailed information on the data and assnmptions used to develop EPA's model CAFOs that were used to estimate aggregate incremental costs to the CAFO industry is provided in the Development Document.

h. *Compliance Costs to Recipients of CAFO Manure.* To calculate the cost to offsite recipients of CAFO mannre under the proposed regulations, EPA builds upon the cropland availability information in the CAFO models, focusing on the two categories of farms that heve excess manure nutrients and that need to haul manure offsite for alternative use or to be spread as fertilizer (i.e., Category 2 and Category 3 CAFOs, where facilities are assumed to have insufficient or no available cropland to land apply nutrients, respectively). EPA also uses this information to determine the number of offsite recipients affected under select regulatory alternatives, shown in Tables 10–3 and 10–4.

USDA defines farm level "excess" of manure nutrients on a confined livestock farm as manure nutrient production less crop assimilative capacity. USDA has estimated manure nutrient production using the number of animals by species, standard manure production per animal unit, and nutrient composition of each type of manure. Recoverable manure is the amount that can be collected and disposed by spreading on fields or transporting off the producing farm.

Depending on the nutrient used to determine the rate of manure application (nitrogen or phosphorus), EPA estimates that approximately 7,500 to 10,000 CAFOs with more than 300 AU are expected to generate excess manure. This includes about 2,600 animal feeding operations that have no major crop or pasture land. These estimates were derived from a USDA analysis of manure nutrients relative to the capacity of cropland and pastureland to assimilate nutrients. EPA's estimate does not account for excess manure that is already disposed of via alternative uses such as pelletizing or incineration.

For the purpose of this analysis, EPA assumes that affected offsite facilities are field crop producers who use CAFO manure as a fertilizer substitute. Information on crop producers that currently receive animal manure for use as a fertilizer substitute is not available. Instead, EPA approximates the number of operations that receive CAFO manure and may be subject to the proposed regulations based on the number of acres that would be required to land apply manure nutrients generated by Category 2 and Category 3 CAFOs. EPA assumes that offsite recipients will only accept manure when soil conditions allow for application on a nitrogen basis. Therefore, the manure application rate at offsite acres in a given region is the nitrogen-based application rate for the typical crop rotation and yields obtained in that region. EPA then estimates the number of farms that receive CAFO manure by dividing the acres needed to assimilate excess manure nitrogen by the national average farm size of 487 acres, based on USDA data. The results of this analysis indicate that 18,000 to 21,000 offsite recipients would receive excess CAFO manure.

The costs assessed to manure recipients include the costs of soil testing and incremental recordkeeping. EPA evaluated these costs using the approach described in Section X.C.2(a). Excess manure hanling costs are already included in costs assessed to CAFOs with excess manure. For the purpose of this analysis, EPA has assumed that crop farmers already maintain records documenting crop yields, crop rotations, and fertilizer application, and that crop farmers already have some form of nutrient management plan for determining crop nutrient requirements. EPA estimates, on average, per-farm incremental costs of approximately $540 to non-CAFOs for complying with the offsite certification requirements. This analysis is provided in the Development Document.

3. Cost Annualization Methodology

As part of EPA's costing analysis, EPA converts the capital costs that are estimated to be incurred by a CAFO to comply with the proposed requirements, described in Section X.C.2, to incremental annualized costs. Annualized costs better describe the actual compliance costs that a model CAFO would incur, allowing for the effects of interest, depreciation, and taxes. EPA uses these annualized costs to estimate the total annual compliance costs and to assess the economic impacts of the proposed requirements to regulated CAFOs that are presented in Sections X.E and X.F.

Additional information on the approach used to annualize the incremental compliance costs developed by EPA is provided in Appendix A of the Economic Analysis. EPA uses a 10-year recovery period of depreciable property based on the Internal Revenue Code's guidance for single purpose agricultural or horticultural structures. The Internal Revenue Service defines a single purpose agricultural structure as any enclosure or structure specifically designed, constructed and used for housing, raising, and feeding a particular kind of livestock, including structures to contain produce or equipment necessary for housing, raising, and feeding of livestock. The method EPA uses to depreciate capital investments is the Modified Accelerated Cost Recovery System (MACRS).

EPA assumes a real private discount/interest rate of 7 percent, as recommended by the Office of Management and Budget. EPA also assumes standard federal and average state tax rates across the broad facility size categories to determine an operation's tax benefit or tax shield, which is assumed as an allowance to offset taxable income.

D. Method for Estimating Economic Impacts

To estimate economic impacts under the proposed regulations, EPA examined the impacts across three industry segments: regulated CAFOs, processors, and national markets.

1. CAFO Analysis

EPA estimates the economic impacts of today's proposed regulations using a representative farm approach. A representative farm approach is consistent with past research that USDA and many land grant universities have conducted to assess a wide range of policy issues, including environmental legislation pertaining to animal agriculture. A representative farm approach provides a means to assess average impacts across numerous facilities by grouping facilities into broader categories to account for the multitude of differences among animal confinement operations. Information on how EPA developed its model CAFOs is available in the Economic Analysis. Additional information on EPA's cost models is provided in the Development Document. At various stages in the proposed rulemaking, EPA presented its proposed methodological approach to USDA personnel and to researchers at various land grant universities for informal review and feedback.

Using a representative farm approach, EPA constructed a series of model facilities that reflect the EPA's estimated compliance costs and available financial data. EPA uses these model CAFOs to develop an average characterization for a group of operations. EPA's cost models were described earlier in Section X.C.2(a). From these models, EPA estimates total annualized compliance costs by aggregating the average facility costs across all operations that are identified for a representative group. EPA's cost models are compared to corresponding model CAFOs that characterize financial conditions across differently sized, differently managed, and geographically distinct operations. As with EPA's cost models, EPA's financial models are grouped according to certain distinguishing characteristics for each sector, such as facility size and production region, that may be shared across a broad range of facilities. Economic impacts under a post-regulatory scenario are approximated by extrapolating the average impacts for a given model CAFO across the larger number of operations that share similar production characteristics and are identified by that CAFO model.

EPA compares its estimated compliance costs at select model CAFOs to corresponding financial conditions at these model facilities. For this analysis, EPA focuses on three financial measures that are used to assess the affordability of the proposed CAFO regulations. These include total gross revenue, net cash income, and debt-to-asset ratio. Financial data used by EPA to develop its financial models are from the 1997 ARMS data summaries prepared by ERS and form the basis for the financial characterization of the model CAFOs. To account for changes in an operation's income under post-compliance conditions, EPA estimated the present value of projected facility earnings, measured as a future cash flow stream. The present value of cash flow represents the value in terms of today's dollars of a series of future receipts. EPA calculated baseline cash flow as the present value of a 10-year stream of an operation's cash flow. EPA projected future earnings from the 1997 baseline using USDA's Agricultural Baseline Projections data. Section 4 of the Economic Analysis provides additional information on the baseline financial conditions attributed to EPA's model CAFO across all sectors as well as information ou the data and assumptions used to develop these models.

EPA evaluates the economic achievability of the proposed requirements based on changes in representative financial conditions for select criteria, as described in Section X.F.1. For some sectors, EPA evaluates economic impacts at model CAFOs under varying scenarios of cost passthrough between the CAFO and the latter stages in the food marketing chain, such as the processing and retail sectors. These three scenarios include: zero cost passthrough, full (100 percent) cost passthrough, and partial cost passthrough (greater than zero). Partial cost passthrough values used for this analysis vary by sector and are based on estimates of price elasticity of supply and demand reported in the academic literature. This information is available in the docket.

Table 10–1 lists the range of annualized compliance costs developed for EPA's analysis. Annualized costs for each sector are summarized across the estimated range of minimum and maximum costs across all facility sizes and production regions and are broken out by land use category (described in Section X.C.2). In some cases, "maximum" costs reflect average costs for a representative facility that has a large number of animels on-site; EPA's cost models for very large CAFOs are intended to approximate the average unit costs at the very largest animal feeding operations. More detailed annualized costs broken out by production region, land use category, and broad facility size groupings are provided in the Economic Analysis.

Estimated annualized costs shown in Table 10–1 are presented in 1999 dollars (post-tax). All costs presented in today's preamble have been converted using the Construction Cost Index to 1999 dollars from the 1997 dollar estimates that are presented throughout the Development Document and the Economic Analysis. As shown in the table, costs for Category 3 CAFOs may be lower than those for Category 1 CAFOs since facilities without any land do not incur any additional incremental costs related to hauling. EPA has assumed that these operations are already hauling off-site in order to comply with existing requirements. More detailed cost estimates for individual technologies are provided in the Development Document.

To assess the impact of the regulations on offsite recipients of CAFO manure, EPA compares the estimated cost of this requirement to both aggregate and average per farm production costs and revenues (a sales test). This analysis uses EPA's estimated compliance costs and 1997 aggregate farm revenues and production costs reported by USDA. For the purpose of this analysis, EPA assumes that these costs will be incurred by non-CAFO farming operations (i.e., crop producers) that use animal manures as a fertilizer substitute and will not be borne by CAFOs.

TABLE 10–1.—RANGE OF ANNUALIZED MODEL CAFO COMPLIANCE COSTS ($1999, POST-TAX)

Sector	Category 1[1]		Category 2[1]		Category 3[1]	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
	(1999 dollars per model CAFO across all size groups)					
Beef	2,100	986,000	8,500	1,219,800	1,000	896,700
Veal	1,500	8,100	1,100	6,100	1,000	6,000
Heifers	1,700	16,900	2,000	17,900	1,200	11,700
Dairy	5,200	44,600	14,700	67,700	4,200	40,300
Hogs: GF[2]	300	52,300	5,500	63,500	11,400	81,500
Hogs: FF[2]	300	82,900	8,800	100,600	10,000	115,500
Broilers	4,800	36,300	4,400	25,800	3,900	21,400
Layers: wet[3]	300	24,800	2,100	29,300	1,500	18,100
Layers: dry[3]	1,500	59,000	1,400	31,700	1,200	27,600
Turkeys	4,900	111,900	4,800	29,500	3,800	20,800

Source: EPA.
[1] Category 1 CAFOs have sufficient cropland for all on-farm nutrients generated; Category 2 CAFOs have insufficient cropland; and Category 3 CAFOs have no cropland.
[2] "Hogs: FF" are farrow-finish (includes breeder and nursery pigs); "Hogs: GF" are grower-finish only.
[3] "Layers: wet" are operations with liquid manure systems; "Layers: dry" are oparations with dry systems.

2. Processor Analysis

As discussed in Section VI, EPA estimates that 94 meat packing plants that slaughter hogs and 270 poultry processing facilities may be subject to the proposed co-permitting requirements (Section VI). Given the structure of the beef and dairy sectors and the nature of their contract relationships, EPA expects that no meat packing or processing facilities in these sectors will be subject to the proposed co-permitting requirements. EPA bases these assumptions on data from the Department of Commerce on the number of slaughtering and meat packing facilities in these sectors and information from USDA on the degree of animal ownership at U.S. farms, as described in Section VI of this document. Additional information is provided in Section 2 of the Economic Analysis. EPA is seeking comment on this assumption as part of today's notice.

EPA did not conduct a detailed estimate of the costs and impacts that would accrue to individual co-permittees. Information on contractual relationships between contract growers and processing firms is proprietary and EPA does not have the necessary market information and data to conduct such an analysis. Market information is not available on the number and location of firms that contract out the raising of animals to CAFOs or on the number and location of contract growers, and the share of production, that raise animals under a production contract. In addition, EPA does not have data on the exact terms of the contractual agreements between processors and CAFOs to assess when a processor would be subject to the proposed co-permitting requirements, and EPA does not have financial data for processing firms or contract growers that utilize production contracts.

EPA, however, believes that the framework used to estimate costs to CAFOs does provide a means to evaluate the possible upper bound of costs that could accrue to processing facilities in those industries where production contracts are more widely utilized and where EPA believes the proposed co-permitting requirements may affect processors. EPA's CAFO level analysis examines the potential share of (pre-tax) costs that may be passed on from the CAFO, based on market information for each sector. Assuming that a share of the costs that accrue to the CAFO are eventually borne by processors, EPA is proposing that this amount approximates the magnitude of the costs that may be incurred by processing firms in those industries that may be affected by the proposed co-permitting requirements. EPA solicits comment on this approach.

To assess the impact of the regulations on processors, EPA compares the passed through compliance costs to both aggregate processor costs of production and to revenues (a sales test). These analyses use estimated compliance costs, cost passthrough estimates, and aggregate revenues and production costs by processing sector. National processor cost and revenue data are from the U.S. Department of Commerce's Census of Manufacturers data series. For some sectors, EPA evaluates the impact of the proposed regulations on processors under two scenarios of cost passthrough from the animal production sectors (described in Section X.D.1), including full cost and partial cost passthrough. More detail on this approach is provided in Section 4 of the Economic Analysis.

This suggested approach does not assume any addition to the total costs of the rule as a result of co-permitting. This approach also does not assume that there will be a cost savings to contract growers as a result of a contractual arrangement with a processing firm. This approach merely attempts to quantify the potential magnitude of costs that could accrue to processors that may be affected by the co-permitting requirements. Due to lack of information and data, EPA has not analyzed the effect of relative market power between the contract grower and the integrator on the distribution of costs, nor the potential for additional costs to be imposed by the integrator's need to take steps to protect itself against liability and perhaps to indemnify itself against such liability through its production contracts. EPA has also not specifically analyzed the environmental effects of co-permitting. EPA has conducted an extensive review of the agricultural literature on market power in each of the livestock and poultry sectors and concluded that there is little evidence to suggest that increased production costs would be prevented from being passed on through the market levels. This information is provided in the rulemaking record. However, as discussed in Section VII.C.5, EPA recognizes that some industry representatives do not support these assumptions of cost passthrough from contract producers to integrators and requests comments on its cost passthrough assumptions, both in general and as they relate to the analysis of processor level impacts under the proposed co-permitting requirements.

EPA's processor analysis does not explicitly account for the few large corporate operations that are vertically integrated, to the extent that the corporation owns and operates all aspects of the operation, from animal production to final consumer product. These operations are covered by EPA's CAFO analysis to the extent that they are captured by USDA's farm survey and are included among EPA's model CAFOs. While the ARMS data may include information on CAFOs that are owned by corporate operations, these data cannot be broken out to create a model specifically designed to represent these operations. Since EPA's analysis uses farm financial data and not corporate data, this analysis does not reflect the ability of corporations to absorb compliance costs that may be incurred at CAFOs that are owned by that entity. EPA expects that its analysis overestimates the impact to corporate entities since revenues of corporate entities are, in most cases, no less than and are likely to exceed those at a privately-owned and operated CAFOs.

3. Market Analysis

EPA's market analysis evaluates the effects of the proposed regulations on national markets. This analysis uses a linear partial equilibrium model adapted from the COSTBEN model developed by USDA's Economic Research Service. The modified EPA model provides a means to conduct a long-run static analysis to measure the market effects of the proposed regulations in terms of predicted changes in farm and retail prices and product quantities. Market data used as inputs to this model are from a wide range of USDA data and land grant university research. EPA consulted researchers from USDA and the land grant universities in the development of this modeling framework. The details of this model are described in Appendix B of the Economic Analysis.

Once price and quantity changes are predicted by the model, EPA uses national multipliers that relate changes in sales to changes in total direct and indirect employment and also to national economic output. These estimated relationships are based on the Regional Input-Output Modeling System (RIMS II) from the U.S. Department of Commerce. This approach is described in Section 4 of the Economic Analysis.

E. Estimated Annual Costs of the Proposed Regulatory Options/Scenarios

As discussed in Section VII and VIII, EPA considered various technology options and also different scope scenarios as part of the development of today's proposed regulations. A summary overview of the ELG options and NPDES scenarios is provided in Table 10–2. More detail is available in Sections VII and VIII of today's preamble.

TABLE 10–2.—SUMMARY DESCRIPTION OF OPTIONS/SCENARIOS CONSIDERED BY EPA

Technology Options (ELG)	
Option 1	N-based land application controls and inspection and recordkeeping requirements for the production area (described in Section VIII.C.3).
Option 2	Same as Option 1, but restricts the rate of manure application to a P-based rate where necessary (depending on specific soil conditions at the CAFO).
Option 3 BAT (Beef/Heifers/Dairy)	Adds to Option 2 by requiring all operations to determine whether the groundwater beneath the production area has a direct hydrologic connection to surface water; if so, requires groundwater monitoring and controls.
Option 4	Adds to Option 3 by requiring sampling of surface waters adjacent to production area and/or land under control of the CAFO to which manure is applied.
Option 5 BAT (Swine/Poultry/Veal)	Adds to Option 2 by establishing a zero discharge requirement from the production area that does not allow for an overflow under any circumstances.
Option 6	Adds to Option 2 by requiring that large hog and dairy operations install and implement anaerobic digestion and gas combustion to treat their manure.
Option 7	Adds to Option 2 by prohibiting manure application to frozen, snow covered or saturated ground.
Regulatory Scope Options (NPDES)	
Scenario 1	Retains existing 3-tier framework and establishes additional requirements (described in Section VII.C.2).
Scenario 2	Same as Scenario 1; operations with 300–1,000 AU would be subject to the regulations based on certain "risk-based" conditions (described in VII.C.3.b).
Scenario 3 "Three-Tier"	Same as Scenario 2, but allows operations with 300–1,000 AU to either apply for a NPDES permit or to certify to the permit authority that they do not meet any of the conditions and thus are not required to obtain a permit.
Scenario 4a "Two-Tier" (500 AU)	Establishes 2-tier framework and applies ELG standard to all operations with more than 500 AU.
Scenario 4b	Establishes 2-tier framework and applies ELG standard to all operations with more than 300 AU.
Scenario 5 "Two-Tier" (750 AU)	Establishes 2-tier framework and applies ELG standard to all operations with more than 750 AU.
Scenario 6	Retains existing 3-tier framework and establishes a simplified certification process (described in Section VII.C.2).

The "BAT Option" refers to EPA's proposal to require nitrogen-based and, where necessary, phosphorus-based land application controls of all livestock and poultry CAFOs (Option 2), with the additional requirement that all cattle and dairy operations must conduct groundwater monitoring and implement controls, if the groundwater beneath the production area has a direct hydrologic connection to surface watar (Option 3 BAT), and with the additional requirement that all hog, veal, and poultry CAFOs must also achieve zero discharge from the animal production area with no exception for storm events (Option 5 BAT). For reasons outlined in Section VIII, EPA is not proposing that beef and dairy CAFOs meet the additional requirements under Option 5 or that hog and poultry CAFOs meet the additional requirements under Option 3. Section VIII discusses EPA's basis for the selection of these technology bases for the affected subcateogries.

EPA is jointly proposing two NPDES Scenarios that differ in terms of the manner in which operations are defined as a CAFO. Scenario 4a is to the two-tier alternative that defines as CAFOs all animal feeding operations with more than 500 AU (alternatively, Scenario 5 is the two-tier alternative that defines all animal feeding operations with more than 750 AU as CAFOs). Scenario 3 is three-tier structure that defines as CAFOs all animal feeding operations with more than 1,000 AU and any operation with more than 300 AU, if they meet certain "risk-based" conditions, as defined in Section VII. Under Scenario 3, EPA would require all confinement operations with between 300 and 1,000 AU to either apply for a NPDES permit or to certify to the permit authority that they do uot meet certain conditions and thus are not required to obtain a permit.

For the purpose of this discussion, the "two-tier structure" refers to the combination of BAT Option 3 (beef and dairy subcategories) and BAT Option 5 (swine and poultry subcategories), and NPDES Scenario 4a that covers all operations with more than 500 AU. Where indicated, the two-tier structure may refer to the alternative threshold at 750 AU. The "three-tier structure" refers to the combination of ELG Option 3 (beef and dairy subcategories) and Option 5 (swine and poultry subcategories), and NPDES Scenario 3 that covers operations down to 300 AU based on certain conditions. More detail of the technology options considered by EPA is provided in Section VIII. Section VII of this preamble provides additional information on the alternative scope scenarios considered by EPA. EPA did not evaluate costs and economic impacts under the alternative three-tier structure that combines the BAT Option with Scenario 6, as described in Table 10–2.

Under the two-tier structure, EPA estimate that 25,540 CAFOs with more than 500 AU may be defined as CAFOs and subject to the proposed regulations. EPA estimates that 19,100 CAFOs may be defined as CAFOs under the alternative two-tier threshold of 750 AU. Under the three-tier structure, an estimated 31,930 CAFOs would be defined as CAFOs (Table 6–2) and an additinnal 7,400 operations in the 300 to 1,000 AU size range would need to certify that they do not need to apply for a permit. This total estimate counts operations with more than a single animal type only once. EPA's analysis computes total compliance costs based on the total number of CAFOs in each sector, including mixed operations that have more than 300 or 500 AU of at least one animal type. This approach avoids understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site that meets the size threshold for a CAFO or is designated as a CAFO by the permitting anthority. Therefore, EPA's compliance costs estimates likely represent the upper bound since costs at facilities with more than a single animal type may, in some cases, be lower due to shared production technologies and practices across all animal types that are produced on-site.

1. Costs to CAFOs Under the Proposed Regulations

Tables 10–3 and 10–4 summarize the total annualized compliance costs to CAFOs attributed to the proposed two-tier structure and three-tier structure. The table shows these costs broken out by sector and by broad facility size group. EPA calculated all estimated costs using the data, methodology and assumptions described in Sections X.B and X.C.

Under the two-tier structure, EPA estimates that the incremental annualized compliance cost to CAFO operators would be approximately $831 million annually (Table 10–3). Table 10–5 shows estimated costs for the two-tier structure at the 750 AU threshold, estimated by EPA to total $721 million annually. Most of this cost (roughly 70 percent) is incurred by CAFOs with more than 1,000 AU. Overall, about one-third of all estimated compliance costs are incurred within the hog sectors.

Under the three-tier structure, EPA estimates that the total cost to CAFO operators would be $925 million annually (Table 10–4). These costs are expressed in terms of pre-tax 1999 dollars. (Post-tax costs are estimated at $573 million and $635 million annually, respectively, and include tax savings to CAFOs. EPA uses estimated post-tax costs to evaluate impacts to regulated facilities, discussed in Section X.F.). Estimated total annualized costs for the three-tier structure include the cost to permitted CAFOs as well as the estimated cost to operations to certify to the permit authority that they do not meet any of the conditions and are thus are not required to obtain a permit. EPA estimates certification costs at about $80 million annually, which covers phosphorus-based PNP costs, facility upgrades, and letters of certification from manure recipient. More information on these costs and how they are calculated is provided in Section 5 of the Economic Analysis.

Estimated total annualized costs shown in Table 10–3 and 10–4 include costs to animal confinement operations that may be designated as CAFOs. Total annualized costs to designated facilities is estimated at less than one million dollars annually (Tables 10–3 and 10–4). As discussed in Section VI, EPA assumes that designation may bring an additional 50 operations each year under the two-tier structura; under the three-tier structure, EPA expects that an additional 10 operations may be designated each year. In this analysis, estimated costs to designated facilities are expressed on an average annual basis over a projected 10-year period. For the purpose of this analysis, EPA assumes that operations that may be designated as CAFOs and subject to the proposed regulations will consist of beef, dairy, farrow-finish hog, broiler and egg laying operations under the two-tier structure. Under the three-tier structure, EPA estimates that fewer operations would be designated as CAFOs, with 10 dairy and hog operations being designated each year, or 100 operations over a 10-year period. Additional information is provided in the Economic Analysis.

TABLE 10–3.—ANNUAL PRE-TAX COST OF TWO-TIER STRUCTURE (BAT OPTION/SCENARIO 4A), $1999

Sector	Number of operations	Total	>1000 AU	500–1000 AU	<500 AU[1]
	(number)[2]	($1999, millions, pre-tax)			
Regulated CAFOs					
Beef	3,080	216.4	191.5	24.7	0.1
Veal	90	0.3	0.03	0.3	NA
Heifer	800	11.6	3.7	7.9	NA
Dairy	3,760	177.6	108.6	65.4	3.6
Hog	8,550	294.0	225.5	67.0	1.5
Broiler	9,780	97.1	55.4	41.6	0.1
Layer	1,640	14.2	9.9	4.3	NA
Turkey	1,280	19.6	10.4	9.2	NA
Subtotal	25,540	830.7	605.0	220.2	5.4
Other Farming Operations					
Offsite Recipients	17,923	9.6	NA	NA	NA
Total	NA	840.3	NA	NA	NA

Source: USEPA. See Economic Analysis. Table 6–2 provides information on affected operations.
Numbers may not add due to rounding. NA = Not Applicable. Option/Scenario definitions provided in Table 10–2.
[1] Cost estimates shown are for designated CAFOs (see Section VI).
[2] "Total" adjusts for operations with more than a single animal type. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

TABLE 10–4.—ANNUAL PRE-TAX COST OF THREE-TIER STRUCTURE (BAT OPTION/SCENARIO 3), $1999

Sector	Number of operations	Total	>1000 AU	300–1000 AU	<300 AU[1]
	(number)[2]	($1999, million, pre-tax)			
Regulated CAFOs					
Beef	3,210	227.7	191.5	36.2	0.0
Veal	140	0.8	0.03	0.8	0.0
Heifer	980	14.4	3.7	10.7	0.0
Dairy	6,480	224.6	108.6	115.3	0.7
Hog	8,350	306.1	225.5	80.4	0.2

TABLE 10–4.—ANNUAL PRE-TAX COST OF THREE-TIER STRUCTURE (BAT OPTION/SCENARIO 3), $1999—Continued

Sector	Number of operations	Total	>1000 AU	300–1000 AU	<300 AU[1]
Broiler	13,740	116.6	55.4	61.2	0.0
Layer	2,010	15.3	9.9	5.4	0.0
Turkey	2,060	24.9	10.4	14.5	0.0
Subtotal	31,930	930.4	605.0	324.5	0.8
Other Farming Operations					
Offsite Recipients	21,155	11.3	NA	NA	NA
Total	NA	936.7	NA	NA	NA

Source: USEPA. See Economic Analysis. Table 6–2 provides information on affected operations.
Numbers may not add due to rounding. NA = Not Applicable. Option/Scenario definitions provided in Table 10–2.
[1] Cost estimates shown are for designated CAFOs (see Section VI).
[2] "Total" adjusts for operations with more than a single animal type. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

2. Costs to CAFOs of Alternative Regulatory Options and Scenarios

Alternative regulatory options considered by EPA during the development of today's proposed regulations include various technology options and also different regulatory scope scenarios. Sections VII and VIII present the Agency's rationale for each regulatory decision.

Table 10–5 summarizes the total annualized (pre-tax) costs of alternative technology options for each NPDES scenario and ELG technology basis considered by EPA. As shown in the table, the total estimated costs across these options range from $355 million (Option 1/Scenario 1) to $1.7 billion annually (Option 5, applicable to all the animal sectors, and Scenario 4b). By scenario, this reflects the fact that fewer CAFOs would be affected under Scenario 1 (a total of about 16,400 operations) as compared to Scenario 4b (about 39,300 operations affected). As noted in Section X.E, EPA's estimate of the number of CAFOs and corresponding compliance costs does not adjust for operations with mixed animal types and may be overstated. By technology option, with the exception of Options 1 and 4, costs are evaluated incremental to Option 2 (see Table 10–2). Compared to Option 2, Option 5 costs are greatest. Additional breakout of these costs by sector are provided in the Economic Analysis.

TABLE 10–5.—ANNUALIZED PRE-TAX COSTS FOR THE ALTERNATIVE NPDES SCENARIOS ($1999, MILLION)

Option/Scenario	Scenario 4a "Two-Tier"	Scenaro 2/3 "Three-Tier"	Scenario 1	Scenario 5 >750 AU	Scenario 4b >300 AU
Number of CAFOs[1]	25,540	28,860	16,420	25,770	39,320
Option 1	$432.1	$462.8	$354.6	$384.3	$493.6
Option 2	$548.8	$582.8	$444.4	$484.0	$633.3
Option 3	$746.7	$854.1	$587.0	$649.5	$883.6
Option 4	$903.9	$1,088.2	$707.0	$768.0	$1,121.2
Option 5	$1,515.9	$1,632.9	$1,340.9	$1,390.4	$1,671.3
Option 6	$621.6	$736.9	$501.5	$541.3	$706.6
Option 7	$671.3	$781.9	$542.4	$585.1	$756.6
BAT Option	$830.7	$925.1	$680.3	$720.8	$979.6

Source: USEPA. See Economic Analysis. Cost estimates shown include costs to designated operations.
Numbers may not add due to rounding. NA = Not Applicable. Option/Scenario definitions provided in Table 10–2.
[1] "Total" adjusts for operations with more than a single animal type. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

3. Costs to Offsite Recipients of CAFO Manure Under the Proposed Regulations

As described in Section VII, EPA is proposing that offsite recipients of CAFO manure certify to the CAFO that manure will be land applied in accordance with proper agriculture practices. As shown in Table 10–3, EPA estimates that 18,000 non-CAFO farming operations will receive manure and therefore be required to certify proper manure utilization under the proposed two-tier structure. Under the alternative three-tier structure, up to 3,000 additional farming operations may be affected. EPA's analysis assumes that affected CAFO manure recipients are mostly field crop producers who use CAFO manure as a fertilizer substitute. EPA's analysis does not reflect manure hauled offsite for alternative uses such as incineration or pelletizing. EPA estimates the annualized cost of this requirement to offsite recipients to be $9.6 to $11.3 million across the co-proposed alternatives (Tables 10–3 and 10–4). This analysis is provided in the Development Document.

Estimated costs to recipients of CAFO manure include incremental recordkeeping and soil tests every 3 years. Conservation Technology Information Center (CTIC) Core 4 survey data suggest an average of 46 percent crop farmers regularly sample their soil. EPA believes crop farmers already maintain records pertaining to crop yields, nutrient requirements, and fertilizer applications. EPA also assumed that crop farmers have a nutrient management plan, though the plan is not necessarily a PNP (Permit Nutrient Plan) or CNMP (Comprehensive Nutrient Management Plan). EPA has evaluated alternative approaches to ensuring that manure is handled properly, bnt is not proposing to establish specific requirements for offsite recipients. The costs to offsite recipieuts do not include the costs of spreading manure at the offsite location or any additional payments made to brokers or manure recipients in counties with excess manure. These costs are likely to be offset by the fertilizer saviugs and organic value associated with manure. EPA's analysis accounts for the costs incurred by the CAFO for offsite transfer of excess manure in the estimated indnstry complianco costs, described in Section X.E.1. These costs include the cost of soil and manure sampling at the CAFO site, training for manure applicators, application equipment calibration, and the hauling cost of excess manure generated by the CAFO.

Under the proposed regulations, CAFOs would be required to apply manure on a phosphorus basis where necessary, based on soil conditions, and on a nitrogen basis elsewhere. EPA anticipates that offsite recipients of CAFO manure will only accept manure when soil conditions allow for application on a nitrogen basis. EPA believes this is a reasonable assumption because crop farms are less likely to have a phosphorus buildup associated with long term application of manure. EPA's analysis assumes a nitrogen-based application rate for offsite locations that is identical to the rate used by CAFOs in the same geographic region. A summary of the data and methodology used by EPA to calcnlate the number of affected offsite recipients and to estimate costs is presented in Section X.C.2(b). EPA solicits comment on the costs and assumptions pertaining to offsite recipients.

F. Estimated Economic Impacts of the Proposed Regulatory Options/Scenarios

This section provides an overview of EPA's estimated economic impacts across four industry segments that are included for this analysis: CAFOs (both existing aud new sources), non-CAFO recipients of manure, processors, and consumer markets. More detailed information on each of these analyses is available in the Economic Aualysis.

1. CAFO Level Analysis

This section presents EPA's analysis of financial impacts to both existing and new CAFOs that will be affected by the proposed regulations, as well as impacts to offsite recipients of CAFO menure who will also be required to comply with the proposed PNP requirements.

e. *Economic Impacts to Existing CAFOs under the Proposed Regulations.* As discussed in Section X.C.1, EPA's CAFO level analysis examines compliance cost impacts for a representative "model CAFO." EPA evaluates the economic achievability of the proposed regulatory options at existing animal feeding operations based on changes in representative financial conditions across three criteria. These criteria are: a comparison of incremental costs to total revenue (sales test), projected post-compliance cash flow over a 10-year period, and an assessment of an operation's debt-to-asset ratio under a post-compliance scenario. To evaluate economic impacts to CAFOs in some sectors, impacts are avaluated two ways'assuming that a portion of the costs may be passed on from the CAFO to the consumer and assuming that no costs passthrough so that all costs are absorbed by the CAFO.

EPA used the financial criteria to divide the impacts of the proposed regulations into three impact categories. The first category is the affordable category, which means that the regulations have little or no financial impact on CAFO operations. The second category is the moderate impact category, which means that the regulations will have some financial impact on operations at the affected CAFOs, but EPA does not consider these operations to be vulnerable to closure as a result of compliance. The third category is the financial stress category, which means that EPA considers these operations to be vulnerable to closure post-compliance. More information on these criteria is provided in Section 4 of the Ecouomic Analysis.

The basis for EPA's economic achievability criteria for this rulemaking is as follows. USDA's financial classification of U.S. farms identifies au operation with negative income and a debt-asset ratio in excess of 40 percent as "vulnerable." An operation with positive income and a debt-asset ratio of less than 40 percent is considered "favorable." EPA adopted this classification scheme as part of its economic achievability criterie, using net cash flow to represent income. This threshold and cash flow criterion is established by USDA and other land grent universities, as further described in Section 4 of the Economic Analysis. The threshold values used for the cost-to-sales test (3 percent, 5 percent and 10 percent) are those determined by EPA to be appropriate for this rulemaking and are consistent with threshold levels used by EPA to measure impacts of regulations for other point source dischargers (as also documented in the Economic Analysis).

For this analysis, EPA's determination of economic achievability used all three criteria. EPA considered the proposed regulations to be economically achievable for a representative model CAFO if the average operatiou has a post-compliance sales test estimate within an acceptable range, positive post-compliance cash flow over a 10-year period, and a post-compliance debt-to-asset ratio not exceeding 40 percent. If the sales test shows that compliance costs are less than 3 percent of sales, or if post-compliance cash flow is positive and the post-compliance debt-to-asset ratio does not exceed 40 percent and compliance costs are less than 5 percent of sales, EPA considers the options to be "Affordable" for the representative CAFO group. A sales test of greater than 5 percent but less than 10 percent of sales with positive cash flow and a debt-to-asset ratio of less than 40 percent is considered indicative of some impact at the CAFO level, but at levels not as severe as those indicative of financial distress or vulnerability to closure. These impacts are labeled "Moderate" for the representative CAFO group. EPA considers both the "Affordable" and "Moderate" impact categories to be economically achievable by the CAFO.

If (with a sales test of greater than 3 percent) post-compliance cash flow is negative or the post-compliance debt-to-asset ratio exceeds 40 percent, or if the sales test shows costs equal to or exceeding 10 percent of sales, the proposed regulations are estimated to be associated with potential financial stress for the entire representative CAFO group. In such cases, each of the operations represented by that group may be vulnerable to closure. These impacts are labeled as "Stress." EPA considers the "Stress" impact category to indicate that the proposed requiremeuts may not be economically achievable by the CAFO, subject to other considerations.

Tables 10–6 and 10–7 present the estimated CAFO level impects in terms of the number of operations that fall within the affordable, moderate, or stress impact categories for each of the co-proposed alternatives by sector end facility size group. For some sectors, impects are shown for both the zero and the partial cost passthrongh assumptions (discussed more fully below). Partiel cost passthrough values very by sector, as described iu Section X.D.1.

EPA's costs model analyzes impacts under two sets of conditions for ELG Option 3. Option 3A assumes that there is a hydrologic connection from groundwater to surface waters at the

CAFO; Option 3 assumes average costs conditions across all operations—both operations with and without a hydrologic link. Based on available data and information, EPA's analysis assumes 24 percent of the affected operations heve a hydrologic connection to surface waters. More detail on this assumption may be fouud in the rulemaking record. EPA solicits comment on this assumption as part of today's proposed rulemaking.

Based on results showu in Tables 10–6 and 10–7, EPA proposes that the regulatory alternatives are economically achievable for all representative model CAFOs in the veal, turkey and egg laying sectors. The proposed requirements under the two-tier structure are also expected to be economically achievable by all affected heifer operations. Furthermore, although operations across most sectors may experience moderate impacts, EPA does not expect moderate finaucial impacts to result in closure and considers this level of impact to be economically achievable.

In the beef cattle, heifer, dairy, hog and broiler sectors, however, EPA's analysis indicates that the proposed regulations will cause some operations to experience financial stress, assuming no cost passthrough. Those operations may be vnlnerable to closure by complying with the proposed regulations. Across all sectors, an estimated 1,890 operations would experience financial stress under the two-tier structure and an estimated 2,410 operations would experience stress under the three-tier structure. For both tier structures, EPA estimates that the percentage of operations that would experience impacts under the stress category represent 7 percent of all affected CAFOs or 8 percent of all affected operations in the sectors where impacts are estimated to cause financial stress (cattle, dairy, hog, and broiler sectors).

Tables 10–6 shows results for the two-tier structure at the 500 AU threshold. By sector, EPA estimates that 1,420 hog operations (17 percent of affected hog CAFOs), 320 dairies (9 percent of operations), 150 broiler operations (2 percent), and 10 beef operations (less than 1 percent) would experience financial stress. The broiler and hog operations with these impacts have more than 1,000 AU on-site (i.e., no operations with between 500 and 1,000 AU fall in the stress category). The dairy and cattle operations with stress impacts are those that have a ground water link to surface water. Although not presented here, the results of the two-tier structure at the 750 AU threshold are very similar in terms of number of operations affected. The results of this analysis are presented in the Economic Analysis.

Table 10–7 presents results for the three-tier strncture, and show that 1,420 hog operations (17 percent of affected hog CAFOs under that alternative), 610 dairies (9 percent of operations), 330 broiler operations (2 percent), and 50 beef aud heifer operations (1 percent) will he adversely impacted. Hog operations with stress impacts all have more than 1,000 AU. Affected broiler facilities include operations with more than 1,000 AU, as well as operations with less than 1,000 AU. Dairy and cattle operations in the stress category are operations that have a hydrologic link from ground water to surface water. Based on these results, EPA is proposing that the proposed regulations are economically achievable.

In the hog and broiler sectors, EPA also evaluated financial impacts with an assumption of cost passthrough. For the purpose of this analysis, EPA assumes that the hog sector could passthrough 46 percent of compliance costs and the broiler sector could passthrough 35 percent of compliance costs. EPA derived these estimates from price elasticities of supply and demand for each sector reported in the academic literature. More detailed information is provided in Section 4 and Appendix C of the Economic Analysis. Assuming these levels of cost passthrough in these sectors, the magnitnde of the estimated impacts decreases to the affordable or moderate impact category. Even in light of the uncertainty of cost passthrough (both in terms of whether the operations are able to pass cost increases up the marketing chain and the amount of any cost passthrough), EPA proposes that the proposed regulations will be economically achievable to all hog and broiler operations.

Although EPA's analysis does not consider cost passthrough among cattle or dairy operations, EPA does expect that long-run market and structural adjustment by producers in this sector will diminish the estimated impacts. However, EPA did determine that an evaluation of economic impacts to dairy producers would require that EPA assume cost passthrough levels in excess of 50 percent before operations in the financial stress category would, instead, fall into tha affordable or moderate impact category. EPA did not conduct a similar evaluation of estimated impacts to beef cattle and heifer operations.

EPA believes that the assumptions of cost passthrough are appropriate for the pork and poultry sectors. As discussed in Section VI, EPA expects that meat packing plants and slaughtering facilities in the pork and poultry industries may be affected by the proposed co-permitting requirements in today's proposed regulations. Given the efficiency of integration and closer producer-processor linkeges, the processor has an incentive to eusure a coutinued production by contract growers. EPA expects that these operations will be able to pass on a portion of all incurred compliance costs and will, thus, more easily absorb the costs associated with today's proposed rule. This passthrough may be achieved either through higher contract prices or through processor-subsidized centralized off-site or on-site waste treatment and/or development of marketable uses for manure.

EPA recognizes, however, that some industry representatives do not support assumptions of cost passthrough from contract producers to integrators, as also noted by many small entity represantatives during the SBREFA outreach process as well as by members of the SBAR Panel. These commenters have noted that integrators have a bargaining advantage in negotiating contracts, which may ultimately allow them to force producers to incur all compliance costs as well as allow them to pass any additional costs down to growers that may be incurred by the processing firm. To examine this issue, EPA conducted an extensive review of the agricultural literature on market power in each of the livestock and poultry sectors and concluded that there is little evidence to suggest that increased production costs would be prevented from being passed on throngh the market levels. This information is provided in the rulemaking record. Given the uncertainty of whether costs will be passed on, EPA's results are presented assuming some degree of cost passthrough and also no cost passthrough (*i.e.*, the highest level of impacts projected). EPA requests comment on its cost passthrough assumptions. Although EPA does consider the results of both of these analyses in making its determination of economic achievability, EPA's overall conclusions do not rely on assumptions of cost passthrough.

Finally, EPA believes its estimated impacts may be overstated since the analysis does not quantify various cost offsets that are available to most operations. One source of potential cost offset is cost share and technical assistance available to operators for on-site improvements that are available from various state and federal programs, such as the Environmental Quality

Incentives Program (EQIP) administered by USDA. Another source of cost offset is revenue from manure sales, particularly of relatively higher value dry poultry litter. EPA's analysis does not account for these possible sources of cost offsets because the amonnt of cost offset is likely variable among facilities, depending on certain site-specific conditions. If EPA were to quantify the potential cost offsets as part of its analysis, this would further support EPA's proposed determination that the proposed requirements are economically achievable to affected operations. This analysis and additional supporting documentation is provided in Section 6 of the Economic Analysis.

Appendix D of the Economic Aualysis provides results of sensitivity analyses, conducted by EPA, to examine the impact under differiug model assumptions. This analysis examines the change in the modeling results from varying the baseline assnmptions on gross and net cash income, debt-to-asset ratios as well as other variability factors for model CAFOs. These sensitivity analyses conclude that the results presented here are stable across a range of possible modeling assumptions. EPA also conducted sensitivity analysis of the compliance costs developed for the purpose of estimating CAFO level impacts, as documented in the Development Document.

TABLE 10–6.—IMPACTED OPERATIONS UNDER THE TWO-TIER STRUCTURE (BAT OPTION/SCENARIO 4A)

Sector	Number of CAFOs	(Number of affected operations)					
		Zero cost passthrough			Partial cost passthrough		
		Affordable	Moderate	Stress	Affordable	Moderate	Stress
Fed Cattle	3,080	2,830	240	10	ND	ND	ND
Veal	90	90	0	0	ND	ND	ND
Heifer	800	680	120	0	ND	ND	ND
Dairy	3,760	3,240	200	320	ND	ND	ND
Hogs: GF[1]	2,690	1,710	180	810	2,690	0	0
Hogs: FF[1]	5,860	5,210	30	610	5,860	0	0
Broilers[4]	9,780	1,960	7,670	150	8,610	1,170	0
Layers—Wet[2]	360	360	0	0	ND	ND	ND
Layers—Dry[2]	1,280	1,280	0	0	ND	ND	ND
Turkeys	1,280	1,230	50	0	ND	ND	ND
Total[3]	28,970	18, 580	8,490	1,890	26,840	1,800	330

Source: USEPA. See Economic Analysis. Impact estimates shown include impacts to designated operations.
Numbers may not add due to rounding. ND=Not Determined. Option/Scenario definitions provided in Table 10–2.
Category definitions ("Affordable," "Moderate" and "Stress") are provided in Section X.F.1.
[1] "Hogs: FF" are farrow-finish (includes breeder and nursery pigs); "Hogs: GF" are grower-finish only.
[2] "Layers: wet" are operations with liquid manure systems; "Layers: dry" are operations with dry systems.
[3] "Total" does not adjust for operations with mixed animal types, for comparison purposes, to avoid understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site.

TABLE 10–7.—IMPACTED OPERATIONS UNDER THE THREE-TIER STRUCTURE (BAT OPTION/SCENARIO 3)

Sector	Number of CAFOs	(Number of affected operations)					
		Zero cost passthrough			Partial cost passthrough		
		Affordable	Moderate	Stress	Affordable	Moderate	Stress
Fed Cattle	3,210	2,540	650	20	ND	ND	ND
Veal	140	140	0	0	ND	ND	ND
Heifer	980	800	150	30	ND	ND	ND
Dairy	6,480	5,300	560	610	ND	ND	ND
Hogs: GF[2]	2,650	1,660	190	810	2,650	0	0
Hogs: FF[1]	5,710	5,070	30	610	5,710	0	0
Broilers	13,740	1,850	11,560	330	12,320	1,440	0
Layers—Wet[2]	360	360	0	0	ND	ND	ND
Layers—Dry[2]	1,660	1,660	0	0	ND	ND	ND
Turkeys	2,060	1,950	110	0	ND	ND	ND
Total[3]	37,000	21,300	13,250	2,410	33,410	2,930	660

Source: USEPA. See Economic Analysis. Impact estimates shown include impacts to designated operations.
Numbers may not add due to rounding. ND=Not Determined. Option/Scenario definitions provided in Table 10–2.
Category definitions ("Affordable," "Moderate" and "Stress") are provided in Section X.F.1.
[1] "Hogs: FF" are farrow-finish (includes breeder and nursery pigs); "Hogs: GF" are grower-finish only.
[2] "Layers: wet" are operations with liquid manure systems; "Layers: dry" are operations with dry systems.
[3] "Total" does not adjust for operations with mixed animal types, for comparison purposes, to avoid understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site.

h. *Economic Impacts to Existing CAFOs under Alternative Regulatory Options and Scenarios.* Table 10–8 presents estimated financial stress impacts to model CAFOs under alternative option and scenario combinations, assuming that no costs passthrough. The results shown are aggregated and combine impacts in the cattle sector (including all beef, veal and heifer operations), hog sector (including all phases of production), and poultry sector (including all broiler, egg laying and turkey operations). Results are shown for Scenario 4a (two-tier), Scenario 3 (three-tier), and Scenario 4b. Results are shown for technology Options 1 through 5. Additional information is available in the Economic Analysis that supports today's rulemaking.

As shown in Table 10–8, the number of potential closures range from 610 operations (Option 1 in combination with all Scenarios) to more than 14,000 potential closures (Option 4/Scenario 4b). Among options, the number of possible closures are highest under the more stringent options, including Options 3A (i.e., requires groundwater controls at operations where there is a determined groundwater hydrologic connection to surface waters), Option 4 (groundwater controls and surface water sampling), and Option 5 (i.e., zero discharge from the animal production area with no exception for storm events). Differences across scenarios reflects differences in the number of affected operations; accordingly, the number of closures is greatest under Scenario 4b that would define as CAFOs all confinement operations with more than 300 AU.

TABLE 10–8.—"STRESS" IMPACTS AT CAFOS UNDER ALTERNATIVE OPTIONS/SCENARIOS

Sector	Number of CAFOs	(Number of operations)						
		Option 1	Option 2	Option 3	Option 3A[1]	Option 4	Option 5	BAT option
BAT Option/NPDES Scenario 4a (>500 AU)								
Cattle	3,960	0	0	0	10	0	30	10
Dairy	3,760	0	0	0	320	0	0	320
Hogs	8,550	610	300	230	310	570	1,420	1,420
Poultry	12,700	0	150	260	100	6,660	150	150
Total[2]	28,970	610	450	490	730	7,230	1,590	1,890
BAT Option/NPDES Scenario 4b (>300 AU)								
Cattle	5,330	0	0	0	90	30	180	90
Dairy	7,140	0	0	0	700	0	0	700
Hogs	14,370	610	300	230	330	570	1,420	1,420
Poultry	18,300	0	320	470	380	11,030	320	320
Total[2]	45,140	610	620	700	1,500	11,630	1,910	2,530
BAT Option/NPDES Scenario 3 (>300 AU with certification)								
Cattle	4,330	0	0	0	50	0	100	50
Dairy	6,480	0	0	0	610	0	0	610
Hogs	8,360	610	300	230	320	570	1,420	1,420
Poultry	17,830	0	330	470	370	10,740	330	330
Total[2]	37,000	610	630	700	1,350	11,310	1,850	2,410

Source: USEPA. See Economic Analysis. Impact estimates shown include impacts to designated operations.
Numbers may not add due to rounding. ND = Not Determined. Option/Scenario definitions provided in Table 10–2.
[1] Option 3A impacts reflect operations where there is a determined groundwater hydrologic connection to surface waters (assumed at 24 percent of the affected operations).
[2] "Total" does not adjust for operations with mixed animal types, for comparison purposes, to avoid understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

c. *Economic Analysis of New CAFOs from NSPS under the Proposed Regulations.* For new sources, EPA is proposing that operations meet performance standards, as specified by the BAT requirements (Option 3 NSPS, beef and dairy subcategories, and Option 5 NSPS, swine and poultry subcategories), with the additional requirement that all new hog and poultry operations also implement groundwater controls where there is a hydrologic link to surface water (Option 3 NSPS, swine and poultry subcategories). Additional information on new source requirements is provided in Section VIII of this document.

In general, EPA believes that new CAFOs will be able to comply at costs that are similar to, or less than, the costs for existing sources, because new sources can apply control technologies more efficiently than sources that need to retrofit for those technologies. New sources will be able to avoid these costs that will be incurred by existing sources. Furthermore, EPA believes that new sources can avoid the costs associated with ground water protection through careful site selaction. There is nothing about today's proposal that would give existing operators a cost advantage over new feedlot operators; therefore, new source standards are not expected to present a barrier to entry for new facilities.

EPA's analysis of the NSPS costs indicate that requiring Option 3 for new sources in the beef and dairy subcategories and both Option 3 NSPS and Option 5 NSPS for the swine and poultry subcategories ("Option 5+3 NSPS") would be affordable and would not create any barriers to entry into those sectors. The basis for this determination is as follows. Option 5+3 NSPS is considered equivalent to Option 5 for new sources in terms of cost. EPA is proposing that Option 3 NSPS for beef and dairy subcategories and Option 5 NSPS for swine and poultry subcategories is economically achievable for existing sources. Since the estimated costs for these options are the same as or less expensive than costs for these same options for existing sources, no barriers to entry are created.

Under Option 5+3 NSPS, costs for new sources in the swine and poultry subcategories would be the same as or less than those for equivalent existing sources (BAT under Option 5), as long as new sources are not sited in areas where there is a hydrulogic link to surface water. New operations are not expected to incur costs estimated under Option 3A, which includes groundwater controls, since they are not likely to establish a new operation where there is a hydrologic link to surface waters (and where operating expenses would be more costly). Thus EPA assumes that tha costs for Option 5+3 NSPS are the same as those for Option 5 NSPS, which in turn are the same as those for Option 5 BAT. EPA is proposing that Option 5 BAT is economically achievable for existing sources in the swine and poultry subcategories and therefore this same option should be affordable to new sources. Furthermore, because costs to new sources for meeting Option 5 NSPS are no more expensive than the costs for existing sources to meet Option 5 BAT, there should be no barriers to entry.

The estimated costs of Option 3 NSPS for the beef and dairy subcategories are the same as or less than the costs for Option 3 BAT, which includes retrofitting costs. EPA is proposing that Option 3 BAT is economically achievable for existing sources in these sectors. Since Option 3 NSPS is no more expensive than Option 3 BAT, this option should also be economically achievable for new sources and should not create any barriers to entry. In fact, new sources may be able to avoid the cost of implementing groundwater controls through careful site selection, thus their costs may be substantially lower than similar existing sources.

EPA did not consider an option similar to Option 5+3 NSPS for the beef and dairy subcategories (Option 8 NSPS), but found this option to be substantially more expensive than Option 3 BAT for the dairy sector and could create barriers to entry for this sector. Therefore, EPA rejected this option. See Section 5 of the Economic Analysis for more details on these analyses.

d. *Economic Impacts to Offsite Recipients of CAFO Manure of the Proposed Regulations.* As discussed in Section X.D.1, EPA assesses the economic impact to offsite recipients of CAFO manure by comparing the estimated cost of this requirement to both aggregate and average per-farm production costs and revenues. For the purpose of this analysis, EPA assumes that these regulatory costs will be borne by a non-CAFO farming operation that uses animal manures as a fertilizer substitute.

EPA estimates that 17,900 to 21,200 farming operations will incur $9.6 million to $11.3 million in costs associated with requirements for the offsite transfer of CAFO manure (Tables 10–3 and Table 10–4). This translates to an average cost of roughly $540 per recipient. As reported by USDA, farm production expenses in 1997 totaled $150.6 billion nationwide. Revenue from farm sales totaled $196.9 billion. Averaged across the total number of farms, average per-farm costs and revenues were $78,800 and $113,000 in 1997, respectively. Using these data, the ratio of incremental costs to offsite recipients as a share of average operating expenses and average farm revenue is well under one percent. Total estimated compliance costs ($9.6 million to $11.3 million annually) as a share of aggregate farm expenses and sales is also under one percent. This analysis is provided in Section 5 of the Economic Analysis.

2. Processor Level Analysis

As discussed in Section X.D.2, EPA did not conduct a detailed estimate of the costs and impacts that would accrue to individual co-permittees due to lack of data and market information. However, EPA believes that the framework used to estimate costs to CAFO provides a means to evaluate the possible upper bound of costs that could accrue to potential co-permittees, based on the potential share of (pre-tax) costs that may be passed on from the CAFO (described in Section X.D.2). EPA is proposing that this amount approximates the magnitude of the costs that may be incurred by processing firms in those industries that may be affected by the proposed co-permitting requirements.

Table 10–9 presents the results of EPA's analysis. This analysis focuses on the potential magnitude of costs to co-permittees in the pork and poultry sectors only since these are the sectors where the proposed co-permitting requirements could affect processing facilities. However, EPA did not evaluate the potential magnitude of costs to egg and turkey processors because the compliance costs to CAFOs in these industries is projected to be easily absorbed by CAFOs (see Section X.F.1). The results presented in Table 10–9 are for the pork and broiler industries only. EPA also did not evaluate the potential costs to cattle and dairy processors because EPA does not expect that the proposed co-permitting requirements to affect meat packing and processing facilities in these industries, for reasons outlined in Section VI.

The potential magnitude of costs to co-permittees is derived from the amount of cost passthrough assumed in the CAFO level analysis, described in Section X.F.1. For this analysis, two scenarios of cost passthrough to processors are evaluated: partial cost passthrough (greater than zero) and also 100 percent cost passthrough. EPA's partial cost passthrough scenario assumes that 46 percent of all hog compliance costs and that 35 percent of all broiler compliance costs are passed on to the food processing sectors. Based on the results of this analysis, EPA estimates that the range of potential annual costs to hog processors is $135 million (partial cost passthrough) to $306 million (full cost passthrough). EPA estimates that the range of potential annual costs to broiler processors as $34 million (partial cost passthrough) to $117 million (full cost passthrough). These results are shown in Table 10–9 and are expressed in 1999 pre-tax dollars.

To assess the magnitude of impacts that could accrue to processors using this approach, EPA compares the passed through compliance costs to both aggregate processor costs of production and to revenues (a sales test). The results of this analysis are shown in Table 10–9 and are presented in terms of the equivalent 1997 compliance cost as compared to 1997 data from the Department of Commerce on the revenue and costs among processors in the hog and broiler industries. As shown, EPA estimates that, even under full cost passthrough, incremental cost changes are less than two percent and passed through compliance costs as a share of revenue are estimated at less than one percent. EPA solicits comment on this approach. Additional information is provided in the Economic Analysis.

TABLE 10–9.—IMPACT OF PASSED THROUGH COMPLIANCE COSTS UNDER CO-PROPOSED ALTERNATIVES

Sector	Passed through compliance cost		1997 revenues	1997 delivered cost	1997 Passed through cost-to-revenues		Passed through cost-to-delivered cost	
	Partial CPT	100% CPT			Partial CPT	100% CPT	Partial CPT	100% CPT
	($1999, million)		($1997, million)		(percent, comparing costs in $1997)			
Hog Processors								
Two-Tier	135	294	38,500	15,700	0.3%	0.7%	0.8%	1.8%
Three-Tier	141	306			0.4%	0.8%	0.9%	1.9%
Broiler Meat Processors								
Two-Tier	34	97	17,700	9,100	0.2%	0.5%	0.4%	1.0%
Three-Tier	41	117			0.2%	0.6%	0.4%	1.2%

Source: USEPA. 1997 processor revenues and costs are from the Department of Commerce. Option/Scenario definitions provided in Table 10–2. Estimated compliance costs are pre-tax. CPT = Cost passthrough. Partial CPT assumes 46% CPT for the hog sector and 35% CPT for the broiler sector.

3. Market Level Analysis

As discussed in Section X.D.3, EPA's market analysis evaluates the effects of the proposed regulations on commodity prices and quantities at the national level. EPA's market model predicts that the proposed regulations will not result in significant industry-level changes in prodnction and prices for most sectors. Tables 10–10 aud 10–11 show predicted farm and retail price changes across the two-tier (500 AU threshold) and three-tier strnctures. For comparison purposes, the average annual percentage change in price from 1990 to 1998 is shown. Analyses of other technology options and scenarios considered by EPA are provided in the record.

EPA expects that predicted changes in animal production may raise prodncer prices, as the market adjusts to the proposed regulatory requirements. For most sectors, EPA estimates that producer price changes will rise by less than one percent of the pre-regulation baseline price (Table 10–10). The exception is in the hog sector, where estimated compliance costs slightly exceed one percent of the baseline price. At the retail level, EPA expects that the proposed regulations will not have a substantial impact on overall production or consumer prices for value-added meat, eggs, and flnid milk and dairy products. EPA estimates that retail price increases resulting from the proposed regulations will be nnder one perceut of baseline prices in all sectors, averaging below the rate of general price inflation for all foods (Table 10–11). In terms of retail level price changes, EPA estimates that poultry and red meat prices will rise about one cent per pound. EPA also estimates that egg prices will rise by about one cent per dozen and that milk prices will rise by about one cent per gallon.

Appendix D of the Economic Analysis provides results of sensitivity analyses, conducted by EPA, to examine the impact under differing model assumptions. EPA examined variations in the price elasticities and prices assumed for these industries, based on information reported in the agricultural literature and statistical compendiums. These sensitivity analyses demonstrate that the results presented here are stable across a range of possible modeling assumptions.

TABLE 10–10.—ESTIMATED INCREASES IN FARM PRICES UNDER THE CO-PROPOSED ALTERNATIVES

Option/Scenario	Beef ($/cwt)	Dairy ($/cwt)	Hogs ($/cwt)	Broilers (cents/lb)	Layers (cents/doz.)	Turkeys (cents/lb)
Pre-reg. Avg Price	$68.65	$13.90	$56.41	38.43	72.51	41.66
Avg. Chg 90–98	4.6%	8.0%	15.2%	5.7%	11.5%	4.4%
Two-Tier	0.22	0.06	0.61	0.19	0.14	0.13
Three-Tier	0.24	0.08	0.66	0.23	0.15	0.16

Source: USEPA, except historical data that are from USDA. Option/Scenario definitions provided in Table 10–2.

TABLE 10–11.—ESTIMATED INCREASES IN RETAIL PRICES UNDER THE CO-PROPOSED ALTERNATIVES

Option/Scenario	Beef ($/lb)	Dairy (index)	Hogs ($/lb)	Broilers (cents/lb)	Layers (cents/doz.)	Turkeys (cents/lb)
Pre-reg. Avg Price	$2.91	145.50	$2.55	156.86	110.11	109.18
Avg. Chg 90–98 (%)	2.3%	2.4%	5.1%	3.0%	7.2%	2.4%
Two-Tier	0.00	0.61	0.01	0.19	0.14	0.13
Three-Tier	0.00	0.78	0.01	0.23	0.15	0.16

Source: USEPA, except historical data that are from USDA. Option/Scenario definitions provided in Table 10–2.

EPA does not expect that the proposed regulations will result in significant changes in aggregate employment or national ecouomic output, measured in terms of Gross Domestic Product (GDP). EPA expects, however, that there will be losses in employment and economic output associated with decreases in animal production due to rising compliance costs. These losses are estimated throughout the entire economy, using available modeling approaches, and are not attributable to the regulated community only. This analysis also does not adjust for offsetting increases in other parts of the economy and other sector employment that may be stimulated as a result of the proposed regulations, such as the construction and farm services sectors.

Table 10–12 show these predicted changes. Employment losses are measured in full-time equivalents (FTEs) per year, including both direct and indirect employment. Under tha two-tier structure (500 AU threshold), EPA estimates that the reduction in aggregate national level of employment is 16,600 FTEs. Under the three-tier structure, EPA estimates total aggregate job losses at 18,900 FTEs. This projected change is modest when compared to total national employment, estimated at about 129.6 million jobs in 1997. EPA's estimate of the aggregate reductions in national economic output is $1.7 billion under the two-tier structure. Under the three-tier structure, EPA estimates the loss to GDP at $1.9 billion. This projected change is also modest when compared to total GDP, estimated at $8.3 trillion in 1997. Additional information is available in the Economic Analysis.

TABLE 10–12.—ESTIMATED DECREASES IN EMPLOYMENT AND ECONOMIC OUTPUT

Option/ Scenario	Beef	Dairy	Hogs	Poultry	Total
Estimated Decreases in Employment (Number of FTEs)					
Two-Tier	4,600	3,200	6,400	2,400	16,600
Three-Tier	4,900	4,100	6,900	3,000	18,900
Estimated Decreases In Economic Output ($GDP)					
Two-Tier	$476	$307	$681	$251	$1,715
Three-Tier	$510	$396	$734	$306	$1,946

Source: USEPA. Option/Scenario definitions provided in Table 10–2. FTE = Full-time equivalent.

G. Additional Impacts

1. Costs to the NPDES Permitting Authority

Additional costs will be incurred by the NPDES permitting anthority to alter existing state programs and obtain EPA approval to develop new permits. review new permit applications and issne revised permits that meet the proposed regulatory requirements. Under the proposed rnle, NPDES permitting authorities will incur administration costs related to the development, issuance, and tracking of general or individual permits.

State and federal administrative costs to issoe a general permit include costs for permit development, pnblic notice and response to comments, and public hearings. States and EPA may also incur costs each time a facility operator applies for coverage under a general permit due to the expenses associated with a Notice of Intent (NOI). These per-facility administrative costs include initial facility inspections and annual record keeping expenses associated with tracking NOIs. Administrative costs for an individual permit include application review by a permit writer, public notice, and response to comments. An initial facility inspection may also be necessary. EPA developed its unit permit costs assumed for this analysis based on information obtained from a state permitting personnel. The cost assumptions used to estimate develop, review, and approve permits and inspect facilities are presented in the Development Document.

EPA assumes that, under the two-tier structure, an estimated 25,590 CAFOs would be permitted. This estimate consists of 24,760 State permits (17,340 General and 7,420 Individual permits) and 1,030 Federal permits (720 General and 310 Individual permits). Under the three-tier structure, an estimated 31,930 CAFOs would be permitted, consisting of 30,650 State permits (21,460 General and 9,190 Individual permits) and 1,280 Federal permits (900 General and 380 Individnal permits). Information on the estimated number of permits required under other regulatory alternatives is provided in the Economic Analysis. The basis for these estimates is described in the Development Document that snpports this rulemaking.

As shown in Table 10–13, under the two-tier structure, EPA estimates State and Federal administrative costs to implement the permit program to be $6.2 million per year: $5.9 million for states and $350,000 for EPA. Under the three-tier structure, EPA estimates State and Federal administrative costs to implement the permit program to be $7.7 million per year: $7.3 million for states and $416,000 for EPA. EPA expects that the bulk (95 percent) of estimated administrative costs will be incurred by the state permitting authority. EPA has expressed these costs in 1999 dollars, annualized over the 5-year permit life using a seven percent discount rate. The range of costs across each of the regulatory options is $4.2 million to $9.1 million annually (alternatives Scenario 1 and Scenario 4b, respectively). See Table 10–13. (EPA did not estimate permit authority costs under alternative NPDES Scenarios 5 and 6, described in Table 10–2.) This analysis is available in the record and is summarized in Section 10 of the Economic Analysis.

This analysis was conducted to evaluate the costs of the proposed rule to governments, as reqnired under the Uufunded Mandates Reform Act (UMRA), as discussed in Section XIII.C of this preamble.

TABLE 10–13.—ANNUAL STATE AND FEDERAL ADMINISTRATIVE COSTS, $1999

Regulatory scenario	State	Federal	Total
Scenario 1	3,922,990	268,630	4,191,620
Scenario 2	7,233,470	413,060	7,646,530
Scenario 3 ("Three-tier")	7,279,560	415,600	7,695,160
Scenario 4a ("Two-tier")	5,910,750	351,090	6,224,040

TABLE 10–13.—ANNUAL STATE AND FEDERAL ADMINISTRATIVE COSTS, $1999—Continued

Regulatory scenario	State	Federal	Total
Scenario 4b	8,645,520	483,010	9,128,530

Source: USEPA. See Economic Analysis. Other supporting documentation is in the Development Document.

2. Community Impacts

As discussed in Section X.F.3, EPA does not expect that the proposed regulations will result in significant increases in retail food prices or reductious in national level employment.

EPA also considered other community level impacts associated with this rulemaking. In particular, EPA considered whether the proposed rulo could have community level and/or regional impacts if it substantially altered the competitive position of livestock and poultry production across the nation, or led to growth or rednctions in farm production (in- or out-migration) in different regions and communities. Ongoing structural and technological change in these industries has influenced where farmers operate and has contributed to locational shifts between the more traditional prodnction regions and the more emergent, nontraditional regions. Production is growing rapidly in these regions due to competitive pressures from more specialized producers who face lower per-unit costs of production. This is especially true in hog and dairy production.

To evaluate the potential for differential impacts among farm production regions, EPA examined employment impacts by region. EPA concluded from this analysis that more traditional agricultural regions would not be disproportionately affected by the proposed regulations. This analysis is provided in the Economic Analysis.

EPA does uot expect that today's proposed requirements will have a significant impact on where animals are raised. On one hand, on-site improvements in waste management and disposal, as required by the proposed regulations, could accelerate recent shifts in production to more nontraditional regions as higher cost producers in some regions exit the market to avoid relatively higher retrofitting associated with bringing existing facilities into compliauce. On the other hand, the proposed regulations may favor more traditional production systems where operators grow both livestock and crops, since these operations tend to have available cropland for land application of manure nutrients. These types of operations tend to be more diverse and not as specialized and, generally, tend to be smaller in size. Long-standing farm services and inpnt supply industries in these areas could likewise benefit from the proposed rule, given the need to support on-site improvements in manure management and disposal. Local and regional governments, as well as other non-agricultural enterprises, would also benefit.

3. Foreign Trade Impacts

Foreign trade impacts are difficult to predict, since agricultural exports are determined by economic conditions in foreign markets and changes in the international exchange rate for the U.S. dollar. However, EPA predicts that foreign trade impacts as a result of the proposed regulations will be minor given the relatively small projected changes in overall supply and demand for these products and the slight increase in market prices, as described in Section X.F.3.

Despite its position as one of the largest agricultural producers in the world, historically the U.S. has uot been a major player in world markets for red meat (beef and pork) or dairy products. In fact, until recently, the U.S. was a net importer of these products. The presence of a large domestic market for value-added meat and dairy products has limited U.S. reliance on developing export markets for its products. As the U.S. has taken steps to expand export markets for red meat and dairy products, one major obstacle has been that it remains a relatively high cost producer of these products compared to other net exporters, such as New Zealand, Australia, and Latin America, as well as other more established and government-subsidized exporting countries, including the European Union and Canada. Increasingly, however, continued efficiency gains and low-cost feed is making the U.S. more competitive in world markets for these products, particularly for red meat. While today's proposed regulations may raise production costs and potentially reduce production quantities that would otherwise be available for export, EPA believes that any quantity and price chauges resulting from the proposed requirements will not significantly alter the competitiveness of U.S. export markets for red meat or dairy foods.

In contrast, U.S. poultry products account for a controlling share of world trade and exports account for a sizable and growing share of annual U.S. production. Given the established presence of the U.S. in world poultry markets and the relative strength in export demand for these products, EPA does not expect that the predicted quantity and price changes resulting from today's proposed regulations will have a significant impact on the competitiveness of U.S. poultry exports.

As part of its market analysis, EPA evaluatad the potential for changes in traded volumes, such as increases in imports and decreases in exports, and concluded that volume trade will not be significantly impacts by today's proposed regulations. EPA estimates that imports (exports) will increase (decrease) by less than 1 percent compared to baseline (pre-regulation) levels in each of the commodity sectors. By sector, the potential change in imports compared to baseline trade levels ranges from a 0.02 percent increase in broiler imports to a 0.34 percent increase in dairy product imports. The predicted drop in U.S. exports ranges from a 0.01 percent reduction in turkey exports to a 0.25 percent reduction in hog exports.

H. Cost-Effectiveness Analysis

As part of the process of developing effluent limitations guidelines and standards, EPA typically conducts a cost-effectiveness analysis to compare the efficiencies of regulatory options for removing pollutants and to compare the proposed BAT option to other regulatory alternatives that were considered by EPA. For the purpose of this regulatory analysis, EPA defines cost-effectiveness as the incremental annualized cost of a technology option per incremental pound of pollutant removed annually by that option. The analyses presented in this section include a standard cost-effectiveness (C–E) analysis for toxic pollutants, but also expand upon EPA's more traditional approach to include an analysis of the cost-effectiveness of removing nutrients and sediments. This expanded approach is more appropriate for evaluating the broad range of pollutants in animal manure and wastewater.

The American Society of Agricultural Engineers (ASAE) reports that the constituents present in livestock and poultry manure include: boron, cadmium, calcium, chlorine, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, sodium, sulfur, zinc, nitrogen and phosphorns species, total suspended solids, and pathogens. Of these pollutants, EPA's standard C–E analysis is suitable to analyze only the removal of metals and metallic compounds. EPA's standard C–E analysis does not adequately address removals of nutrients, total suspended solids, and pathogens. To account for the estimated removals of nutrients and sediments under the proposed regulations in the analysis, the Agency has developed an alternative approach to evaluate the pollutant removal effectiveness relative to cost. At this time, EPA has not developed an approach that would allow a similar assessment of pathogen removals. Section 10 of the Economic Analysis describes the methodology, data, and results of this analysis. (EPA did not estimate cost-effectiveness for the alternative NPDES Scenarios 5 and 6, described in Table 10–2.)

For this analysis, EPA has estimated the expected reduction of select pollutants for each of the regulatory options considered. These estimates measure the amount of nutrients, sediments, metals and metallic compounds that originate from animal production areas that would be removed nnder a post-regulation scenario (as compared to a baseline scenario) and not reach U.S. waters. Additional information on EPA's estimated loadings and removals under post-compliance conditions is provided in the Development Document and the Benefits Analysis that support today's rulemaking.

1. Cost-Effectiveness: Priority Pollutants

For this rulemaking, EPA identified a subset of metallic compounds for use in the C–E

For this rnlemaking, EPA identified a subset of metallic compounds for use in the C–E analysis: zinc, copper cadmium, nickel, arsenic, and lead. These six componnds are a subset of all the toxic compounds reported to be present in farm animal mannre (varies by animal species). Therefore, if loadiug reductious of all priority pollutants in manure were evaluated, the proposed regulations would likely be even more cost-effective (i.e., lower cost per pound-equivalent removal).

EPA calculates cost-effectiveness as the incremental annual cost of a pollution control option per incremental pollutant removal. In C–E analyses, EPA measures pollutant removals in toxicity normalized units called "pounds-equivalent," where the pounds-equivalent removed for a particular pollutant is determined by multiplying the number of pounds of a pollutant removed by each option by a toxicity weighting factor. The toxic weighting factors account for the differences in toxicity among pollutants and are derived nsing ambient water quality criteria. The cost-effectiveness value, therefore, represents the unit cost of removing an additional pound-equivalent of pollutants. EPA calculates the cost-effectiveness of a regulatory option as the ratio of pre-tax annualized costs of an option to the annual pounds-equivalent removed by that option, expressed as the average or incremental cost-effectiveness for that option. EPA typically presents C–E results in 1981 dollars for comparison purposes with other regulations. EPA uses these estimated compliance costs to calcnlate the cost-effectiveness of the proposed regulations, which include total estimated costs to CAFOs and offsite recipients of CAFO mauure (Section X.E) and costs to the permitting authority (Section X.G.1). Additional detail on this approach is provided in Appendix E of the Economic Analysis.

Cost-effectiveness results for select regulatory alternatives are presented in Table 10–14. Resnlts shown in Table 10–14 include the BAT Option (Option 3 for beef and dairy subcategories and Option 5 for the swine and ponltry subcategories) and Option 3+5 (both Option 3 and 5 for all subcategories). Options are showu for four CAFO coverage scenarios, including CAFOs with more than 1,000 AU and CAFOs with more than 500 AU (two-tier structure), and operations with more than 300 AU, both under Scenario 4b and as defined uuder Scenario 3 (three-tier structnre). The differences in CAFO coverage provide an upper and lower bound of the analysis to roughly depict the alternative NPDES scenarios. Both incremental and average C–E valnes are shown.

Incremental cost-effectiveuess is the appropriate measure for comparing one regulatory alternative to another for the same subcategory. In general, the lower the incremeutal C–E value, the more cost-efficient the regulatory option is in removing pollntants, taking into account their toxicity. For this rulemaking, EPA compares the cost-effectiveness across alternative NPDES Scenarios to assess the Agency's decisiou to define as CAFO operations with more than 500 AU (two-tier structure) and, alternatively, some operations with more than 300 AU (two-tier structure).

As shown in Table 10–14, the BAT Option is the most cost-efficient under each of the co-proposed alternatives. Under both the two-tier (500 AU) and three-tier structures, EPA estimates an incremental cost-effectiveness value of about $30 per pounds-equivalent (lbs.-eq.) removed. This compares to the alternative Scenario 4b that have a higher estimated incremental cost-effectiveness ($76/lbs.-eq., if all CAFOs with more than 1,000 AU are regulated). (Since the change in removals between Scenario 3 and Scenario 4b is zero, the incremental C–E value is "undefined.") The BAT Option is also more efficient than reqniring Option 3+5 for all subcategories, which has higher costs but results in no additional pollutaut removals compared to the BAT Option. This is because the ELG options differ mostly in terms of their monitoring and sampling requirements but establish no additional pollutant controls. (Since the change in removals between the BAT Option and Option 3+5 is zero, the incremental C–E value is undefined.)

The average cost-effectiveness reflects the "increment" between no regulation and regnlatory options shown. For the BAT Option, EPA estimates an average value at $55 per lbs.-eq. to $58 per lbs.-eq., depending on the proposed tier structure (Table 10–14). These estimated average values are low compared to the alternative NPDES scenarios since the average cost-effectiveness value is higher ($76/lbs.-eq., if all CAFOs with more than 1,000 AU are regulated; $62/lbs.-eq. for all CAFOs with more than 300 AU). This average cost is also low compared to previous ELG rulemakings, where estimated costs have, in some cases, exceeded $100/lbs.-eq. removed. This informatiou is provided in the Economic Analysis. In addition, as shown in Table 10–14, average cost-effectiveness is nearly twice as high under the more stringent Option 3+5 for all subcategories (estimated at more than $100 per lbs.-eq. removed). Costs, but also removals, are lower under the less stringent Option 1 (also referred to as the "nitrogen-based" option) compared to other technology options. As described in Section VIII, EPA determined that this option would not represent the best available technology and so chose not to propose it. This analysis, along with additional results for each subcategory and other regulatory alternatives, is provided in Appendix E on the Economic Analysis.

TABLE 10–14.—COST-EFFECTIVENESS RESULTS BY SELECT OPTION/SCENARIO ($1981)

Option	Total annual: Pound-equivalents removed [1]	Total annual: Total cost [2]	Average cost-effectiveness	Incremental cost-effectiveness
	(million pounds)	($ millions)	($/lbs.-eq.)	
"BAT Option" ELG Option 3 (Beef/Dairy) and 5 (Swine/Poultry)				
>1000 AU	5.3	402	76	76
>500 AU "Two-tier"	8.4	491	58	29
Scenario 3 "Three-tier"	9.4	518	55	28
>300 AU	9.4	579	62	ND
ELG Option 3+5 (All Subcategories)				
>1000 AU	5.3	1,047	197	197
>500 AU "Two-tier"	8.4	1,212	144	53
Scenario 3 "Three-tier"	9.4	1,251	133	40
>300 AU	9.4	1,353	144	ND

Source: USEPA. See Economic Analysis. Option/Scenario definitions provided in Table 10–2. ND=Not Determined.
[1] Pound-equivalent removals are calculated from removals estimated by EPA's loadings analysis, described in the Benefits Analysis and the Development Document, adjusting for each pollutants toxic weighting factor (as described in the Economic Analysis).
[1] Costs are pre-tax and indexed to 1981 dollars using the Construction Cost Index.

2. Cost-Effectiveness: Nutrients and Sediments

In addition to conducting a standard C–E analysis for select toxic pollutants (Section X.H.1), EPA also evaluated the cost-effectiveness of removing select non-conventional and conventional pollutants, inclnding nitrogen, phosphorns, and sediments. For this analysis, sediments are used as a proxy for total suspended solids (TSS). This analysis does not follow the methodological approach of a standard C–E analysis. Instead, this analysis compares the estimated compliance cost per pound of pollutant removed to a recognized benchmark, such as EPA's benchmark for conventional pollutants or other criteria for existing treatment, as reported in available cost-effectiveness studies.

The research in this area has mostly been conducted at municipal facilities, including publicly owned treatment works (POTWs) and wastewater treatment plants (WWTPs). Additional information is available based on the effectiveness of various nonpoint source controls and BMPs (Best Management Practices) and other pollntant control technologies that are commonly used to control runoff from agricultural lands. A summary of this literature is provided in the Economic Analysis. Benchmark estimates are used to evaluate the efficiency of regulatory options in removing a range of pollutants and to compare the results for each of the co-proposed tier structures to other regulatory alternatives. This approach also allows for an assessment of the types of management practices that will be implemented to comply with the proposed regulations.

Cost-effectiveness results for select regulatory alternatives are presented in Table 10–15. Results shown in Table 10–15 include the BAT Option (Option 3 for beef and dairy subcategories and Option 5 for the swine and poultry subcategories) and Option 3+5 (both Option 3 and 5 for all subcategories). Options are shown for four CAFO coverage scenarios, including CAFOs with more than 1,000 AU and CAFOs with more than 500 AU (two-tier structnre), and operations with more than 300 AU, both under Scenario 4b and as defined under Scenario 3 (three-tier structure). The differences in CAFO coverage provide an upper and lower bound of the analysis to roughly depict the alternative NPDES scenarios.

The values in Table 10–15 are average cost-effectiveness values that reflect the increment between no regulation and the considered regulatory options. All costs are expressed in pre-tax 1999 dollars. Estimated compliance costs used to calculate the cost-effectiveness of the proposed regulations include total estimated costs to CAFOs and offsite recipients of CAFO manure (Section X.E) and costs to the permitting authority (Section X.G.1).

Under the co-proposed tier structures, EPA estimates an average cost-effectiveness of nutrient removal at $4.60 per pound (two-tier) to $4.30 per pound (three-tier) of nitrogen removed. For phosphorus removal, removal costs are estimated at $2.10 to $2.20 per pound of phosphorus removed (Table 10–15). For nitrogen, EPA uses a cost-effectiveness benchmark established by EPA's Chesapeake Bay Program to assess the costs to WWTPs to implement BNR (biological nutrient removal) retrofits. EPA's average benchmark estimate is about $4 per pound of nitrogen removed at WWTPs in four states (MD, VA, PA, and NY), based on a range of costs of $0.80 to $5.90 per pound of nitrogen removed. Using this benchmark, EPA's estimated cost-effectiveness to remove nitrogen under the proposed regulations exceed EPA's average benchmark value, but falls within the estimated range of removal costs. However, EPA's estimated cost-effectiveness to remove phosphorus is lower than benchmark used for phosphorus of roughly $10 per pound, reported in the agricultural research as the costs to remove phosphorus using varions nonpoint source controls and management practices. Available data on phosphorus removal costs for industrial point source dischargers are much higher (exceed $100 per pound of phosphorus removed). Based on these results, EPA concludes that these values are cost-effective.

Costs and removals are nearly twice as high under the more stringent Option 3+5 for all subcategories (Table 10–15). Costs and removals are lower under the loss stringent Option 1, but EPA chose not to propose Option 1 because it does not represent the best available technology (also described in Section VIII of the preamble).

EPA estimates that the co-proposed thresholds (two-tier and three-tier structures) are more cost-effective compared to alternative AU thresholds, given slightly lower average cost-effectiveness values (Table 10–15). EPA estimates that the average cost-effectiveness to removo nitrogen is $5.10 per pound of nitrogen removed at a threshold that would regulate as CAFOs all operations with more than 1,000 AU; the average cost-effectiveness is $4.80 per pound of nitrogeu removed at the alternative 300 AU threshold (Table 10–15). EPA estimates that the average cost-effectiveness to remove phosphorus is $2.50 per pound and $2.30 per pound of phosphorus removed at the 1,000 AU and 300 AU threshold. EPA also estimates that the co-proposed tier structures are also the most cost-efficient, compared to other alternatives considered by EPA. These results, based on incremental cost-effectiveness values, are provided in the Economic Analysis.

Table 10–15 also shows that the cost to remove sediments under the BAT Option/Scenario is estimated at $0.003 per pound of sediment removal (1999 dollars). This estimated per-pound removal cost is low compared to EPA's POTW benchmark for conventional pollutants. This benchmark measures the potential costs per pound of TSS and BOD (biological nutrient demand) removed for an "average" POTW (see 51 FR 24982). Indexed to 1999 dollars, EPA's benchmark costs are about $0.70 per pound of TSS and BOD removed. The average cost-effectiveness of sediment removal uuder the BAT Option/Scenario is lower than under the alternative options. Option 1 results across the range of NPDES Scenarios are estimated at about $0.05 per-pound removal of sediments. This analysis, along with additional results for each subcategory and other regulatory alternatives, is provided in Appendix E on the Economic Analysis.

TABLE 10–5.—COST-EFFECTIVENESS RESULTS BY SELECT OPTION/SCENARIO ($1999)

Option/Scenario	Total cost [1]	Sediments	Nitrogen	Phosphorus	Sediments	Nitrogen	Phosphorus
	($m 1999)	(million pounds of removals)			(average $ per pound removed		
"BAT Option" ELG Option 3 (Beef/Dairy) and 5 (Swine/Poultry)							
>1000 AU	$688	209050	136	280	$0.003	$5.1	$2.5
>500 AU "Two-tier"	840	299708	182	377	0.003	4 6	2.2
>300 AU "Three-tier"	887	335456	206	425	0.003	4.3	2.1
>300 AU	991	335456	206	425	0.003	4.8	2.3
ELG Option 3+5 (All subcategories							
>1000 AU	1,791	209050	136	280	0.009	13.2	6.4
>500 AU "Two-tier"	2,074	299708	182	377	0.007	11.4	5.5
>300 AU "Three-tier"	2,141	335456	206	425	0.006	10.4	5.0
>300 AU	2,316	335456	206	425	0.007	11.2	5 5

Source: USEPA. See Economic Analysis. Option/Scenario definitions provided in Table 10–2. ND=Not Determined.
[1] Costs are pre-tax.

I. Cost-Benefit Analysis

EPA estimated and compared the costs and henefits attributed to the proposed regulations. The cost and benefit categories that the Agency was able to quantify and monetize for the proposed regulations are shown in Table 10–16.

Total social costs of the proposed regulations range from $847 milliou to $949 million annnelly, depending on the co-proposed approach (Table 10–16). These costs include complianca costs to industry, costs to recipients of CAFO manure, and administrative costs to States and Federal governments.

Under the two-tier structure, EPA projects that total compliance cost to industry is $831 million per year (pre-tax)/$572 million (post-tax). By comparison, under the thrae-tier structure, EPA estimates that the cost to industry is $930 million per year (pre-tax)/$658 million (post-tax). Costs to industry include annualized capital costs, operating and maintenance costs, start-up and recurring costs, and also recordkeeping costs. Estimated costs cover four broad categories: nutrient management planning, facility upgrades, land application, and technologios for balancing on-farm nutrients. In addition, under the two-tier structure, EPA estimates that the cost to off-site recipients of CAFO manure is $10 million per year. The administrative cost to State aud Federal governments to implement the permit program is $6 million per year. Under the three-tier structure, the annual cost to off-sita recipients of manure is $11 million and State and Federal administrative costs are $8 million per year.

EPA estimates that the monetized benefits of the proposed regulatious range from $146 million to $182 million annually, depending on the co-proposed approach (Table 10–16). Annual benefits are estimated to range from $146 million to $165 million under the two-tier structure; under the three-tier structure, estimated benefits range from $163 million to $182 million annually. EPA was only able to monetize (*i.e.*, place a dollar value on) a small subset of the range of potential benefits that may accrue under the proposed regulations. Data and methodological limitations restricted the uumber of benefits categories that EPA wes able to reasonably quantify and monetize. The proposed regulations benefits are primarily in the areas of reduced health risks and improved water quality, as shown in Table 10–16. In addition to these monetized benefits, EPA expects that additional benefits will accrue under the regulations, including reduced drinking water treatment costs, reduced odor and air emissions, improved water quality in estuaries, and avoided loss io property value near CAFOs, among other benefits. These benefits are described in more detail in the Benefits Analysis and other supporting documentation provided in the record.

TABLE 10–16.—TOTAL ANNUAL SOCIAL COSTS AND MONETIZED BENEFITS, $1999

[In millions of dollars]

Total social costs	"Two-Tier" structure (500 AU threshold)	Three-Tier structure (Scenario 3)
Industry Compliance Costs (pre-tax)	830.7	930.4
NPDES Permitting Costs	6.2	7.7
Offsite Recipients of CAFO Manure	9.6	11.3
Total Social Costs	846.5	949.4
Monetized Benefits		
Improved surface water quality	108.5	127.1
Reduced shellfish bed closures	0.2–2.4	0.2–2.7
Reduced fish kills	0.2–0.4	0.2–0.4
Improved water quality in private wells	36.6–53.9	35.4–52.1
Total Monetized Benefits	145.5–165.1	163.0–182.3

J. Initial Regulatory Flexibility Analysis

Pursuant to Section 603 of the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), the Agency prepared an Initial Regulatory Flexibility Analysis (IRFA) to assess the impacts on small livestock and poultry feeding operations. EPA's IRFA and other supplemental economic analyses, as required under Section 607 of the RFA, are provided in Section 9 of the Economic Analysis. This section summarizes the estimated number of small entities to which the rule will apply and quantitatively describes the effects of the proposed regulations. Other information on EPA's approach for estimating the number of small businesses in these sectors is provided in the Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule on National Pollutant Discharge Elimination System (NPDES) and Effluent Limitations Guideline (ELG) Regulations for Concentrated Animal Feeding Operations (referred to as the "Panel Report"). The Panel Report is available in the rulemaking record, as well as online at http://www.epa.gov/sbrefa. A summary of the Small Business Advocacy Review (SBAR) Panel proceedings and recommendations is provided in Section XII.G of this preamble. Section XIII.B of this preamble summarizes other requirements to comply with the RFA.

1. Definition of Small Business

The Small Business Administration (SBA) defines a "small business" in the livestock and poultry sectors in terms of average annual receipts (or gross revenue). SBA size standards for these industries define a "small business" as one with average annual revenues over a 3-year period of less than $0.5 million annually for dairy, hog, broiler, and turkey operations; $1.5 million for beef feedlots; and $9.0 million for egg operations. In today's rule, EPA is proposing to define a "small" egg laying operation for purposes of its regulatory flexibility assessments as an operation that generates less than $1.5 million in annual revenue. Because this definition of small business is not the definition established under the Regulatory Flexibility Act (RFA), EPA is specifically seeking comment on the use of this alternative definition as part of today's notice of the proposed rulemaking (see Section XIII.B and Section XIV). EPA also has consulted with the SBA Chief Counsel for Advocacy on the use of this alternative definition. EPA believes this definition better reflects the agricultural community's sense of what constitutes a small business and more closely aligns with the small business definitions codified by SBA for other animal operations. A summary of EPA's rationale and supporting analyses pertaining to this alternative definition is provided in the record and in the *Economic Analysis*.

2. Number of Small Businesses Affected under the Proposed Regulations

Table 10–17 shows EPA's estimates of the number of small businesses in the livestock and poultry sectors and the number of small businesses that are expected to be affected by the proposed regulations. The approach used to derive these estimates is described in more detail in Section 9 of the Economic Analysis and also in Sections 4 and 5 of the Panel Report. EPA presented this and other alternative approaches during the SBAR Panel proceedings, as discussed in Section XII.G.2.a of this document. EPA is requesting public comment on this approach.

EPA uses three steps to determine the number of small businesses that may be affected by the proposed regulations. First, EPA identifies small businesses in these sectors by equating SBA's annual revenue definition with the number of animals at an operation. Second, EPA estimates the total number of small businesses in these sectors using farm size distribution data from USDA. Third, based on the regulatory thresholds being proposed, EPA estimates the number of small businesses that would be subject to the proposed requirements. These steps are summarized below.

In the absence of farm or firm level revenue data, EPA identifies small businesses in these sectors by equating SBA's annual revenue definitions of "small business" to the number of animals at those operations (step 1). This step produces a threshold based on the number of animals that EPA uses to define small livestock and poultry operations and reflects the average farm inventory (number of animals) that would be expected at an operation with annual revenues that define a small business. This initial conversion is necessary because USDA collects data by farm size, not by business revenue. With the exception of egg laying operations, EPA uses SBA's small business definition to equate the revenue threshold with the number of animals raised on-site at an equivalent small business in each sector. For egg laying operations, EPA uses its alternative revenue definition of small business.

EPA estimates the number of animals at an operation to match SBA's definitions using SBA's annual revenue size standard (expressed as annual revenue per entity) and USDA-reported farm revenue data that are scaled on a per-animal basis (expressed as annual revenue per inventory animal for an average facility). Financial data used for this calculation are from USDA's 1997 ARMS database. This approach and the data used for this calculation are outlined in Section 9 of the Economic Analysis. The resultant size threshold represents an average animal inventory for a small business. For the purpose of conducting its IRFA for this rulemaking, EPA is evaluating "small business" for these sectors as an operation that houses or confines less than: 1,400 fed beef cattle; 200 mature dairy cattle; 1,400 market hogs; 25,000 turkeys; 61,000 layers; or 260,000 broilers (Table 10–17).

EPA then estimates the total number of small businesses in these sectors using facility size distribution data from USDA (step 2). Using the threshold sizes identified for small businesses, identified above, EPA matches these thresholds with the number of operations associated with those size thresholds to estimate the total number of small animal confinement operations in these sectors. Finally, based on the regulatory thresholds being proposed—e.g., operations with more than 500 AU are CAFOs—EPA estimates the number of small businesses that will be subject to the proposed requirements (step 3). The 1997 Census constitutes the primary data source that EPA uses to match the small business thresholds (e.g., a small dairy operation has less than 200 milk cows) to the number of facilities that match that size group (e.g., the number of dairies with less than 200 cows, as reported by USDA). EPA also used other supplemental data, including other published USDA data and information from industry and the state extension agencies.

TABLE 10–17.—NUMBER OF SMALL CAFOS THAT MAY BE AFFECTED BY THE PROPOSED REGULATIONS

Sector	Total annual ($million) revenue [1] (a)	Revenue per head [2] (b)	No. of animals (Avg. U.S.) (c=a/b)	Estimated number of small AFOs	Two-Tier "Small" CAFOs	Three-Tier "Small" CAFOs
Cattle [3]	1.5	1,060	1,400	106,450	2,280	2,600
Dairy	0.5	2,573	200	109,740	50	50
Hogs	0.5	363	1,400	107,880	300	300
Broilers	0.5	2	260,000	34,530	9,470	13,410
Egg Layers	9.0	25	365,000	ND	ND	ND
	1.5	....	61,000	73,710	200	590
Turkeys	0.5	20	25,000	12,320	0	500
All AFOs [4]	NA	NA	NA	355,650	10,550	14,630

NA=Not Applicable. ND = Not Determined. "AFOs" have confined animals on-site. "CAFOs" are assumed to have more than 500 AU.
[1] SBA Size Standards by SIC industry (13 CFR Part 121). EPA assumes an alternative definition of $1.5 million in annual revenues for egg layers.
[2] Average revenue per head across all operations for each sector derived from data obtained from USDA's 1997 ARMS data.
[3] Includes fed cattle, veal and heifers.
[4] Total adjusts for operations with mixed animal types and includes designated CAFOs (expressed over a 10-year period). See Section VI.1 of this document for estimates of the total number of AFOs (including operations that are not defined as small businesses by SBA).

EPA estimates that there were approximately 376,000 animal confinement facilities in 1997 (Table 6–1). Most of these (95 percent) are small businesses, as defined by this approach (Table 10–17). However, not all of these operations will be affected by the proposed regulations.

For this analysis, EPA has identified the number of CAFOs that are also small businesses that would be subject to today's proposal. Under the two-tier structure, EPA estimates that 10,550 operations that will be subject to the proposed requirements that are small businesses. Under the three-tier structure, an estimated 14,630 affected operations are small businesses. See Table 10–17. The difference in the number of affected small businesses is among poultry producers, particularly broiler operations.

Under the two-tier structure, EPA estimates that there are 10,050 operations with more than 500 AU that may be defined as CAFOs that also meet the "small business" definition. Under the three-tier structure, there are 14,530 operations with more than 300 AU that may be defined as CAFOs that are small businesses that meet the proposed risk-based conditions (described in Section VII). These totals adjusts for the number of operations with more than a single animal type. Under both co-proposed alternatives, most operations are in the broiler and cattle sectors. By broad facility size group, an estimated 4,060 operations have more than 1,000 AU, most of which are broiler operations (about 77 percent) and cattle operations (18 percent), including fed cattle, veal, and heifer operations. An estimated 6,490 operations have between 500 and 1,000 AU. The number of operations that would be regulated with between 300 and 1,000 AU is estimated at 10,570 operations (accounting for mixed operations).

Due to continued consolidation and facility closure since 1997, EPA's estimates may overstate the actual number of small businesses in these sectors. In addition, ongoing trends are causing some existing small and medium size operations to expand their inventories to achieve scale economies. Some of the CAFOs considered here as small businesses may no longer be counted as small businesses because they now have higher revenues. Furthermore, some CAFOs may be owned by a larger, vertically integrated firm, and may not be a small business. EPA expects that there are few such operations, but does not have data or information to reliably estimate the number of CAFOs that meet this description.

Under the two-tier structure, EPA estimates also include an additional 500 operations with fewer than 500 AU that may be designated as CAFOs under the proposed regulations over a 10-year period. See Section VI. Of these, 330 operations meet the small business definition: 50 dairies, 200 hog, 40 beef, 20 broiler, and 20 egg laying operations. Under the three-tier structure, EPA estimates that 100 operations with fewer than 300 AU may be designated over ten years, including 50 dairies and 50 hog operations, all of which are small businesses. As these facilities are designated, EPA did not adjust this total to reflect possible mixed animal operations. Each of these operations are small businesses.

3. Estimated Economic Impacts to Small CAFOs under the Proposed Regulations

EPA conducted a preliminary assessment of the potential impacts to small CAFO busiuesses based on the results of a costs-to-sales test. This screen test indicated the need for additional analysis to characterize the nature and extent of impacts ou small entities. The results of this screening test indicate that about 80 percent (about 9,600) of the estimated number of small businesses directly subject to the rule as CAFOs may incur costs in excess of three percent of sales (evaluated for all operations with more than 500 AU). Compared to the total number of all small animal confiuemeut facilities estimated by EPA (356,000 facilities), operations that are estimated to incur costs in excess of three percent of sales comprise less than two perceut of all small businesses in these sectors. The results of this analysis are provided in Section 9 of the Economic Analysis.

Based on the results of this initial assessment, EPA projected that it would likely not certify that the proposal, if promulgated, would not impose a significant economic impact on a substantial number of antities. Therefore, EPA convened a Small Business Advocacy Review Panel and prepared an Initial Regulatory Flexibility Analysis (IRFA) pursuant to Sections 609(b) and 603 of the RFA, respectively. Section XII.G provides more information on EPA's small business ontreach and the Panel activities duriug the development of this rulemaking.

The results of EPA's assessment of the financial impacts of the proposed rule on small entities are as follows. To further examine small businesses effects, EPA used the same approach as that used to evaluate the impact to CAFOs under the proposed regulations described in Section X.D.1. Ecouomic achievability is determined by applying the proposed criteria described in Section X.F.1. These criteria include a seles test and also analysis of post-compliance cash flow and debt-to-asset ratio for an average model CAFO.

Accordingly, if an average model fecility is determined to incur economic impacts under regulation thet are regarded as "Affordable" or "Moderate," then the proposed reguletions ere considered economically achievable. ("Moderate" impacts are not expected to result in closnre and are considered to be economically achievable by EPA.) If an average operation is determined to incur "Stress," then the proposed regulations are not considered to be economically achievable. "Affordable" and "Moderate" impacts are associated with positive post-compliance cash flow over a 10-year period and a debt-to-asset ratio not exceeding 40 percent, in conjunction with a sales test result thet shows that compliance costs are less thao 5 percent of sales ("Affordable") or between 5 and 10 percent ("Moderate"). "Stress" impacts are associated with uegative cash flow or if the post-compliance deht-to-asset ratio exceeds 40 percent, or sales test results that show costs equal to or exceeding 10 percent of sales. More detail on this classification scheme is provided in Section X.F.1.

EPA is proposing that the proposed regulations are economically achievable by small busiuesses in the livestock and poultry sectors. The results of this analysis are presented in Tables 10–18 and 10–19. As defined for this analysis, EPA's analysis indicates that the proposed requirements are economically achievable to all affected small businosses in the beef, veal, heifer, dairy, hog, and egg laying sectors ("Affordable" and also "Moderate"). Moderate impacts may be incurred by small businesses in some sectors, but these impacts are not associated with operational change at the CAFO. Under the two-tier structure, EPA expects that there are no small businesses in the turkey sector, as defined for this analysis. Under the threa-tier structure, EPA expects that there are an estimated 500 small businesses in the turkey sector (operations with 16,500 to 25,000 birds) (Table 10–17).

EPA's IRFA analysis indicates that the proposed requirements will not result in financial stress to auy affected small businesses in the veal, heifer (two-tier only), hog, dairy, egg laying, and turkey sectors. In the beef, heifer (threa-tier only), and broiler sectors, however, EPA's analysis indicates that proposed regulations could result in financial stress to some small businesses, making these businesses vulnerable to closure. Overell, these operatious comprise ebout 2 percent of all effected small CAFO businesses. For the two-tier structure, EPA estimates that 10 small beef operations aud 150 small broiler operations will experience financiel stress. For the three-tier structure, EPA estimates that 40 small beef and heifer operations and 280 small broiler operations will experionce financial stress. Small broiler facilities with stress impacts are larger operations with more thau 1,000 AU under both tier structures. Small cattle and heifer operations with stress impacts are those that have a ground water link to surface water. This analysis is conducted assuming that no costs are passed through between the CAFO and processor segments of these industries. Based on the results of this analysis, EPA is proposing that the proposed regulations are economically achievable to small businesses in these sectors.

EPA believes that the small business impacts presented are overstated for reasons summarized below. As noted in the Panel Report, EPA believes that the number of small broiler operations is overestimated. In the absence of business level revenue data, EPA estimated the number of "small businesses" using the approach described in Sections X.J.1 and X.J.2. Using this approach, virtually all (>99.9 percent) broiler operations are considered "small" businesses. This categorization may not accurately portray actual small operations in this sector since it classifics a 10-house broiler operation with 260,000 birds as a small business. Information from industry sources suggests that a two-house broiler operation with roughly 50,000 birds is more appropriately charactarized as a small business in this sector. This information is available in the rulemaking record. Therefore, it is likely that the number of small broiler operations may reflect a number of medium and large size broiler operations heing considered as small entities. (During the development of the rulemaking, EPA did consult with SBA on the use of an alternative definition for small businesses in all affected soctors based on animal inventory at an operation. Following discussions with SBA, EPA decided not to use this alternative definition. This information is provided in the record.)

EPA believes that the use of a costs-to-sales comparison is a crude measure of impacts on small business in sectors where production contracting is commonly used, such as in the broiler sector (but also in the turkey, egg, and hog sectors, though to a lesser extent). As documented in the Economic Analysis, lower reported operating revenues in the broiler sector reflect the predominance of contract growers in this sector. Contract growers receive a pre-negotiated contract price that is lower than the USDA-reported producer price, thus contributing to lower gross revenues at these operations. Lower producer prices emong contract growers is often offset by lower overall production costs at these operations siuce the affiliated processor firm pays for a substantial portiou of the grower's ennual variable cash expenses. Iuputs supplied by the integrator may include feeder pigs or chicks, feed, veterinary services and medicines, technical support, and transportation of animals. These variable cash costs comprise a large component of annual operating costs, averaging more than 70 percent of total variable and fixed costs at livestock and poultry operations. The contract grower also faces reduced risk becanse the integrator guarantees the grower a fixod output price. Because production costs at a contract grower operation are lower than at an independently owued operation, a profit tast (costs-to-profit comparison) is a more accurate measure of impacts at grower operations. However, financial data are not available that differentiate between contract grower and independent operations.

EPA's analysis also does not consider a range of potential cost offsets available to most operations. One source of potential cost offset is cost share and technical assistance available to operators for on-site improvements that are available from varions state and federal programs, such as the Environmental Quality Incentives Program (EQIP) administered by USDA. These programs spacifically target smaller farming operations. Another potential sonrce of cost offset is manure sales, particularly of relatively higher value dry poultry litter. More information on how these potential sources of cost offset would reduce the economic impacts to small operations is described in Section X.F.1 in this document and also in the Economic Analysis. EPA's analysis also does not account for eventual cost passthrough of estimated compliance costs through the marketing chain under longer run market adjustment. Finally, this analysis does not take into account certain non-economic factors that may influence a CAFO's decision to weather the boom and bust cycles that are commonplace in agricultural markets. These other industry-specific factors are discussed in more detail throughout the Economic Analysis.

EPA expects that the proposed regulations will benefit the smallest businesses in these sectors since it may create a comparative advantage for smaller operations (less than 500 AU), especially those operations which are not subject to the regulations. Except for the few AFOs which are designated as CAFOs, these operations will not incur costs associated with the proposed requirements but could benefit from eventual higher producer prices as these markets adjust to higher production costs in the longer term.

As detailed in Sections XII.G and XIII.B of this document, EPA convened a Small Business Advocacy Review Panel during the development of this rule. As described in the Panel Report, EPA considered certain regulatory alternatives to provide relief for small businesses. Some of these alternatives are discussed in other sections of this document, including Section VII and Section VIII. These alternative options are summarized in the following section and are doscribed in more detail in Section 9 of the Economic Analysis.

TABLE 10–18.—RESULTS OF EPA'S SMALL BUSINESS ANALYSIS UNDER THE BAT OPTION/SCENARIO 4A

Sector	Number of small CAFOs	Zero cost passthrough					
		(Number of operations			(% Affected operations)		
		Affordable	Moderate	Stress	Affordable	Moderate	Stress
Fed Cattle	1,390	1,130	250	10	81	18	1
Veal	90	90	0	0	100	0	0
Heifer	800	680	120	0	85	15	0
Dairy	50	40	10	0	80	20	0
Hogs	300	300	0	0	100	0	0
Broilers	9,470	1,860	7,460	150	20	79	2
Layers	200	200	0	0	100	0	0
Turkeys	0	0	0	0	NA	NA	NA
Total	10,550	4,300	7,840	160	41	74	2

Source: USEPA. Impact estimates shown include impacts to designated operations. Option/Scenario definitions provided in Table 10–2. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Section X.F.1. Numbers may not add due to rounding. NA = Not Applicable.

[1] "Total" does not adjust for operations with mixed animal types, for comparison purposes, to avoid understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

TABLE 10–19.—RESULTS OF EPA'S SMALL BUSINESS ANALYSIS UNDER THE BAT OPTION/SCENARIO 3

Sector	Number of small CAFOs	Zero cost passthrough					
		(Number of operations			(% Affected operations)		
		Affordable	Moderate	Stress	Affordable	Moderate	Stress
Fed Cattle	1,490	1,100	380	10	74	26	1
Veal	140	140	0	0	100	0	0
Heifer	980	800	150	30	82	15	3
Dairy	50	40	10	0	80	20	0
Hogs	300	300	0	0	100	0	0
Broilers	13,410	1,910	11,220	280	14	84	2
Layers	590	590	0	0	100	0	0
Turkeys	500	460	40	0	92	8	0

TABLE 10–19.—RESULTS OF EPA'S SMALL BUSINESS ANALYSIS UNDER THE BAT OPTION/SCENARIO 3—Continued

Sector	Number of small CAFOs	Zero cost passthrough					
		(Number of operations			(% Affected operations)		
		Affordable	Moderate	Stress	Affordable	Moderate	Stress
Total	14,630	5,340	11,800	320	37	81	2

Source: USEPA Impact estimates shown include impacts to designated operations. Option/Scenario definitions provided in Table 10–2. Category definitions ("Affordable," "Moderate" and "Stress") are provided in Section X.F.1. Numbers may not add due to rounding. NA = Not Applicable.

[1] "Total" does not adjust for operations with mixed animal types, for comparison purposes, to avoid understating costs at operations with more than one animal type that may incur costs to comply with the proposed requirements for each type of animal that is raised on-site. The number of CAFOs shown includes expected defined CAFOs only and excludes designated facilities.

4. Regulatory Relief to Small Livestock and Poultry Businesses

EPA proposes to focus the regulatory revisions in this proposal on the largest operations, which present the greatest risk of causing environmental harm, aud in so doing, has minimized the effects of the proposed regulations on small livestock and poultry operations. First, EPA is proposing to establish a two-tier structure with a 500 AU threshold. Unlike the current regulations, under which some operations with 300 to 500 AU are defined as CAFOs, operations of this size under the revised regulations would be CAFOs only by designation. Second, EPA is proposing to uliminate the "mixed" animal calculation for operations with more than a single animal type for determining which AFOs are CAFOs. Third, EPA is proposing to raise the size standard for defining egg laying operations as CAFOs.

EPA estimates that under the co-proposed alternatives, between 64 percent (two-tier) aud 72 perceut (three-tier) of all CAFO manure would be covered by the regulation. (See Section IV.A of this preamble.) Under the two-tier structure, the inclusion of all operations with more than 300 AU instead of operations with more than 500 AU, the CAFO definition would result in 13,800 additional operations being regulated, along with an additional 8 percent of all manure. An estimated 80 percent of these additional 13,800 CAFOs are small businesses (about 10,870 CAFOs). EPA estimates that by not exteuding the regulatory definition to operations with between 300 and 500 AU, thesa 10,870 small businesses will not be defined as CAFOs and will therefore not be subject to the proposed regulations. The additional costs of extending the regulations to these small CAFO businesses is estimated at almost $150 million across all sectors. The difference in costs betweeu the two-tier and the three-tier structures may be approximated by comparing the estimated costs for these regulatory options, which are shown in Table 10–5. Also, under the two-tier structure, EPA is proposing to raise the size standard for defining egg laying operations as CAFOs. This alternative would remove from the CAFO definition egg operations with between 30,000 and 50,000 laying hens (or 75,000 hens) that under the current rules are defined as CAFOs, if they utilize a liquid manure management system.

In addition, under both co-proposed alternatives, EPA is proposing to exclude mixed operations with more than a single animal type. The Agency determined that the inclusion of these operations would disproportionately burden small businesses while resulting in little additional environmental benefit. Since most mixed operations tend to be smaller in size, this exclusion represents important accommodations for small businesses. If certain of these smaller operations are determined to be discharging to waters of the U.S., States can later designate them as CAFOs and subject them to the regulations.

XI. What are the Environmental Benefits of the Proposed Revisions?

A. Non-Water Quality Environmental Impacts

The regulatory options developed for this proposed rule are intended to ensure the protection of surface water in and arouud animal feeding operatious. However, one or more of the requirements included in these options may also have an impact on the amouut and form of compounds released to air, as well as the energy that is required to operate the feedlot. Under sections 304(b) and 306 of the CWA, EPA is to consider the non-water quality environmental impacts (NWQI) when setting effluent limitations guidelines and standards. This section describes the methodology EPA used to estimate the NWQI for each of the options considered for this proposed rule. These non-water quality environmental impacts include:

- Air emissions from the feedlot operation, including animal housing and animal waste storage and treatment areas;
- Air emissions from land application activities;
- Air emissions from vehicles, including the off-site transport of waste and on-site composting operations; aud
- Energy impacts from land application activities and the use of digesters.

For each regulatory option, EPA estimated the potential for uew water pollution control requiremeuts to cause cross-media pollutaut transfers. Consistent with the approach used to estimate compliance costs, EPA used a model-facility approach to estimate NWQIs and to define baseline conditions. Industry-level non-water quality impacts for each animal sector (i.e., beef, dairy, swine, and poultry) were then estimated by multiplying the model farm impacts by the number of facilities represented by that model farm. These results are presented in Tables 11–1 through 11–4 for the population of operations defiued as CAFOs under the two-tier structure (operations with more than 500 AU) and Tables 11–5 through 11–8 for the population defined as CAFOs under the three tier structure. For details on the derivatiou of the model farms, including definitious of geographic location, method of determining model farm populations, and data on waste generation, see the Technical Development Document.

1. Sources of Air Emissious

Animal feeding operatious generate various types of animal wastes, iucluding manure (feces and urine), waste feed, water, bedding, dust, and wastewater. Air emissions are generated from the decomposition of these wastes from the point of generation through the management and treatment of these wastes on site. The rate of generation of these emissions varies based on a number of operational variables (e.g., animal species, type of housing, waste management system), as well as weather conditions (temperature, humidity, wind, time of release). A fraction of the air emissions from AFOs are subseqnently redeposited on land or in surface waters. This atmospheric redeposition in turn can be a source for water quality impacts.

a. *Air Emissions from the Feedlot Operation.* Animal housing and manure management systems can be a significant source of air emissions. Little data exist on these releases to allow a complete analysis of all possible compounds. For this proposed rule, EPA has focused on the release of greenhouse gases (methane, carbon dioxide, and nitrous oxide), ammonia, and certain criteria air pollutants (carbon monoxide, nitrogen oxides, volatile organic compounds, and particulate matter).

i. *Greenhouse Gas Emissions from Manure Management Systems.* Manure management systems, including animal honsing, produce methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) emissious. Methane and carbon dioxide are produced by the anaerobic decomposition of mauure. Nitrous oxide is produced as part of the agricultural uitrogen cycle through the denitrification of the organic nitrogen in livestock manure and urine. Greenhouse gas emissions for methane and uitrous oxide were estimated for this proposed rule based ou methodologies previously used by EPA's Office of Air and Radiation. Emission estimates for carbon dioxide are based on the relationship of carbon dioxide generation compared to methane generation.

Methane. Methane production is directly related to the quantity of waste, the type of waste management system used, and the temperature and moisture of the waste. Some of the regulatory options evaluated for animal feeding operations are based on the use of different waste management systems which may increase or decrease methane emissions from animal operations. In general, manure that is handled as a liquid or in anaerobic management systems tends to produce more methane, while manure that is handled as a solid or in aerobic managemeut systems produces little methaue. The methane producing capacity of animal waste is related to the maximum quantity of methane that can be produced per kilogram of volatile solids. Values for the methane producing capacity are available from literature and are based on animal diet. EPA estimated methane emissions for each type of waste management system included in the cost models. These values vary by animal type, geographic region (the methane conversion factor is a function of the mean ambient temperature), and type of waste management system (e.g., anaerobic lagoon, composting, drylot, stacked solids, or runoff storage pond).

Methane is also produced from the digestive processes of ruminant livestock due to enteric fermentation. Certain animal populations, such as beef cattle on feedlots, tend to produce more methane because of higher energy diets that produce manure with a high methane-producing capacity. However, since the proposed regulatory options do not impose requirements forcing CAFOs to use specific feeding strategies, potential impacts on enteric fermentation methane emissions are speculative and were not estimated.

Carbon Dioxide. Carbon dioxide is a natnrally occurring greenhouse gas aud is continually emitted to and removed from the atmosphere. Certain human activities, such as fossil fuel burning, cause additional quantities of carbon dioxide to be emitted to the atmosphere. In the case of feedlot operations, the anaerobic degradation of manure results not only in methane emissions, but also carbon dioxide emissions. These carbon dioxide emissions due to anaerobic degradation were estimated for each regulatory option. In addition, under Option 6, large dairies and swine operations would install and operate anaerobic digestion systems with energy recovery units. The biogas produced in the digester is burned in an engine to recover energy. EPA's emission estimates for Option 6 include the carbon dioxide produced during this combustion process.

Nitrous Oxide. The emission of nitrous oxide from manure management systems is based on the nitrogen content of the manure, as well as the length of time the manure is stored and the specific type of system used. In general, manure that is handled as a liquid tends to produce less nitrous oxide than manure that is handled as a solid. Some of the regulatory options evaluated for animal feeding operations are based on the use of waste management systems which may increase nitrous oxide emissions from animal operations. Values for total Kjeldahl nitrogen (TKN), a measure of organic nitrogen plus ammonia nitrogen, vary by animal type and are typically available in the literature for animal waste. EPA estimated nitrous oxide emissions by adjusting these literature values with an emission factor that accounts for the varying degree of nitrous oxide production, based on the type of manure management system.

ii. *Ammonia Emissions and Other Nitrogen Losses from Housing and Manure Management Systems.* Much of the nitrogen emitted from animal feeding operations is in the form of ammonia. Ammonia is an important component responsible for acidification and overnutrification of the environment. The loss of ammonia occurs at both the point of generation of manure, typically from urine, as well as during the storage and treetment of animal waste. As the pH of a system rises above 7, nitrogen in the form of ammonium is transformed into ammonia. A number of variables affect the volatilization of ammonia from animal waste, including the method in which the waste is stored, transported, and treated on site and the environmental conditions present (e.g., temperature, pH, wind).

Animals at the feedlot operation may be housed in a number of different ways that have an impact on the type and amount of nitrogen emissions that will occur. Some animals are huused in traditional confined housing (e.g., tie stall barns, freestall barns), while others are housed in ontdoor areas (e.g., drylots, paddocks). Studies have shown that the type of housing used has a great effect on the emission of ammonia. Management of waste within the housing area also affects emissions (e.g., litter system, deep pit, freestall).

Anaerobic lagoons and waste storage ponds are a major component of the waste management systems. EPA has estimated volatilizatiou of total nitrogen and ammonia from lagoons and ponds based on emission factors published in the scientific literature.

iii. *Criteria Air Emissions from Energy Recovery Systems.* Option 6 requires the implementation of anaerobic digestion systems with energy recovery for large dairy and swine operations. The operation of the digestion system greatly reduces the emission of methane through the capture of the biogas. However, the use of the biogas in an energy recovery system does generate certain criteria air pollutauts when burned for fuel. Literature values for emission factors for carbon monoxide (CO), oxides of nitrogen (NO_X), and volatile organic compouuds (VOCs) were used to estimate releases of criteria air pollutants.

b. *Air Emissions from Land Application Activities.* Animal feeding operations generate air emissions from the land application of animal waste on cropland. Air emissions are primarily generated from the volatilization of ammonia at the point the material is applied to land. Additional emissious of nitrous oxide are liberated from agricultural soils when nitrogen applied to the soil undergoes nitrification and denitrification. Loss through denitrification is dependent on the oxygen levels of the soil to which manure is applied. Low oxygen levels, resulting from wet, compacted, or warm soil, increase the amount of nitrate-nitrogen released to the air as nitrogen gas or nitrous oxide. The analysis of air emissions from land application activities for this proposed rule focused on the volatilization of nitrogen as ammonia because the emission of other constituents is expected to be less significant.

The amount of nitrogen released to the environment from the application of animal waste is affected by the rate and method in which it is applied, the quantity of material applied, and site-specific factors such as air temperature, wind speed, and soil pH. There is insufficient data to quantify the effect of site-specific factors.

Since regulatory options in this proposed rule do not dictate particular application methods, EPA assumed that the application methods used by animal feeding operations will not significantly change from baseline.

Because EPA expects application methods to remain stable, EPA assumed that only the quantity of waste applied to cropland will change. On-site nitrogen volatilization will decrease as the quantity of waste applied to cropland decreases. The reductions of nitrogen volatilization will be the result of reductions in the total amount of manure applied on site. However, when both on-site and off-site nitrogen volatilization are considered, total nitrogen volatilization from manure is expected to remain constant. The movement of waste off-site changes the location of the nitrogen releases but not the quantity released. On-site, however, the volatilization rate will decrease, reflecting the decrease in the quantity of applied waste.

EPA used the same assumptions that were used to estimate compliance costs for land application of animal waste in order to estimate the change in air emissions from the application of nitrogen under baseline conditions and for each regulatory option. The cost methodology defines three types of animal feeding operations: Category 1 facilities currently have sufficient land to apply all manure on site; Category 2 facilities currently do not have enough land to apply all manure on site; and Category 3 facilities currently apply no manure on site (this manure is already being spread offsite). Neither Category 1 nor Category 3 facilities will show a change in nitrogen emission rates from the land application of animal manure under the proposed regulatory options. However, Category 2 facilities will be required to apply their waste at the agricultural rate under the regulatory options, thus reducing the amount of manure applied on site and subsequently reducing air emissions from on-site land application.

Under a phosphorus-based application scenario, facilities will have to apply supplemental nitrogen fertilizer to meet crop nutrient needs. The cost model assumes facilities will apply commercial ammonium nitrate or urea. The application of commercial fertilizer represents an increase in applied nutrients on site. While losses from applied commercial nitrogen are expected to be less than those from applied manure, data from Ohio State Extension states that both of these fertilizers can experience losses through denitrification if placed on wet or compacted soils. There is also a possibility that urea will volatilize if it is dry for several days after soil application. Ammonium nitrate fertilizer (when injected) is less likely to volatilize because it quickly converts to nitrate nitrogen which will not volatilize.

EPA estimated a "worst-case scenario" for ammonia emissions due to commercial fertilizer application based on a 35% loss of applied nitrogen.

c. *Air Emissions from Vehicles.* i. *Off-Site Transportation.* All options are expected to result in increasing the amount of manure hauled off-site, at least for some operations. Consistent with the cost model, EPA has grouped operations into three possible transportation categories. Category 1 facilities currently land apply all manure on site and Category 3 facilities currently transport all manure off site. Neither Category 1 nor Category 3 facilities require additional transportation of manure and will not have an increase in criteria air emissions. Category 2 facilities do not have enough land to apply all waste on site and do not currently transport waste. These facilities are expected to transport manure off site and therefore will have an increase in the amount of criteria air pollutants generated by the facility.

Hauling emissions estimates are based on calculations of the annual amount of waste generated, the annual number of miles traveled, and truck sizes. The number of trucks, number of trips per truck, the amount of waste and transportation distance are all calculated within the cost model. Vehicle emissions are calculated based on emission factors for diesel-fueled vehicles presented in "Compilation of Air Pollution Emission Factors" (AP–42). Estimates were calculated for volatile organic compounds, nitrogen oxides, particulate matter, and carbon monoxide.

ii. *On-Site Composting Activities.* Farm equipment used for on-site composting activities also affect the generation of air emissions, although composting of waste may also result in a reduction in transportation air emissions. While composting waste prior to hauling offsite can increase the marketability of the manure and may decrease hauling costs per ton of waste for some operations, not all operations can be expected to realize such benefits. Under Option 5, beef and dairy operations would be required to compost their solid manure. The criteria air emissions from on-site composting of manure were estimated for beef and dairy operations under Option 5. The source of criteria air emissions from composting are tractors and associated windrow-turning equipment.

2. Summary of Air Emission Impacts

Option 1: Emissions of methane and carbon dioxide from beef and dairy operations decrease under Option 1 due to the addition of solids separation in the waste management system. The separated solids are stockpiled rather than held in waste storage ponds or anaerobic lagoons. Anaerobic conditions, and the potential of the volatile solids to convert to methane, decrease using this drier method of handling the waste. However, this method also results in greater conversion of nitrogen to nitrous oxide. An increase in nitrous oxide emissions from dairies occurs for this reason. Greenhouse gas emissions from dry poultry operations (broilers, turkeys, and dry layers) do not change under Option 1 since no change to the waste handling practices are expected. These operations are already handling the waste as a dry material. Although indoor storage of poultry litter is included in the options, it is not expected to significantly alter the air emissions from the litter. Emissions of greenhouse gases from swine and wet poultry operations also do not change since no change to the waste handling practices are expected.

Ammonia emissions occur primarily from liquid waste storage areas, including ponds and lagoons. Under Option 1, all facilities are required to contain surface runoff from the feedlot, thereby increasing ammonia emissions from smaller beef and dairy CAFOs that do not currently have runoff control ponds or lagoons. Ammonia emissions for the poultry and swine sectors are not expected to change under Option 1.

Option 1 requires the application of animal waste to cropland at agronomic rates for nitrogen. Animal feeding operations that have excess nitrogen for their crops will need to transport their waste to another location. The generation of criteria pollutants for all animal sectors are expected to increase from baseline to Option 1 due to the additional transportation of waste off-site.

Options 2–4 and 7: No change in emissions of methane, carbon dioxide, or nitrous oxide occurs for all sectors relative to Option 1 because no significant changes in waste management are anticipated. Likewise, no large changes are expected for ammonia emissions.

These options require the application of animal waste to cropland at agronomic rates for phosphorus. Animal feeding operations that have excess phosphorus for their crops will need to transport their waste to another location. The generation of criteria pollutants are expected to increase from Option 1 to these options because more waste will need to be transported off site to maet agronomic rates for phosphorus.

Option 5A: Option 5A does not apply to the beef and dairy sectors. Emissions of greenhouse gases at swine operations significantly decrease under Option 5A, due to covering lagoons. The swine operations are expected to flare the gas that is generated in the lagoon. The methane will be converted, although carbon dioxide emissions will increase. In addition, the emissions of NO_X and SO_X increase because of the flaring of biogas collected from the covered lagoon.

On-site ammonia emissions at swine operations will decrease because the lagoon cover prevents the ammonia from leaving solution. Ammonia in the effluent from the covered lagoon will volatilize, however, soon after it is exposed to air.

Option 5B: Emissions of greenhouse gases from beef and dairy operations increase under Option 5B (i.e., mandated technology of composting), relative to Options 1 and 2. Compost operations include the addition of organic material to the waste pile to aid in the decomposition of the waste. This additional material also decomposes and contributes to increased methane emissions compared to other options. In addition, compost operations liberate more methane than stockpiles because the windrows are turned regularly. Stockpiles tend to form outer crusts that reduce the potential for air emissions to occur.

Emissions of greenhouse gases for swine operations under Option 5B are less than Option 2 due to the conversion of liquid manure handling systems (e.g., flush lagoons) to dry manure handling systems. Dry manure generates less methane than liquid systems. However, the emissions are higher than either Options 5A or 6, which allow liquid manure systems, but includa destruction of the biogas generated from those systems.

Ammonia emissions at beef and dairy operations are expected to increase. During composting operations, the aeration of the compost pile liberates nitrogen in the form of ammonia. Ammonia emissions at swine operations are expected to decrease compared to Option 2, because of liquid manure systems converting to dry operations.

Option 5B generates the least criteria air pollutants compared to any other option for beef operations. Although composting operations include the operation of turning equipment which uses fuel and generates additional tractor air emissions, the process reduces the overall volume of waste to be transported. However, for dairy, additional organic material is added to the compost pile, which results in slightly higher transportation emissions than Option 2. Option 5B emissions of criteria pollutants for poultry operations are equal to the emissions for Options 2–4 and 7, since there is no difference in the amount of waste transported off site. The emissions from swine operations are significantly lower than Option 2 because the conversion of flush operations to dry housing significantly decreases the volume of waste to be transported off site.

Option 6: Relative to Option 2, only the dairy and swine sectors see any changes in air emissions. Emissions of methane from swine and dairy waste under Option 6 significantly decrease due to the addition of the anaerobic digester. A significant portion of the methane generated is collected as biogas and converted to energy. Drylot areas at dairies, however, will continue to generate methane that is uncollected. Carbon dioxide emissions significantly increase as methane is converted during the combustion process.

Although waste at large swine and dairy CAFOs will be digested, no significant changes to ammonia emissions are expected. The ammonia nitrogen, which is highly soluble, remains in solution in the digester. When the digester effluent is stored in an open lagoon, the ammonia will then be released.

Emissions of criteria pollutants from swine and dairy operations increase due to the addition of anaerobic digestion for large dairy operations. The digester collects biogas, which is subsequently combusted and converted into VOCs, NO_X, and CO. Hydrogen sulfide contained in swine waste will be converted to Sox.

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Table 11-1. Air Emissions and Energy Use for Beef (Including Heifer) Operations Under the Two-Tier Structure (≥500 AU)

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	72	69	69	69	69		93	69	69
Carbon Dioxide (CO_2) (Gg/yr)	31	30	30	30	30		40	30	30
Nitrous Oxide (N_2O) (Gg/yr)	34	34	34	34	34		49	34	34
Ammonia (NH_3) (1000 Tons/yr)	581	582	582	582	582		902	582	568
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 235	Baseline + 284	Baseline + 284	Baseline + 284		Baseline + 75	Baseline + 284	Baseline + 284
Nitrogen Oxides (NOx) (Tons/yr)	NC	Baseline + 905	Baseline + 1,091	Baseline + 1,091	Baseline + 1,091		Baseline + 291	Baseline + 1,091	Baseline + 1,091
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 18	Baseline + 22	Baseline + 22	Baseline + 22		Baseline + 6	Baseline + 22	Baseline + 22
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 2,800	Baseline + 3,400	Baseline + 3,400	Baseline + 3,400		Baseline + 900	Baseline + 3,400	Baseline + 3,400
Energy Usage									
Electricity Usage (1000 kW-hr/yr)	NC	Baseline + 11,082	Baseline + 45,109	Baseline + 45,109	Baseline + 45,109		Baseline + 45,109	Baseline + 45,109	Baseline + 45,109
Fuel Usage (1000 gallons/yr)	NC	Baseline + 1,917	Baseline + 2,311	Baseline + 2,311	Baseline + 2,311		Baseline + 420	Baseline + 2,311	Baseline + 2,311

Table 11-2. Air Emissions and Energy Use for Dairy Operations Under the Two-Tier Structure (≥500 AU)

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	216	138	138	138	138		163	11	138
Carbon Dioxide (CO_2) (Gg/yr)	93	59	59	59	59		70	1,289	59
Nitrous Oxide (N_2O) (Gg/yr)	4	8	8	8	8		28	8	8
Ammonia (NH_3) (1000 Tons/yr)	217	220	220	220	220		257	207	218
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 222	Baseline + 201	Baseline + 201	Baseline + 201		Baseline + 213	Baseline + 262	Baseline + 201
Nitrogen Oxides (NOx) (Tons/yr)	NC	Baseline + 855	Baseline + 772	Baseline + 772	Baseline + 772		Baseline + 821	Baseline + 4,454	Baseline + 772
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 17	Baseline + 15	Baseline + 15	Baseline + 15		Baseline + 17	Baseline + 15	Baseline + 15
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 2,700	Baseline + 2,400	Baseline + 2,400	Baseline + 2,400		Baseline + 2,500	Baseline + 2,900	Baseline + 2,400
Energy Usage									
Electricity Usage (1000 kW-hr/yr)	NC	Baseline + 8,759	Baseline + 9,899	Baseline + 9,899	Baseline + 9,899		Baseline + 9,899	Baseline + (1,139,200)	Baseline + 9,899
Fuel Usage (1000 Gallons/yr)	NC	Baseline + 1,811	Baseline + 1,635	Baseline + 1,635	Baseline + 1,635		Baseline + 1,646	Baseline + 1,605	Baseline + 1,635

Table 11-3. Air Emissions and Energy Use for Swine Operations under the Two-Tier Structure (≥500 AU)

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	281	281	281	281	281	118	188	164	281
Carbon Dioxide (CO_2) (Gg/yr)	120	120	120	120	120	147	80	73	120
Nitrous Oxide (N_2O) (Gg/yr)	0.5	0.5	0.5	0.5	0.5	0.3	0.5	0 4	0.5
Ammonia (NH_3) (1000 Tons/yr)	128	128	128	128	128	113	93	126	135
Hydrogen Sulfide (H_2S) (1000 Tons/yr)	70	70	70	70	70	0	12	0	101
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 12	Baseline + 31	Baseline + 31	Baseline + 31	Baseline + 50	Baseline + 16	Baseline + 11	Baseline + 31
Nitrogen Oxides (Tons/yr)	NC	Baseline + 43	Baseline + 115	Baseline + 115	Baseline + 115	Baseline + 15,300	Baseline + 63	Baseline + 9,600	Baseline + 115
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 0.9	Baseline + 2	Baseline + 2	Baseline + 2	Baseline + 4	Baseline + 1	Baseline + 1	Baseline + 2
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 130	Baseline + 360	Baseline + 360	Baseline + 360	Baseline + 590	Baseline + 200	Baseline + 130	Baseline + 360
Sulfur Oxides (1000 Tons/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline + 59	Baseline	Baseline + 37	Baseline
Energy Usage									
Electricity Usage (1000 kW-hr/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline + (848,900)	Baseline
Fuel Usage (1000 Gallons/yr)	NC	Baseline + 65	Baseline + 121	Baseline + 121	Baseline + 121	Baseline + 290	Baseline + 4	Baseline + 45	Baseline + 121

Table 11-4. Air Emissions and Energy Use for Poultry Operations Under the Two Tier Structure (≥500 AU)

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	70	70	70	70	70	26	27	70	70
Carbon Dioxide (CO_2) (Gg/yr)	30	30	30	30	30	255	12	30	30
Nitrous Oxide (N_2O) (Gg/yr)	16	16	16	16	16	16	17	16	16
Ammonia (NH_3) (1000 Tons/yr)	17	17	17	17	17	15	14	17	19
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 3	Baseline + 9	Baseline + 9	Baseline + 9	Baseline + 9	Baseline + 9	Baseline + 9	Baseline + 9
Nitrogen Oxides (Tons/yr)	NC	Baseline + 13	Baseline + 36	Baseline + 36	Baseline + 36	Baseline + 3,000	Baseline + 36	Baseline + 36	Baseline + 36
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 0	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 41	Baseline + 110	Baseline + 110	Baseline + 110	Baseline + 110	Baseline + 110	Baseline + 110	Baseline + 110
Energy Usage									
Electricity Usage (kW-hr/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
Fuel Usage (1000 Gallons/yr)	NC	Baseline + 427	Baseline + 1,253	Baseline + 1,253	Baseline + 1,253	Baseline + 1,253	Baseline + 1,253	Baseline + 1,253	Baseline + 1,253

Table 11-5. Air Emissions and Energy Use for Beef Operations Under the Three-Tier Structure (Includes Heifers)

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	70.20	67.32	67.32	67.32	67.32		90.52	67.32	67.32
Carbon Dioxide (CO_2) (Gg/yr)	30.08	28.85	28.85	28.85	28.85		38.79	28.85	28.85
Nitrous Oxide (N_2O) (Gg/yr)	32.55	32.54	32.54	32.54	32.54		47.56	32.54	32.54
Total Kjeldhl Nitrogen (TKN) (Tons/yr)	660580	657464	653382	653382	653382		653382	653382	649063
Ammonia (NH_3) (Tons/yr)	562404	563461	563461	563461	563461		872675	563461	550052
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 234	Baseline + 282	Baseline + 282	Baseline + 282		Baseline + 74	Baseline + 282	Baseline + 282
Nitrogen Oxides (NOx) (Tons/yr)	NC	Baseline + 901	Baseline + 1086	Baseline + 1086	Baseline + 1086		Baseline + 286	Baseline + 1086	Baseline + 1086
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 18	Baseline + 22	Baseline + 22	Baseline + 22		Baseline + 6	Baseline + 22	Baseline + 22
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 2794	Baseline + 3367	Baseline + 3367	Baseline + 3367		Baseline + 889	Baseline + 3367	Baseline + 3367
Energy Usage									
Electricity Usage (kW-hr/yr)	NC	Baseline + 26801558	Baseline + 21706406	Baseline + 21706406	Baseline + 21706406		Baseline + 21706406	Baseline + 21706406	Baseline + 21706406
Fuel Usage (gallons/yr)	NC	Baseline + 1909749	Baseline + 2300912	Baseline + 2300970	Baseline + 2300970		Baseline + 409593	Baseline + 2300996	Baseline + 2300912

Table 11-6. Air Emissions and Energy Use for Dairy Operations Under the Three-Tier Structure

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	213.87	136.19	136.19	136.19	136.19		161.64	11.12	136.19
Carbon Dioxide (CO_2) (Gg/yr)	91.66	58.37	58.37	58.37	58.37		69.27	1290	58.37
Nitrous Oxide (N_2O) (Gg/yr)	4.17	7.56	7.56	7.56	7.56		23.07	7.56	7.56
Total Kjeldhl Nitrogen (TKN) (Tons/yr)	159703	153360	151810	151810	151810		151810	151810	151810
Ammonia (NH_3) (Tons/yr)	218368	221407	221407	221407	221407		258543	207969	218397
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 211	Baseline + 178	Baseline + 178	Baseline + 178		Baseline + 192	Baseline + 242	Baseline + 178
Nitrogen Oxides (NOx) (Tons/yr)	NC	Baseline + 811	Baseline + 691	Baseline + 691	Baseline + 691		Baseline + 741	Baseline + 4377	Baseline + 691
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 16	Baseline + 14	Baseline + 14	Baseline + 14		Baseline + 15	Baseline + 14	Baseline + 14
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 2516	Baseline + 2143	Baseline + 2143	Baseline + 2143		Baseline + 2296	Baseline + 2647	Baseline + 2143
Energy Usage									
Electricity Usage (kW-hr/yr)	NC	Baseline + 11074220	Baseline + 16066951	Baseline + 16066951	Baseline + 16066951		Baseline + 16066951	Baseline + (1,139,200,000)	Baseline + 16066951
Fuel Usage (Gallons/yr)	NC	Baseline + 17192511	Baseline + 1464917	Baseline + 1464917	Baseline + 1464917		Baseline + 1477361	Baseline + 1440274	Baseline + 1464917

Table 11-7. Air Emissions and Energy Use for Swine Operations Under the Three-Tier Structure

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	256.32	256.32	256 32	256.32	256.32	100.84	167 74	139 59	256.32
Carbon Dioxide (CO_2) (Gg/yr)	109.85	109.85	109.85	109.85	109.85	141.79	71.89	62.90	109.85
Nitrous Oxide (N_2O) (Gg/yr)	0.46	0.46	0.46	0.46	0.46	0.28	0.46	0 32	0.46
Total Kjeldhl Nitrogen (TKN) (Tons/yr)	57143	56753	56663	56663	56663	56831	23779	41891	56663
Ammonia (NH_3) (Tons/yr)	115346	115346	115346	115346	115346	101312	82276	115346	122363
Hydrogen Sulfide (H_2S) (Tons/yr)	64511	64511	64511	64511	64511	0	10570	0	93477
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 11	Baseline + 28	Baseline + 28	Baseline + 28	Baseline + 28	Baseline + 16	Baseline + 11	Baseline + 28
Nitrogen Oxides (NOx-N) (Tons/yr)	NC	Baseline + 42	Baseline + 109	Baseline + 109	Baseline + 109	Baseline + 14143	Baseline + 61	Baseline + 9554	Baseline + 109
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 0.88	Baseline + 2	Baseline + 2	Baseline + 2	Baseline + 2	Baseline + 1	Baseline + 0.84	Baseline + 2
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 129	Baseline + 338	Baseline + 338	Baseline + 338	Baseline + 338	Baseline + 189	Baseline + 126	Baseline + 338
Sulfur Oxides (Sox-S) (Tons/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline + 54525	Baseline	Baseline + 36961	Baseline
Energy Usage									
Electricity Usage (kW-hr/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline + (848,900,000)	Baseline
Fuel Usage (Gallons/yr)	NC	Baseline + 61940	Baseline + 111033	Baseline + 111033	Baseline + 111033	Baseline + 110122	Baseline + 3577	Baseline + 41082	Baseline + 111033

Table 11-8. Air Emissions and Energy Use for Poultry Operations Under the Three-Tier Structure

NWQI	Baseline	Regulatory Option							
		Option 1	Option 2	Option 3	Option 4	Option 5A	Option 5B	Option 6	Option 7
Air Emissions									
Methane (CH_4) (Gg/yr)	67.19	67.19	67.19	67.19	67.19	25.79	26.63	67.19	67.19
Carbon Dioxide (CO_2) (Gg/yr)	28.79	28.79	28.79	28.79	28.79	239.24	11.41	28.79	28.79
Nitrous Oxide (N_2O) (Gg/yr)	16.30	16.30	16.30	16.30	16.30	16.27	16.80	16.30	16.30
Total Kjeldhl Nitrogen (TKN) (Tons/yr)	341627	340325	329444	329444	329444	329444	45285	329444	329444
Ammonia (NH_3) (Tons/yr)	16507	16507	16507	16507	16507	14191	14485	16507	18003
Volatile Organic Compounds (VOCs) (Tons/yr)	NC	Baseline + 3	Baseline + 7	Baseline + 7	Baseline + 7	Baseline + 7	Baseline + 7	Baseline + 7	Baseline + 7
Nitrogen Oxides (NOx-N) (Tons/yr)	NC	Baseline + 10	Baseline + 27	Baseline + 27	Baseline + 27	Baseline + 2343	Baseline + 27	Baseline + 27	Baseline + 27
Particulate Matter (PM) (Tons/yr)	NC	Baseline + 0.21	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1	Baseline + 1
Carbon Monoxide (CO) (Tons/yr)	NC	Baseline + 32	Baseline + 82	Baseline + 82	Baseline + 82	Baseline + 82	Baseline + 82	Baseline + 82	Baseline + 82
Energy Usage									
Electricity Usage (kW-hr/yr)	NC	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline
Fuel Usage (Gallons/yr)	NC	Baseline + 314265	Baseline + 893365	Baseline + 893365	Baseline + 893365	Baseline + 893365	Baseline + 893365	Baseline + 893365	Baseline + 893365

3. Energy Impacts

The proposed regulatory options may result in increased energy use for operations that currently do not capture their runoff or other process wastewater. These operations would need to capture the feedlot runoff, divert it to a waste management system, and use this wastewater for irrigation or dispose of it by some alternative means.

For the land application areas, the proposed regulatory options assume all CAFOs will apply their manure and wastewater using agricultural application rates. In many instances this means that facilities would have to limit the amount of manure applied to the land which may result in decreased energy usage at the CAFO. However, total energy requirements for land application increase under all options due to the increased transportation of waste off-site. Additional energy is also required to operate composting equipment, and at swine CAFOs to operate recirculating pumps to reuse lagoon effluent as flush water.

Option 6 includes the use of anaerobic digesters with energy recovery to manage animal waste for large dairy and swine operations. Digesters require a continuous input of energy to operate the holding tank mixer and an engine to convert captured methane into energy. The energy required to continuously operate these devices, as well as the amount of energy generated by the system, have been determined from the FarmWare model, which was also used for estimating compliance costs. Under Option 6, EPA anticipates a net decrease in electricity use due to the energy savings from methane recovery.

B. Quantitative and Monetized Benefits

In addition to costs and impacts, EPA also estimated the environmental and human health benefits of today's proposed requirements. Benefits identified as a result of this proposed rule are associated with improvements in water quality.

EPA is not currently able to evaluate all human health and ecosystem benefits associated with water quality improvements quantitatively. EPA is even mora limited in its ability to assign monetary values to these benefits. The economic benefit values described below and in the "Environmental and Economic Benefits of the NPDES/ELG CAFO Rules" (Benefit Report) should be considered a subset of the total benefits of this rule and should be evaluated along with descriptive assessments of benefits and the acknowledgment that even these may fall short of the real-world benefits that may result from this rule. For example, the economic valuation considers the effects of nitrogen, phosphorous, pathogens and sediment but does not evaluate the economic impacts of metals or hormones which can produce significant adverse environmental impacts.

Within these confines, EPA analyzed the effects of current water discharges and assessed the benefits of reductions in these discharges resulting from this proposed regulation. The CAFO industry waste effluents contain pollutants that, when discharged into freshwater and estuarine ecosystems, may alter aquatic habitats, affect aquatic life, and adversely affect human health.

For this proposed rule, EPA conducted four benefit studies to estimate the impacts of controlling CAFO manure. The first study is a national water quality model (National Water Pollution Control Assessment Model) that estimates runoff from land application areas to rivers, streams, lakes and impoundments in the U.S. This study estimates the value society places in improvements in surface water quality associated with the different regulatory scenarios. Another study examines the expected improvements in shellfish harvesting as a result of CAFO regulation. A third study looks at incidences of fish kills that are attributed to animal feeding operations and estimates the cost of replacing the lost fish stocks. A fourth study estimates the benefits associated with reduced groundwater contamination. Each of these studies is described below.

1. Benefit Scenarios

There are eight benefit scenarios under consideration, four scenarios (1, 2/3, 4a and 4b) using a nitrogen application rate and the same 4 scenarios using a phosphorus application rate. Scenarios 1 2/3 have a three-tiered structure similar to the current rule. Tier 1 is 1,000 AU and greater; Tier 2 is 300—999 AU; Tier 3 is less than 300 AU. Scenarios 4a and 4b have a two-tiered structure. Under Scenario 4a, Tier 1 is 500 AU and greater; Tier 2 is less than 500 AU. Under Scenario 4b, Tier 1 is 300 AU and greater; Tier 2 is less than 300 AU. EPA is co-proposing a two-tier and a three-tier structure (phosphorus—Scenario 2/3 and Phosphorus—Scenario 4a). Table 11–9 summarizes the regulatory scenarios considered in the benefits analysis.

TABLE 11–9.—REGULATORY SCENARIOS CONSIDERED IN THE BENEFITS ANALYSIS

Regulatory scenario	NPDES revisions	Effluent guidelines revisions
Baseline	CAFOs include any AFO with over 1,000 AUs, as well as AFOs with 300 or more AUs that meet certain requirements.	Manure application not regulated.
Nitrogen—Scenario 1	Baseline scenario plus dry poultry and immature swine and heifer operations.	Nitrogen-based manure application.
Nitrogen—Scenario 2/3	New NPDES conditions for identifying CAFOs among AFOs with 300–1000 AUs, plus dry poultry and immature swine and heifer operations.	Nitrogen-based manure application.
Nitrogen—Scenario 4a	CAFOs include all AFOs with 500 or more AUs, plus dry poultry, immature swine and heifer manure operations.	Nitrogen-based manure application.
Nitrogen—Scenario 4b	CAFOs include all AFOs with 300 or more AUs, plus dry poultry, immature swine and heifer operations.	Nitrogen-based manure application.
Phosphorus Scenario 1	Baseline scenario plus dry poultry and immature swine and heifer operations.	Phosphorus-based manure application.
Phosphorus Scenario 2/3*	New NPDES conditions for identifying CAFOs among AFOs with 300–1000 AUs, plus dry poultry and immature swine and heifer operations.	Phosphorus-based manure application.
Phosphorus Scenario 4a*	CAFOs include all AFOs with 500 or more AUs, plus dry poultry, immature swine and heifer operations.	Phosphorus-based manure application.

TABLE 11–9.—REGULATORY SCENARIOS CONSIDERED IN THE BENEFITS ANALYSIS—Continued

Regulatory scenario	NPDES revisions	Effluent guidelines revisions
Phosphorus Scenario 4b	CAFOs include all AFOs with 300 or more AUs, plus dry poultry, immature swine and heifer operations.	Phosphorus-based manure application.

* Proposed scenarios.

EPA has developed a model facility analysis to assess changes in pollutant loadings under baseline conditions and proposed regulatory scenarios. First, the analysis disaggregates the universe of AFOs according to a suite of characteristics directly affecting manure generation, manure management, and pollutant loadings. AFOs are then grouped into five geographic regions. Within each geographic region, EPA defines model facilities by production sector, subsector, and size (number of animals).

EPA then calculates manure production and the associated production of pollutants for each model facility. EPA multiplies the number of animal units per model facility by the manure production per animal unit to determine total manure production. EPA then calculates total generation of nutrients based on the typical pollutant concentrations per unit of recoverable manure for each animal type.

The core modeling analysis focuses on land application practices for each model facility and the capacity for soil and crop removal of nutrients applied to the land.[1] EPA divides the total nitrogen and phosphorus generated in manure by the average total acreage available for land application for an operation in the given region, size class, and production sector. The ratio of nutrients applied to crop nutrient requirements provides a measure of the excess nutrients applied in the manure. This in turn forms the foundation for loadings analyses of regulatory scenarios that call for adherence to agronomic rates of nutrient application.

EPA models "edge-of-field" loadings (i.e., pollutant loadings at the boundary of the model facility) using the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model. This field-scale model simulates hydrologic transport, erosion, and biochemical processes such as chemical transformation and plant uptake. The model uses information on soil characteristics and climate, along with nutrient production data, to model losses of nutrients in surface runoff, sediment, and groundwater leachate. Loadings are modeled for the pre- and post-regulatory scenarios to estimate changes in loadings attributable to the proposed standards.

Finally, EPA extrapolates from the model facilities to develop national estimates of baseline and post-regulatory pollutant loadings from AFOs. Using the USDA Census of Agriculture, EPA determines the number of operations that raise animals under confinement. Then, EPA determines the number of CAFOs based on operations that are defined as CAFOs and smaller operations that are designated as CAFOs based on site-specific conditions, as established by the permitting authority. Finally, AFOs and CAFOs by region are placed into counties (and evantually watersheds) using published county level Census data. Therefore, the end product of the GLEAMS modeling is a spatial distribution of aggregated edge-of-field loadings that can be used in the water quality modeling and benefits monetization process described below.

National Surface Water Pollution Study. The National Water Pollution Control Assessment Model (NWPCAM) was employed to estimate national economic benefits to surface water quality resulting from implementation of various scenarios for regulating CAFOs. NWPCAM is a national-scale water quality model for simulating the water quality and economic benefits that can result from various water pollution control policies. NWPCAM is designed to characterize water quality for the Nation's network of rivers and streams, and, to a more limited extent, its lakes. Using GLEAMS output data, NWPCAM is able to translate spatially varying water quality changes resulting from different pollution control policies into terms that reflect the value individuals place on water quality improvements. In this way, NWPCAM is capable of deriving economic benefit estimates for scenarios for regulating CAFOs.

NWPCAM estimates pollutant loadings to the stream (nitrogen, phosphorous, metals, pathogens and sediment) for each regulatory scenario. These loadings by scenario (NWPCAM output) are used as input to the other studies. Thus, all stream loading estimates are derived from NWPCAM.

1. NWPCAM Loading reductions

Table 11–10 shows the estimated pollutant reduction for nitrogen, phosphorus, fecal coliform, fecal streptococci, and sediment for each of the five NPDES regulatory scenarios based on eithar nitrogen or phosphorus manure land application. Nitrogen reductions range from 14 million to 33 million kgs per year; phosphorus ranges from 35 million to 59 million kgs per year; fecal coliform from 26 billion to 38 billion colonies per year; fecal streptococci from 37 to 65 billion colonies per year; and sediment from 0 kgs to 38 million kgs per year.

The proposed Phosphorus—Scenario 2/3 shows a reduction of 30 M kg (66M lbs) of nitrogen, 54M kg (119M lbs) of phosphorus, 34 billion colonies of fecal coliform, 60 billion colonies of fecal strep, and 35B kg (77B lbs) of sediment. Phosphorus—Scenario 4a shows a reduction of 29 million kg (64M lbs)of nitrogen, 52 million kg (115 M lbs) of phosphorus, 32 billion and 58 billion colonies of fecal coliform and fecal streptococci, respectively and 34 billion kg (75B lbs) of sediment to our nation's waters each year.

[1] In addition to modeling loadings based on manure application, EPA develops two complementary analyses to examine loadings from storage structures and feedlots.

TABLE 11–10.—POLLUTANT REDUCTION BASED ON NITROGEN OR PHOSPHORUS MANURE APPLICATION RATES BY NPDES SCENARIO

	Nitrogen (million kg)	Phosphorus (million kg)	Fecal Coliform (billion colonies)	Fecal Strep (billion colonies)	Sediment (billion (billion kg)
Nitrogen—Scenario 1	14	35	26	37	0
Nitrogen—Scenario 2/3	16	45	31	45	0
Nitrogen—Scenario 4a	15	42	29	44	0
Nitrogen—Scenario 4b	18	48	34	47	0
Phosphorus—Scenario 1	25	42	29	50	26
Phosphorus—Scenario 2/3*	30	54	34	60	35
Phosphorus— Scenario 4a*	29	52	32	58	34
Phosphorus—Scenario 4b	33	59	38	65	38

*proposed scenarios.

Iu addition, EPA estimated loadings reductions to surface waters for various metals found in mauure: zinc, copper, cadmium, nickal and lead. The range of loadings reductions is shown iu Table 11–11.

TABLE 11–11.—RANGE OF METAL LOADING REDUCTIONS ACROSS SCENARIOS

Metal	low (kg)	high (kg)
Zinc	10 M	19 M
Copper	546 K	1,051 K
Cadmium	23 K	39 K
Nickel	219 K	418 K
Lead	395 K	777 K

Table 11–12 is a list of metals and load reductious per year for the proposed scenarios.

TABLE 11–12.—METAL LOADING REDUCTIONS FOR SCENARIO 2/3–SCENARIO 4A

Metal	Kilograms*
Zinc	18 million/17 million.
Copper	1 million/895 thousand.
Cadmium	37 thousand/35 thousand.
Nickel	400 thousand/345 thousand.
Lead	740/690 thousand.

*rounded to the nearest 10.

The methods used to develop these loading reduction estimates are outlined in detail in the Environmental and Economic Benefits of the NPDES/ELG CAFO Rules.

2. Monetized Benefits

a. National Water Pollution Control Assessment Model (NWPCAM). Economic benefits associated with the various AFO/CAFO scenarios are based on changes in water quality use-support (i.e., boatable, fishable, swimmable) and the population benefitting from the changes. Benefits are calculated state-by-state at the State (local) scale as well as at the national level. For each State, benefits at the local-scale represent the value that the State popolation is williug to pay for improvements to waters within the State or adjoining the State. For each State, benefits at the national-scale represent the value that the State population is willing to pay for improvements to waters in all other states in the continental United States.

Based on the NWPCAM analysis, the total national willingness-to-pay (WTP) benefits at the local-scale for all water quality use-supports ranged from approximately $4.3 million (1999 dollars) for the least stringent scenario to $122.1 million for the most stringent scenario. The total national WTP benefits at the national-scale for all water quality use-supports ranged from approximately $0.4 million (1999 dollars) for the least stringent scenario to $22.7 million for the most stringent scenario. Total WTP benefits (i.e., sum of local-scale and uational-scale) for all water quality use-supports ranged from approximately $4.9 million (1999 dollars) for the least stringent scenario to $145 million for the most stringent scenario.

Table 11–13 summarizes the resulting estimates of economic benefits for each of the six regulatory scenarios analyzed. EPA estimates that the annual benefits of Phosphorus—Scenario 2/3 is approximately $127 million per year; for Phosphorus—Scenario 4a is $108 million per year.

TABLE 11–13.—ECONOMIC BENEFIT OF ESTIMATED IMPROVEMENTS IN SURFACE WATER QUALITY

[In millions of 1999 dollars]

Regulatory scenario	Annual benefits
Nitrogen—Scenario 1	$4.9
Nitrogen—Scenario 2/3	6.3
Nitrogen—Scenario 4a	5.5

TABLE 11–13.—ECONOMIC BENEFIT OF ESTIMATED IMPROVEMENTS IN SURFACE WATER QUALITY—Continued

[In millions of 1999 dollars]

Regulatory scenario	Annual benefits
Nitrogen—Scenario 4b	7.2
Phosphorus—Scenario 1	87.6
Phosphorus—Scenario 2/3*	127.1
Phosphorus—Scenario 4a*	108.5
Phosphorus—Scenario 4b	145.0

*Proposed scenarios.

b. *Shellfish Beds.* Pathogen contamination of coastal waters is a leading cause of shellfish bed harvest restrictions and closures. Sources of pathogens include runoff from egricultural lend and activities. Using *The 1995 National Shellfish Register of Classified Growing Waters* (shellfish register) published by the National Oceanic and Atmospheric Administration (NOAA), EPA estimated the possible improvements to shellfish bed harvesting due to expected pathogen reductions of each regulatory scenario.

First, EPA characterized the baseline annual shellfish bed loadings. Then, EPA estimated the area of shellfish-growing waters for which current loadings are harvested. For the third step, EPA calculated the average annual per-acre yield of shellfish form harvested waters. Next, EPA estimated the area of shellfish-growing waters that are currently unharvested as a result of pollution from AFOs. From this, EPA calculated the potential harvest of shellfish from waters that are currently unharvested as a result of pollution from AFOs. Estimates for all scenarios range from $1.8 million to $2.9 million. Phosphorus—Scenario3 is $2.7 million and Phosphorus—Scenario 4a is $2.4 million.

c. *Fishkills.* Episodic fish kill events resulting from spills, manure runoff, and other discharges of manure from animal waste feeding operations continue to remain a serious problem in the United States. The impacts from these incidents range from immediate and dramatic kill events to less dramatic but more widespread events. Manure dumped into and along the West Branch of the Pecatonica River in Wisconsin resulted in a complete kill of smallmouth bass, catfish, forage fish, and all but the hardiest insects in a 13 mile stretch of the river. Less immediate catastrophic impacts on water quality from manure runoff, but equally important, are increased algae growth or algae blooms which remove oxygen from the water and may result in the death of fish. Manure runoff into a shallow lake in Arkansas resulted in a heavy algae bloom which depleted the lake of oxygen, killing many fish.

Fish health and fish kills are an indication of water quality. If fish cannot survive or are sick in their natural habitat then the public may view the water as unsuitable for recreational uses and fish unfit for human consumption. Parts of the Eastern Shore of the United States have been plagued with problems related to pfiesteria, a dinoflagellate algae that exist in rivers at all times, but can transform itself into a toxin that eats fish. Fish attacked by pfiesteria have lesions or large, gaping holes on them es their skin tissue is broken down; the lesions often result in death. The transformation of pfiesteria to the toxic form is believed to be the result of high levels of nutrients. Fish kills related to pfiesteria in the Neuse River in North Carolina have been blamed on the booming hog industry and the associated waste spills and runoff from the hog farms.

There is preliminary evidence that suggests that there are human health problems associated with exposure to pfiesteria. As a result, people most likely would limit or avoid recreational activities in waters with pfiesteria-related fish kills. The town of New Bern, a popular summer vacation spot along the Neuse River in North Carolina, was concerned about a decline in tourism after several major fish kills in the summer of 1995. Not only were fish killed, people became sick after swimming or fishing in the waters. People swimming in the waters reported welts and sores on their body. Summer camps canceled boating classes and children were urged to stay out of the water. Fishing boats were concerned about taking people fishing on the river. People were warned not to eat fish that were diseased or sick. At one point, after seeing miles and miles of dead fish, a top environmental official issued a warning urging people not to swim, fish, or boat in the fish-kill zone. Many blame the heavy rainfall which pumped pollutants from overflowing sewage plants and hog lagoons into the river, creating algae blooms, low oxygen and pfeisteria outbreaks as the canse of the fish kills.

Reports on fish kill events in the United States were collected by the Natural Resources Defense Council and the Izaak Walton League. Nineteen states reported information on historical and current fish kills. Using these data, EPA estimated the benefits related to reduced fish being killed for each regulatory scenario. At a seven percent discount rate, benefits range from $2 million to $42 million. Benefots for Phosphorus—Scenario 3 range from $2.4 million to $30.6 million; for Phosphorus—Scenario 4a, from $2.8 million to $34.5 million.

d. *Groundwater Contamination.* CAFOs can contaminate groundwater and thereby cause health risks and welfare losses to people relying on groundwater sources for their potable supplies or other uses. Of particular concern are nitrogen and other animal waste-related contaminants (originating from manure and liquid wastes) that leach through the soils and the unsaturated zone and ultimetely reach groundwaters. Nitrogen loadings convert to elevated nitrate concentrations at household and community system wells, and elevated nitrate levels in turn pose e risk to human health in households with private wells (nitrate levels in community wells are regulated to protect human health). The proposed regulation will generate benefits by reducing nitrate levels in household wells, and there is clear empirical evidence that households have a positive willingness to pay to reduce nitrate concentrations in their water supplies.

The federal health-based National Primary Drinking Water Standard for nitrete is 10 mg/L, and this Maximum Contaminant Level (MCL) applies to all Community Water Supply systems. Households relying on private wells are not subject to the federal MCL for oitrate but levels above 10 mg/L are considered unsafe for sensitive subpopulations (e.g., infants). Several economic studies indicate a considerable WTP by households to reduce the likelihood of nitrate levels exceeding 10 mg/L (e.g., $448 per year per household (Poe and Bishop, 1991)). There also is evidnnce of a positive household WTP to reduce nitrate levels even wheu baseline concentrations are considerably below the MCL (approximately $2 per mg/L of reduced nitrate concentration (Crutchfield *et al.*, 1997, De Zoysa, 1995)).

Based on extensive U.S. Geologic Survey (USGS) data on nitrate levels in wells throughout the country, an empirical model was developed to predict how each regulatory option would affect the distribution of nitrate concentratious in household wells. Table 11–14 indicates the number of household wells that are estimated to have baseline (i.e., without regulation) concentrations above 10 mg/L and that will have these concentration reduced to levels below the MCL for each option.

Also shown are the households with predicted nitrate levels that are below the MCL at baseline, but that will experience further reductions in nitrate levels due to the proposed regulation.

TABLE 11–14.—REDUCTION IN HOUSEHOLDS EXCEEDING MCL AND MG/L OF NITRATE IN WELLS

Regulatory Scenario	Reduction, from baseline, in # households exceeding 10 mg/L	Total number of mg/L reduced in wells at 1–10 mg/L baseline
Baseline # of households affected	1,277,137	6,195,332
Nitrogen—Scenario 1	152,204	961,741
Nitrogen—Scenario 2/3	152,204	1,007,611
Nitrogen—Scenario 4a	161,384	1,186,423
Nitrogen—Scenario 4b	161,384	1,186,423
Phos.—Scenario 1	161,384	1,103,166
Phos—Scenario 2/3*	161,384	1,159,907
Phos—Scenario 4a*	165.974	1,374,990
Phos—Scenario 4b	165,974	1,374,990

*Proposed scenarios.

The monetized benefits of these nitrate concentration reductions is estimated to be $49.4 million per year for Phosphorus—Scenario 2/3, as shown in Table 11–15. The total benefits of this scenario consist of $47.8 million for the households that have nitrate levels reduced to below the MCL from baseline concentrations above 10 mg/L, plus an additional $1.5 million for those households with nitrate reductions relative to baseline levels below the MCL. The mouetized benefits of these nitrate concentratiou reductions is estimated to be $51.0 million per year for Phosphorus—Scenario 4a. The total beuefits of this option consist of $49.2 million for the households that have nitrate levels reduced to below the MCL from baseline concentrations above 10 mg/L, plus an additional $1.7 million for those households with nitrate reductions relative to baseline levels below the MCL. The household benefits of the other options are also shown in the table, and range from $46.4–$50.1 million per year.

TABLE 11–15.— ANNUALIZED MONETARY BENEFITS ATTRIBUTABLE TO REDUCED NITRATE CONCENTRATIONS

Regulatory scenario	Total benefits	Benefits from households exceeding MCL at baseline	Benefits from households between 1 and 10 mg/L at baseline
Nitrogen—Scenario 1	$46,372,457	$45,118,803	$1,219,763
Nitrogen—Scenario 2/3	46,432,250	45,118,803	1,276,293
Nitrogen—Scenario 4a	49,386,622	47,840,089	1,498,104
Nitrogen—Scenario 4b	49,386,622	47,840,089	1,498,104
Phosphorus—Scenario 1	49,278,094	47,840,089	1,396,043
Phosphorus—Scenario 2/3*	49,352,058	47,840,089	1,465,648
Phosphorus—Scenario 4a*	50,993,067	49,200,732	1,729,337
Phosphorus—Scenario 4b	50,993,067	49,200,732	1,729,337

*Proposed scenarios.

e. *Total Benefit of Proposed Regulatory Scenorio.* Table 11–16 shows the annualized benefits for each of the studies conducted. Table 11–17 shows the summary of annualized benefits for three discount rates (3, 5, and 7 percent). The total monetized benefits for this proposed rule are, at a minimum, $163 million for Phosphorus—Scenario 2/3 and $146 million for Phosphorus—Scenario 4a, discounted at seven percent. At a three percent discount rate, the annualized benefits for Phosphorus—Scenario 3 are $180 million and for Phosphorus—Scenario 4a, $163 milliou. These represent the lower bound estimates for this analysis. The npper end of the range would include estimates for drinking water treatment plant cost savings, surface water improvements from nonboatable to boatable water quality conditions, and other benefits that we were unable to estimate at this time. We plan to include some of these monetized benefits iu the final rule.

TABLE 11–16.—ESTIMATED ANNUALIZED BENEFITS OF REVISED CAFO REGULATIONS

[1999 dollars, millions]

Regulatory Scenario	Recreational and non-use benefits	Reduced fish kills	Improved shellfishing	Reduced private well contamination
Nitrogen—Scenario 1	4.9	0.1–0.2	0.1–1.8	33.3–49.0
Nitrogen—Scenario 2/3	6.3	0.1–0.3	0.2–2.4	33.3–49.1
Nitrogen—Scenario 4a	5.5	0.1–0.3	0.2–2.2	35.5–52.2
Nitrogen—Scenario 4b	7.2	0.1–0.3	0.2–2.6	35.5–52.2

TABLE 11–16.—ESTIMATED ANNUALIZED BENEFITS OF REVISED CAFO REGULATIONS—Continued

[1999 dollars, millions]

Regulatory Scenario	Recreational and non-use benefits	Reduced fish kills	Improved shellfishing	Reduced private well contamination
Phosphorus—Scebarui 1	87.6	0.2–0.3	0.2–2.1	35.4–52.1
Phosphorus—Scenario 2/3*	127.1	0.2–0.4	0.2–2.7	35.4–52.1
Phosphorus—Scenario 4a*	108.5	0.2–0.4	0.2–2.4	36.6–53.9
Phosphorus—Scenario 4b	145.0	0.2–0.4	0.2–3.0	36.6–53.9

* Proposed scenarios.

TABLE 11–17.—SUMMARY OF ANNUALIZED BENEFITS

[1999 dollars, millions]

Regulatory scenario	Discount rates					
	3 percent		5 percent		7 percent	
	Low	High	Low	High	Low	High
Nitrogen—Scenario 1	54 1	55.9	45.0	46.9	38.4	40.2
Nitrogen—Scenario 2/3	55.7	58.0	46.6	48.9	39.9	42.3
Nitrogen—Scenario 4a	58.0	60.2	48.3	50.5	41.2	43.4
Nitrogen—Scenario 4b	59.7	62.3	50.1	52.6	43.0	45.5
Phosphorus—Scenario 1	140.0	142.1	130.4	132.4	123.3	125.4
Phosphorus—Scenario 2/3*	179.7	182.3	170.0	172.7	163.0	165.6
Phosphorus—Scenario 4a*	162.8	165.1	152.8	155.2	145.5	147.9
Phosphorus—Scenario 4b	199.4	202.2	189 4	192.2	182.1	185.0

* Proposed scenarios.

XII. Public Outreach

A. Introduction and Overview

EPA has actively involved interested parties to assist it in developing a protective, practical, cost-effective regulatory proposal. EPA has provided many opportunities for input in this rulemaking process. EPA has met with varions members of the stakeholder community on a continuing basis through meeting requests and invitations to attend meetings, conferences, and site visits. These meetings with environmental organizations, agricnltural organizations, producer groups, and producers representing various agricultural sectors have allowed EPA to interact with and receive input from stakeholders about the Unified Strategy and the NPDES and effluent limitations regulatory revisions. In addition, EPA convened a Small Business Advocacy Review Panel to address small entity concerns. EPA also sent an ontreach package to and met with several national organizations representing State and local governments. More detailed information on EPA's public ontreach is provided in the rulemaking record.

B. Joint USDA/EPA Unified AFO Strategy Listening Sessions

In the fall of 1998, EPA and USDA annonnced eleven public outreach meetings designed to allow public comment on the Draft Unified National AFO Strategy. The meetings were held in the following cities: Tulsa, Oklahoma; Harrisburg, Pennsylvania; Ontario, California; Madison, Wisconsin; Seattle, Washington; Des Moines, Iowa; Chattanooga, Tennessee; Indianapolis, Indiana; Fort Worth, Texas; Denver, Colorado; and Annapolis, Maryland. Each meeting included a pre-meeting among state and regional officials, EPA, and USDA representatives to discuss the draft strategy and the issnes posed by CAFOs in general. All participants in the public sessions, including numerous small entities, were given the opportunity to sign up and provide their comments to a panel consisting of EPA, USDA, and local representatives. Many of the commenters made points or raised issues germane to small entities. A transcript of these comments was nsed by EPA and USDA in developing the final Unified National AFO Strategy. These comments and concerns have been considered by EPA in the development of the revised NPDES CAFO regulations. The transcripts of these meetings are available on the OWM Web Site (www.epa.gov/owm/afo.htm) and are available in the record.

C. Advisory Committee Meeting

EPA was invited to meet with the Local Government Advisory Committee, Small Community Advisory Subcommittee on September 8, 1999. At this Federal Advisory Committee Act meeting, EPA described the CAFO regulatory revisions being considered, and responded to questions concerning the effect of EPA's regulatory actions on small communities. While the CAFO regulations do not directly affect small communities, AFOs do have an effect on local economies and on the local environment. Thus, how they are regulated (or not regulated) has implications for local governments. EPA is keeping local government concerns in mind as it proceeds with the CAFO regulatory revisions and general public outreach activities.

D. Farm Site Visits

EPA conducted approximately 110 site visits to collect information abont waste management practices at livestock and poultry operations. Agency staff visited a wide range of operations, including those demonstrating centralized treatment or new and innovative technologies. EPA staff visited livestock and poultry operations throughout the United States, the majority of which were chosen with the assistance of the leading indnstry trade associations and also by the Natural Resources Defense Council, the Clean Water Network, university experts, State cooperative and extension agencies, and state and EPA regional representatives.

EPA also attended USDA-sponsored farm tours, as well as tours offered at industry, academic, and government conferences. Details on these visits are provided in the rulemaking record.

EPA staff visited cattle feeding operations in Texas, Oklahoma, Kansas, Colorado, California, Indiana, Nebraska, and Iowa, as well as veal operations in Indiana. The capacities of the beef feedlots varied from 500 to 120,000 head. EPA also visited dairies in Pennsylvania, Florida, California, Colorado, and Wisconsin, with the total mature dairy cattle at the operations ranging from 40 to 4,000 cows. In addition, EPA visited broiler, layer and turkey facilities in Georgia, Arkansas, North Carolina, Virginia, West Virginia, Maryland, Delaware, Pennsylvania, Ohio, Indiana, and Wisconsin. EPA visited hog facilities in North Carolina, Ohio, Iowa, Minnesota, Texas, Colorado, Oklahoma, and Utah.

E. Industry Trade Associations

Throughout regulatory development, EPA has worked with representatives from the national trade groups, including: National Cattlemen's Beef Association (NCBA); American Veal Association (AVA); National Milk Producers Federation (NMPF); Professional Dairy Heifers Growers Association (PDHGA); Western United Dairymen (WUD); National Pork Producers Council (NPPC); United Egg Producers and United Egg Association (UEP/UEA); National Turkey Federation (NTF); and the National Chicken Council (NCC). All of the above organizations have provided assistance by helping with site visit selection, submitting supplemental data, reviewing descriptions of the industry and waste management practices, and participating in and hosting industry meetings with EPA.

F. CAFO Regulation Workgroup

EPA established a workgroup that included representatives from USDA and seven states, as well as EPA Regions and headquarters offices. The workgroup considered input from stakeholders and developed the regulatory options presented in today's proposal.

G. Small Business Advocacy Review Panel

1. Summary of Panel Activities

To address small business concerns, EPA's Small Business Advocacy Chairperson convened a Small Business Advocacy Review (SBAR) Panel under section 609(b) of the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA). Participants included representatives of EPA, the Small Business Administration (SBA) and the Office of Management and Budget (OMB). "Small Entity Representatives" (SERs), who advised the Panel, included small livestock and poultry producers as well as representatives of the major commodity and agricultural trade associations. Information on the Panel's proceedings and recommendations is in the Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule on National Pollutant Discharge Elimination System (NPDES) and Effluent Limitations Guideline (Effluent Guidelines) Regulations for Concentrated Animal Feeding Operations (hereinafter called the "Panel Report"), along with other supporting documentation included as part of the Panel process. This information can be found in the rulemaking record.

Prior to convening a SBAR Panel, EPA distributed background information and materials to potential SERs on September 3, 1999 and September 9, 1999. On September 17, 1999, EPA held a conference call from Washington, D.C. which served as a pre-panel forum for small business representatives to provide input on key issues relating to the proposed regulatory changes to the "CAFO Rule." Twenty-seven small business representatives from the beef, dairy, swine, poultry, and exotic animal livestock industries participated in the conference call. A summary of the conference call is included in the Panel Report. Following the conference call, 19 of the 41 small business advisors and national organizations invited to participate on the conference call submitted written comments. These written comments are included in the Panel Report.

The SBAR Panel for the "CAFO Rule" was formally convened on December 16, 1999. On December 28, 1999, the Panel distributed an outreach package to the final group of SERs, which included many of the participants in EPA's September 17, 1999 outreach conference call. The package included: a SER outreach document, which provided a definition of a small business and described those entities most likely to be affected by the rule; an executive summary of EPA's cost methodology; regulatory flexibility alternatives; a cost methodology overview for the swine, poultry, beef, and dairy sectors; a cost annualization approach; and a list of questions for SERs. Additional modeling information was also sent to SERs on January 7, 2000 and January 10, 2000. A complete list of these documents can be found in the Panel Report; all information sent to the SERs is included in the record.

The SERs were asked to review the information package and provide verbal comments to the Panel during a January 5, 2000 conference call, in which 22 SERs participated. During this conference call, SERs were also encouraged to submit written comments. SERs were given an additional opportunity to make verbal comments during a second conference call held on January 11, 2000, in which 20 SERs participated. During both conference calls, SERs were asked to comment on the costs and viability of the proposed alternatives under consideration by EPA. A summary of both conference calls can be found in the Panel Report. Following the calls, the Panel received 20 sets of written comments from 14 SERs. A complete set of these comments is included in the Panel Report.

2. Summary of Panel Recommendations

A full discussion of the comments received from SERs and Panel recommendations is included in the Panel Report. The major issues summarized are as follows.

a. *Number of Small Entities.* The Panel reviewed EPA's methodology to develop its estimate of the small entities to which the proposed rule will likely apply. EPA proposed two alternative approaches to estimate the number of small businesses in these sectors. Both approaches identify small businesses in those sectors by equating SBA's annual revenue definition with the number of animals at an operation and estimate the total number of small businesses in these sectors using farm size distribution data from USDA. One approach equates SBA's annual revenue definition with operation size using farm revenue data, as described in Section X.J.2 of this document. Another approach equates SBA's annual revenue definition with the operation size using a modeling approach developed by EPA that calculates the amount of livestock revenue at an operation based market data, including the USDA-reported price received by producers, average yield, and the number of annual marketing cycles. (Additional information on this latter approach is in the rulemaking record.)

During the Panel process, and following formal consultation with SBA, the Panel participants agreed to use the first approach to estimate the number of small businesses in these sectors. More details on this approach is provided in Section X.J.2 and in Section 9 of the

Economic Anelysis. More detail on the Panel's deliberation of the approach used to determine the number of small bnsinesses is provided Sections 4 and 5 of the Panel Report and in other support documentation developed during the SBAR Panel process. The Panel noted that the revised methodology may not accurately portray actual small businesses in all cases across all sectors. The Panel also recognized that, under this small business definition, EPA would be regulating some small facilities, but urged EPA to consider the small business impacts of doing so.

b. *Potential Reporting, Record Keeping, and Compliance Requirements. Record Keeping Related to Off-Site Transfer af Manure.* The Panel reviewed EPA's consideration of record keeping and reportiug requirements in connection with off-site transfer of manure. The Pauel recommended that EPA review and streamline the requirements for small entities. In response to this recommendation, EPA is limiting its proposal to keep records of the name and address of the entity to which the CAFO is transferring manure, how much is being transferred and the nutrient content of the manure on-site. This information would allow EPA to track manure, and to follow-up with the third party recipient to ascertain whether the mauure was applied in accordance with Clean Water Act requirements that may apply. EPA is also proposing under one co-proposed option that a CAFO obtain a certification from recipients that land application is done in accordance with proper agricultural practices. EPA assumes recipients of manure are mostly field crop producers who already maintain appropriate records relating to outrient management. EPA is not proposing to establish specific requirements for these offsite recipients.

Permit Application and Certification Requirements. The Panel asked EPA to consider the burden associated with increasing the number of entities subject to permit between 300 AU and 1,000 AU. Furthermore, the Panel recommended that EPA carefully consider appropriate streamlining options before considering a more burdensome approach. EPA considered several alternative scenarios for the scope of peruit coverage of facilities in this size group, and decided to simultaneously co-propose two scenarios, as each offers different means of accomplishing similar environmental outcomes.

The first alternative proposal would retain the current three-tier structure, but would require an operation in the 300–1,000 AU size tier to certify to the permitting authority that it does not meet any of the "risk-based" conditions (described in Section VII), and thus is not required to obtain a permit. The three-tier structure would require all AFOs with 300 AU or more to, at a minimum, obtain a permit nntrient plan and submit a certification to the permit authority. This alternative would provide the permit anthority the opportnnity to implement effective programs to assist AFOs in order to minimize how many would be required to apply for e permit. Because those certifying would not be CAFOs, however, they would have access to section 319 nonpoint source funds. This co-proposed alternative does not meet one of the goals of today's proposal, as recommended by the Panel, that is, to simplify the regulations to improve understanding and therefore compliance by the regulated community. Further, the conditious are such that all facilities with 300 AU or more would incur some cost associated with certifying they do not meet any of the conditions. EPA is also requesting comment on a variation of the three-tier structure that was presented to the SERs and generally favorably received by the Panel (see detailed discussion in Section VII.B.3).

The second alternative proposal wonld adopt a two-tier structure that defines all operations with 500 AU or more as CAFOs. (EPA is also requesting comment on a 750 AU threshold.) This proposal would provide regulatory relief for operations between 300 AU and 500 AU that may be considered CAFOs under the existing regulations. Operations in this size group would not be subject to the certification process and would not incur the costs associated with certification, such as the costs to obtain a certified Permit Nutrient Plan and to submit a certification to the permit authority. Under the two-tier structnre, operations with more than 500 AU would all be required to apply for a permit. All facilities with fewer thau 500 AU wonld be subject to permitting as CAFOs only through case-by-case designation based on a finding that the operation is a significant contributor of pollution by the permit authority. This proposal offers simplicity and clarity as to which entities will be subject to the proposed regulations and those that will not, which was recommended by the Panel, as well as indicated by the regulated community as one of the goals of today's proposal. Represeutatives of some State programs, however, have indicated that they would prefer an option that allows State non-NPDES programs to address issues at CAFOs in their states, rather than being required to write permits.

EPA is also proposing to provide regulatory relief to small businesses by eliminating the mixed animal calculation. As a result, smaller operations that house a mixture of animal types where none of these animal types independently meets the regulatory threshold are not considered CAFOs under either of today's proposals, unless they are individually designated. EPA believes that this will provide maximum flexibility for these operations since most are now participating in USDA's voluntary CNMP program, as outlined in the AFO Strategy. For more information, see discussion in Section VII. A summary of EPA's ecouomic analysis is provided in Section X.J of this preamble.

Frequency of Testing. The Panel reviewed EPA's consideration of requiring periodic soil testing. The Panel agreed that testing manure and soil at different rates may be appropriate, but expressed concern about the burden of any inflexible testing requirements ou small businesses. The Panel recommended that EPA consider leaving the frequency of required testing to the discretion of local permit writers, and request comment on any testing requirements that are included in the proposed rule. The Panel further recommended that EPA weigh the burden of testing requirements to the need for snch information.

EPA is proposing to require soil testing of each field every three years and mannre testing once per year. The proposed frequency is consistent with standards in many states and also recommendations from agricultnral extension services. To ensure that soils have not reached a critical concentration of phosphorus, EPA believes that it is necessary to establish a minimum sampling frequency and testing requiremonts for all CAFOs, regardless of size. Since it is believed that much of the water pollution from agriculture comes from field rnnoff, information on manure and soil content is essential for the operator to determine at what rate manure should be applied. EPA believes this information is essential for the permitting authority to know whether the manure is being land applied at proper rates. The local permit writer retains the discretion to require more frequent testing.

Groundwater Requirements Where Linked to Surface Water. The Panel reviewed EPA's consideration of an option that would require groundwater controls at facilities that are determined to have a direct hydrological connection to surface water since there is reasonable potential for discharges to surface water via ground water at these facilities ("Option 3"). Because of the potentially high costs to small operators associated with both making a determination of a hydrologic link and installing controls (such as lagoon liners, mortality composting devices, groundwater monitoring wells, concrete pads, and other technologies), the Panel recommended that EPA examine this requirement, giving careful consideration to the associated small entity impacts, in light of the expected environmental benefits resulting from this option. The Panel further recommended that if EPA decides to propose any such requirements that it consider streamlining the requirements for small entities (*e.g.*, sampling at reduced rates) or exempting them altogether.

(i) *Existing CAFOs.* EPA is proposing to require existing beef and dairy CAFOs to install groundwater controls when the groundwater beneath the production area has a direct hydrologic connection to surface water (Option 3, as described in Section VIII). This includes installation of wells and biannual sampling to monitor for any potential discharge from the production area. CAFOs are also expected to construct concrete pads or impermeable surfaces, as well as install synthetic liners if necessary to prevent discharges to surface water via direct hydrologic connection. The groundwater controls which are part of the proposed BAT requirements are in addition to the land application requirements which ensure that the manure and wastewater application to land owned or controlled by the CAFO is done in accordance with a PNP and does not exceed the nutrient requirements of the soil and crop. EPA has determined that this option represents the best available technology for existing beef and dairy CAFOs and that this requirement is economically achievable under both proposed permitting scenarios (*i.e.* the two-tier and three-tier structures), although some CAFOs in these sectors may experience increased financial burden. Because the risks from discharged pollutants from groundwater to surface water are location-specific, EPA believes that the proposed groundwater requirements are necessary at CAFOs where there is a hydrologic connection to surface waters. EPA's is proposing that these requirements are economically achievable by operations that are defined as CAFOs and are also small businesses. The results of EPA's small business analysis is provided in Section X.J of this preamble. Moreover, EPA believes that the estimated benefits in terms of additional groundwater-surface water protections would be significant. EPA's pollution reduction estimates across options are presented in the Development Document.

EPA is not proposing BAT requirements for the existing swine, veal and poultry subcategories on the basis of Option 3, *i.e.*, EPA rejected proposing groundwater monitoring and controls in the effluent guidelines for these CAFOs. As described in Section VIII of this preamble, EPA is proposing Option 5 as the best available technology economically achievable, which requires zero discharge from the animal production area with no exception for storm events. Were EPA to add the requirement to control discharges to groundwater that is directly connected to surface waters in addition to the Option 5 requirements, the costs would result in much greater financial impacts to hog and poultry operations. EPA's analysis shows that the full cost of groundwater controls ("Option 3") in addition to requirements under Option 5 would not be economically achievable by operations in these sectors.

(ii) *New CAFOs.* EPA is proposing to require that all new CAFOs in all subcategories install groundwater controls. EPA expects that requiring groundwater monitoring is affordable to new facilities since these facilities do not face the cost of retrofit. EPA's economic analysis of new facility costs is provided in Section X.F.1(b) of this preamble. More detailed information is provided in the Economic Analysis and the Development Document.

c. *Relevance of Other Federal Rules.* The Panel did not note any other Federal rules that may duplicate, overlap, or conflict with the proposed rule.

d. *Regulatory Alternatives.* The Panel considered a wide range of options and regulatory alternatives for reducing the burden on small business in complying with today's proposal. These included:

Revised Applicability Thresholds. The Panel recommended that EPA give serious consideration to the issues discussed by the Panel when determining whether to establish less stringent effluent limitations guidelines for smaller facilities, and whether to preserve maximum flexibility for the best professional judgement of local permit writers. The Panel also recommended that the Agency carefully evaluate the potential benefits of any expanded requirements for operations with between 300 and 1,000 AU and ensure that those benefits are sufficient to warrant the additional costs and administrative burden that would result for small entities.

EPA is proposing to apply the effluent limitation guidelines to all facilities that are defined as CAFOs, although EPA is also requesting comment on an option under which they would only apply to facilities with greater than 1,000 AUs. Thus, under the three-tier structure all CAFOs with 300 AU or more would be subject to the effluent guidelines. Under the two-tier structure, all CAFOs with 500 AU or more would be subject to the effluent guidelines. EPA is also requesting comment on a 750 AU threshold for the two-tier structure. Under both of the co-proposed alternatives, EPA is proposing to eliminate the "mixed" animal calculation for operations with more than a single animal type for determining which AFOs are CAFOs. As a result, smaller operations that house a mixture of animal types where none of these animal types independently meets the regulatory threshold are not considered CAFOs under today's proposed rulemaking, unless they are individually designated. EPA believes that this will provide maximum flexibility for these operations since most are now participating in USDA's voluntary CNMP program, as outlined in the AFO Strategy. For more information, see discussion in Section VII.

EPA's two-tier proposal provides additional relief to small businesses. Under the two-tier structure, EPA is proposing to establish a regulatory threshold that would define as CAFOs all operations with more than 500 AU. This co-proposed alternative would provide relief to small businesses since this would remove from the CAFO definition operations with between 300 AU to 500 AU that under the current rules are defined as CAFOs. These operations would no longer be defined as CAFOs and may avoid being designated as CAFOs if they take appropriate steps to prevent discharges. In addition, if operations of any size that would otherwise be defined as CAFOs can demonstrate that they have no potential to discharge, they would not need to obtain a permit. Also, under the two-tier structure, EPA is proposing to raise the size standard for defining egg laying operations as CAFOs from 30,000 to 50,000 laying hens. This alternative would remove from the CAFO definition egg operations of this size that under the current rules are defined as CAFOs, if they utilize a liquid manure management system.

EPA believes that revising the regulatory thresholds below 1,000 AU is necessary to protect the environment from CAFO discharges. At the current 1,000 AU threshold, less than 50 percent of all manure and wastewater generated annually would be captured under the regulation. Under the co-proposed alternatives, between 64 percent (two-tier) and 72 percent (three-tier) would be covered. (See Section IV.A of this preamble.) Total pre-tax compliance costs tu CAFOs with fewer than 1,000 AU is estimated to range between $226 million annually (two-tier) to $298 million annually (three-tier), or abont one-third of the total estimated annual costs (see Section X.E.1). EPA believes that the estimated benefits in terms of additional manure coverage justify the estimated costs. EPA estimates that 60 percent (two-tier) to 70 percent (three-tier) of all operations that are defined as CAFOs and are also small businesses are operations with less than 1,000 AU. EPA's economic analysis, however, indicates that these small businesses will not be adversely impacted by the proposed requirements. EPA's estimates of the number of small businesses and the results of its economic analysis is provided in Section X.J of this preamble.

Under each co-proposed alternative, EPA is proposing that operations that are not defined as CAFO (*i.e.*, operations with fewer animals than the AU threshold proposed) could still be designated as CAFOs on a case-by-case basis. During the Panel process, the Panel urged EPA not tu consider changing the designation criteria for operations with less than 300 AU. This includes the criterion that the permitting authority must conduct an on-site inspection of any AFO, in making a designation determination. EPA is not proposing to eliminate the on-site inspection requirement. EPA believes it is appropriate to retain the requirement for an on-site inspection before the permitting authority determines that an operation is a "significant contributor of pollution." No inspection would be required to designate a facility that was previously defined or designated as a CAFO. EPA is, however, requesting comment on whether or not to eliminate this provision or to redefine the term "on-site" to include other forms of site-specific data gathering. In addition, EPA is proposing to delete two criteria, including discharge from manmade device and direct contact with waters of the U.S., as nnnecessary to the determination of whether an operation should be designated as a CAFO. EPA is also proposing to clarify EPA's designation authority in States with NPDES approved programs. For more information, see Section VII.

25-year, 24-hour Storm Event. At the time of SBREFA outreach, EPA indicated to SERs and to the Panel that it was considering removing the exemption, but not changing the design requirement for permitted CAFOs. The Panel expressed concern about removing this exemption for operations with fewer than 1000 AU. The Panel recommended that if EPA removes the exemption, it should fully analyze the incremental costs associated with permit applications for those facilities that are not presently permitted that can demonstrate they do not discharge in less than a 25-year, 24-honr storm event, as well as any costs associated with additional conditions related to land application, nutrient management, or adoption of BMPs that the permit might contain. The Panel recommended that EPA carefully weigh the costs and benefits of removing the exemption for small entities. The Panel also urged EPA to consider reduced application requirements for small operations affected by the removal of the exemption.

EPA is proposing to require that all operations that are CAFOs apply for a permit. EPA is proposing to remove the 25-year, 24-hour storm exemption from the definitiou of a CAFO. It is difficult to monitor, and removal of this exemption will make the rule simpler and more equitable. However, we are proposing to retain the 25-year, 24-honr storm event as a design standard in the effluent limitation guidelines for certain animal sectors (specifically, the beef and dairy cattle sectors). As a result, operations in these sectors that discharge only in the event of a 25-year, 24-hour storm would not be exempt from being defined as CAFOs, but would be in compliance with their permit as long as they met the 25-year, 24-hour storm design standard. EPA is proposing to establish BAT for the swine, poultry, and veal subcategories on the basis of Option 5 which hans discharge from the production area under any circumstances. The technology basis for this option is covered lagoons, and does not establish a different design standard for these lagoons. Removal of the exemption from the CAFO definition should have no impact on operations that are already employing good management practices. More information is provided in Sections VII and VIII of this document. Prior to proposing to remove this exemption, EPA evaluated the incremental costs associated with permit applications for those facilities that are not presently permitted and other associated costs to regulated small entities. EPA's economic analysis is provided in Section X.J of this preamble. Estimated costs to the NPDES Permitting Authority are presented in Section X.G.1. Section X.I presents a comparison of the annnalized compliance costs and the estimated monetized benefits.

Manure and Wastewater Storage Capacity. The Panel noted the SERs' concern about the high cost of additional storage capacity and recommended that EPA consider low-cost alternatives in its assessment of best available technologies economically achievable, especially for any subcategories that may include small bnsinesses. The Panel was concerned about the high cost of ponltry storage and asked EPA to consider low cost storage. EPA is proposing that facilities may not discharge pollutants to surface waters. To meet this requirement, facilities may choose to constrnct storage sheds, cover manure, collect all runoff, or any other equally effective combination of technologies and practices. The proposal does not directly impose any minimum storage requirements.

Land Application. The Panel recommended that EPA continue to work with USDA to explore ways to limit permitting requirements to the minimum necessary to deal with threats to water quality from over-application and to define what is "appropriate" land application, consistent with the agricultural stormwater exemption. The Panel recommended that EPA consider factors such as annual rainfall, local topography, and distance to the nearest stream when developing any certification and/or permitting requirements related to land application. The Panel also noted the high cost of P-based application relative to N-based application, and supported EPA's inteut to require the use of P-based application rates only where necessary to protect water quality, if at all, keeping in mind its legal obligations under the CWA. The Panel recommended that EPA consider leaving the determiuatiou of whether to require the use of P-hased rates to the permit writer's discretion, and continue to work with USDA in exploring such an option.

EPA recognizes that the rate of application of the manure and wastewater is a site-specific determination that accounts for the soil conditions at a CAFO. Depending on soil conditious at the CAFO, EPA is proposing to require that the operator apply the manure and wastewater either according to a nitrogen-standard or, where necessary, on a phosphorus-standard. If the soil phosphorus levels in a region are very high, the CAFO would be prohibited from applying any manure or wastewater. EPA believes that this will improve water quality in some production regions where the amount of phosphorus in animal manure and wastewater being generated exceeds crop needs and has resulted in a phosphorus build-up in the soils in those regions. Evidence of manure-phosphorus generetion in excess of crop needs is reported in analyses cnnducted by USDA. Other data show that larger operations tend to have less land to land apply manure nntrionts that are generated on-site. EPA believes that each of the co-proposed alternatives establish a regnlatory threshold that ensures that those operations with limited land on which to apply manure are permitted. Under the three-tier structure, EPA is proposing risk conditions that would require nutrient management (i.e., PNPs) at operations with 300 to 1,000 AU. In addition, EPA is proposing under one co-proposed option to require letters of certification be obtained from off-site recipients of CAFO manure. Operations that are not defined as CAFOs, bnt that are determined to be a "significant contributor of pollution" by tbe permit authority, may be designated as CAFOs.

EPA is proposing a method for assessing whether phosphorus-based application is necessary that is consistent with USDA's policy on nutrient management. In all nther areas, a nitrogen-based application rate would apply. EPA's proposal grants flexibility to the states in determining the appropriate basis for land application rates. EPA will continue to work with USDA to evaluate appropriate measures to distinguish proper agricnltural use of manure.

Co-Permitting. The Panel reviewed EPA's consideration of requiring corporate entities that exercise substantial operationnal control over a CAFO to be co-permitted. The Panel did not reach consensus on this issue. The Panel was concerned that any co-permitting requirements may entail additinnal costs and that co-permitting cannot prevent these costs from being passed on to small operators, to the extent that corporate entities enjoy a bargaining advantage during contract negotiations. The Panel thns recommended that EPA carefully consider whether the potential benefits from co-permitting warrant the costs particularly in light of the potential shifting of those costs from corporate entities to contract growers. The Panel also recommended that if EPA does require co-permitting in the proposed rule, EPA consider an approach in which responsibilities are allocated between the two parties such that only one entity is responsible for compliance with any given permit requirement. This would be the party that has primary control over that aspect of operations. Flexibility could also be given to local permit writers to determine the appropriate locus of responsibility for each permit component. Finally, the Panel recommended that if EPA does propose any form of co-permitting, it address in the preamble both the environmental benefits and any economic impacts on small entities that may result and request comment on its approach. If EPA does not propose a co-permitting approach, the Panel recommended that EPA discnss the strengths and weaknesses of this approach and request comment on it.

EPA is proposing in the rnle to clarify that co-permitting is appropriate where a corporate or other entity exercises substantial operational control over a CAFO. Data show that some corporations concentrate growers gengraphically, thus producing a high concentration of nutrients over a limited area. EPA is leaving to the States decisions on how to structure co-permitting. A discussion of the strength and weaknosses of co-permitting is contained in Section VII.C.5 with several snlicitations of comment. EPA is also soliciting comment on an Environmental Management System as a snfficient program to meet co-permitting requirements. Please refer to Section VII.C.5 for further discussion of Environmental Management Systems.

CNMP Preparer Requirements. The Panel reviewed EPA's consideration of requiriug permittees to have CNMPs (Comprehensive Nutrient Management Plans) developed by certified planners. The Panel recommended that EPA work with USDA to develop low cost CNMP development services or allow operators to write their own plans. The Panel was concerned about the cost of having a certified planner develop the plans and urged EPA to continue to coordinate with other federal, state and local agencies in the provision of low-cost CNMP development services, and should facilitate operator preparation of plans by providing training, guidance and tools (e.g., computer programs).

EPA is proposing that CAFOs, regardless of size, hava certified Permit Nutrient Plans (PNPs) that will be enforceable under the permit. The proposal states that USDA's Technical Guidance for Developing CNMPs may be used as a template for developing PNPs. EPA believes that USDA documentation and standards will be appropriate for use as the primary technical references for developing PNPs at CAFOs. In the proposal, EPA has identified certain practices that would be required elements of PNPs in order to protect surface water from CAFO pollntant discharges. These practices are consistent with some of the practices recommended in USDA's CNMP gnidance; however, the PNP wonld not need to include all of the practices identified in the USDA guidance. As an enforceable part of the permit, the PNP would need to be written oither by e certified planner or by someone else and reviewed and approved by a certified planner. EPA believes it is essential that the plans be certified by agriculture specialists because the permit writer will likely rely to a large extent on their expertise. The plans would need to be site specific and meet the requirements outlined in this rule. EPA is continuing to coordinate with other regulatory agencies and with USDA on the developmant of these proposed requirements. EPA has concluded that development of the PNP is affordable to small businesses in these sectors and will improve manure management and lead to cost savings at the CAFO. EPA's economic analysis is provided in Section X.J of this preamble. More detailed information on the cost to develop a PNP is in the Development Document.

General vs. Individual Permits. The Panel reviewed EPA's consideration of requiring individual permits for CAFOs that meet certain criteria, or increasing the level of public involvement in general permits for CAFOs. The Panel recommended that EPA not expand the use of individual permits for operations with less than 1,000 AU. EPA balieves that individual permits may be warranted under certain conditions snch as extremely large operations, operations with a history of compliance problems, or operations in environmentally sensitive areas. Accordingly, EPA is co-proposing two options. In one option, each State develops its own criteria, after soliciting public input, for determining which CAFOs would need to have individual rather than general permits. EPA is also coproposing an option that would establish a national criteria for issuing individual permits. The criteria identifies a threshold that represents the largest operations in each sector. (See Section XII for a detailed discussion.)

Immature Animals. The Panel reviewed EPA's consideration to include immature animals for all animal types in determining the total number of animal units at a CAFO. The Panel recommended that EPA count immature animals proportionally to their waste generation. EPA is proposing to continue to account for only the mature animals at operations where all ages of animals are maintained (mostly dairy and hog operations). Once an operation is covered by the existing regulations, however, all manure and wastewater generated by immature animals that are confined at the same operation with mature animals would also be subject to the requirements. EPA is proposing to maintain this requirement because all young animals are not always confined and immature populations vary over time, whereas the mature herd is of a more constant size. Furthermore, the exclusion of immature animals adds to the simplicity we are seeking in this rulemaking. However, EPA is proposing to include immature animals as subject to the regulations only in stand-alone nursary pig and heifer operations. For stand-alone nursery pig operations, EPA is proposing to account for immeture animals proportionate to their waste generation, as discussed in Section VIII. Stand-alone heifer operations are included under the beef subcategory and are subject to the proposed regulations if they confine more than 500 heifers (two-tier) or more than 300 AU, under certain conditions (three-tier).

e. Other Recommendations. Benefits. The Panel recommended that the EPA evaluate the benefits of the selected regulatory options and that EPA carefully evaluate, in a manner consistent with its legal obligations, the relative costs and benefits (including quantified benefits to the extent possible) of each option in order to ensure that the options selected are affordable (inclnding to small farmers), cost-effective, and provide significant environmental benefits. EPA has conducted an extensive benefit analysis of all the options and scenarios considered. The findings of the benefit analysis are fonnd in Section XI of this report. More detailed information is provided in the Benefits Analysis. Sectiou X.I presents a comparison of the annualized compliance costs and the estimated monetized benefits.

Estimated Compliance Costs. The Panel recommended that EPA continne to refine the cost models and consider additional information provided. EPA has continued to refine the cost models and has reviewed all information provided to help improve the accuracy of the models. A summary of EPA's cost models is provided in Section X of this preamble. More detailed information is provided in the Economic Analysis and Development Document provided in the rulemaking record.

Public Availability of CNMP. The Panel urged EPA to consider proprietary business concerns when determining what to make publicly available. To the extent allowed under the law, EPA should continue to explore ways to balance the operators' concerns over the confidentiality of information that could be detrimental if revealed to the operators' competitors, with the public's interest in knowing whether adequate practices are being implemented to protect water quality. EPA is not requiring CAFOs to submit the PNPs to the permit authority. However, EPA is proposing that the PNPs must be available upon the request of States and EPA. The agencies would make the plans available to the public on request. EPA is proposing to require the operator of a permitted CAFO to make a copy of the PNP cover sheet and executive summary available for public review. EPA is also requesting comment as to whether CAFOs should be able to claim these elements of the PNP as confidential business information and withhold those elements of the PNP from public review on that basis, or alternately, that whether other portions of the PNP should be made available es well.

Dry Manure. The Panel asked EPA to consider the least costly requirements for poultry operations with dry manure management systems. The Panel recommended that in evaluating potential reqnirements for dry manure poultry operations, EPA consider the effects of any such requirements on small entities. EPA is not mandating a specific storage technology or practice, but is proposiug a zero discharge performance staudard and a requirement that poultry operations develop and implement a PNP. EPA is also proposing that certain monitoring and recordkeeping requirements would be appropriate. EPA's economic analysis is provided in Section X.J of this preamble. More detailed cost information is provided in the Development Document.

Coordination with State Programs. The Panel recommended that EPA consider the impact of any uew requirements on existing state programs and include in the proposed rule sufficient flexibility to eccommodate snch programs where they meet the minimum requirements of federal NPDES regulations. The Panel further recommended that EPA continue to consult with states in an effort to promote compatibility between federal and state programs. EPA has consulted with states. There were seven states represented on the CAFO workgroup (see Section XII.G.1). In addition, EPA asked for comment on the proposed options from nine national associations that represent state and local government officials. (See Section XIII.G.) In conducting its analyses for this rulemaking, EPA accounted for requirements under existing state programs. A summary of EPA's estimated costs to the NPDES Permittiug Authority are presented in Section X.G.1 and Section XIII.B.

XIII. Administrative Requirements

A. Executive Order 12866: "Regulatory Planning and Review"

Under Executive Order 12866 [58 FR 51735, October 4, 1993], the Agency must determine whether the regulatory action is "significant" and therefore subject to OMB review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

(1) have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) raise novel legal or policy issnes arisiug out of legal mandates, the President's priorities, or the principles set forth in the Executive Order."

It has beeu determined that this proposed rule is a "significant regulatory action" under the terms of Executive Order 12866. As snch, this action was submitted to OMB for review. Changes made in response to OMB suggestions or recommendations will be documented in the public record.

B. Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 U.S.C. 601 et seq.

The RFA generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities.

Small entities include small businesses, small organizations, and small governmental jurisdictions.

The RFA provides default definitions for each type of small entity. It also authorizes an agency to use alternative definitions for each category of small entity, "which are appropriate to the activities of the agency" after proposing the alternative definition in the **Federal Register** and taking comment. 5 U.S.C. § 601(3)–(5). In addition to the above, to establish an alternative small business definition, agencies must consult with the Small Business Administration (SBA) Chief Counsel for Advocacy.

For purposes of assessing the impacts of today's rule on small entities, small entity is defined as: (1) a small business based on annual revenue standards established by SBA, with the exception of one of the six indnstry sectors where an alternative definition to SBA's is proposed; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small orgauization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

The definitions of small business for the livestock and poultry industries are in SBA's regulations at 13 CFR 121.201. These size standards were updated in September, 2000. SBA size standards for these industries define a "small business" as one with average revenues over a 3-year period of less than $0.5 million annually for dairy, hog, broiler, and turkey operations, $1.5 milliou for beef feedlots, and $9.0 million for egg operations. In today's rule, EPA is proposing to defiue a "small" egg laying operation for purposes of its regulatory flexibility assessments under the RFA as an operation that generates less than $1.5 million in annual revenue. Because this definition of small business is not the definition established under the RFA, EPA is specifically seeking comment on the use of this alternative defiuition as part of today's notice of the proposed rnlemaking. EPA has consulted with the SBA Chief Counsel for Advocacy on the nse of this alternative definition. EPA believes this definition better reflects the agricultural community's sense of what constitutes a small business and more closely aligns with the small husiness definitions codified by SBA for other animal operations. A summary of EPA's analysis pertaiuing to the alternative definition is provided iu Section 9 of the Economic Analysis. A snmmary of EPA's consultation with SBA is provided in the record.

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could reduce that impact. The IRFA is available for review in the docket (see Section 9 of the Economic Analysis). This analysis is summarized in Section X.J of this preamble. Based on available information, there are no small governmental operations or nonprofit organizations that operate animal feeding operations that will be affected by today's proposed regulations.

The majority (95 percent) of the estimated 376,000 AFOs are small businesses, as defined by SBA. Of these, EPA estimates that there are 10,550 operations that will be subject to the proposed requirements that are small businesses under the two-tier structure. Under the three-tier structure, an estimated 14,630 affected operations are small businesses. The difference in the number of affected small bnsinesses is among pooltry producers, particularly broiler operations. Section X.J.2 provides additional detail on how EPA estimated the number of small hosinesses.

Based on the IRFA, EPA is proposing concludes that the proposed regulations are economically achievable to small businesses in the livestock and poultry sectors. EPA's economic analysis coucludes that the proposed requirements will not result in fiuancial stress to small businesses in the veal, dairy, hog, turkey, and egg sectors. However, EPA's analysis concludes that the proposed regulations may result iu financial stress to 150 to 280 small broiler operations under the two-tier and three-tier structure, respectively. In addition, EPA estimates that 10 to 40 small beef and heifer operations may also experience financial stress under each of the proposed tier structures. EPA considers these operations—comprising about 2 percent of all affected small CAFO businesses—may be vulnerable to closure. Details of this economic assessment are provided in Section X.J.

EPA believes that moderate financial impacts that may be imposed on some operations in some sectors is justified given tha magnitude of the documented environmental problems associated with auimal feeding operatious, as described in Section V of this document. Section IV further summarizes EPA's rationale for revising the existing regulations, iucluding: (1) address reports of continued discharge and runoff from livestock and poultry operatious in spite of the existing requirements; (2) update the existing regnlations to reflect structural changes in these industries over the last few decades; and (3) improve the effectiveness of the existing regulations. Additional discussion of the objectives of and legal basis for the proposed rule is presented in Sections I through III.

Section XIII.F summarizes the expected reporting and recordkeeping requirements required under the proposed regnlation based on information compiled as part of the Information Collection Request (ICR) document prepared by EPA.

Section X.J.4 summarizes the principal regulatory accommodations that are expected to mitigate future impacts to small businesses under the proposed regulations. Under both of the co-proposed alternatives, EPA is proposing to eliminate the "mixed" animal calculation for operations with more than a single animal type for determining which AFOs are CAFOs. As a result, smaller operations that house a mixtnre of animal types where none of these animal types independeotly meuts the regulatory threshold are not considered CAFOs under today's proposed rulemaking, unless they are individually designated. Additional accommodations are being proposed under the two-tier structure. Under the two-tier structure, EPA is proposing to establish a regulatory threshold that would define as CAFOs all operations with more than 500 AU. EPA is also considering a two-tier alternative that would define all operations with more than 750 AU as CAFOs. The two-tier structure would provide relief to small businesses since this would remove from the CAFO definition operations with between 300 AU and 500 AU (or 750 AU) that under the current rules may be defined as CAFOs. Also, under the two-tier structure, EPA is proposing to raise the size standard for defining egg laying operations as CAFOs. This alternative wonld remove from the CAFO defiuition egg operations with between 30,000 and 50,000 layiug hens (or 75,000 hens) that under the current rules are defined as CAFOs, if they utilize a liqnid manure management system. Additional information on the regulatory relief provisions heing proposed by EPA is provided in Section VII of this preambla.

As required by section 609(b) of the RFA, as amended by SBREFA, EPA also conducted outreach to small entities and convened a Small Business Advocacy Review Panel to obtain advice and recommendations from represeotatives of the small entities that potentially would be subject to the rule's requirements. Consistent with the

RFA/SBREFA requirements, the Panel evaluated the assembled materials and small entity comments on issues related to the elements of the IRFA. A complete summary of the Panel's recommendations is provided in the Final Report of the Small Business Advocacy Review Panel on EPA's Planned Proposed Rule on National Pollutant Discharge Elimination System (NPDES) and Effluent Limitations Guideline (Effluent Guidelines) Regulations for Concentrated Animal Feeding Operations (April 7, 2000). This document is included in the public record. As documented in the panel report, the participants of the Small Business Advocacy Review Panel did not identify any Federal rules that duplicate or interfere with the requirements of the proposed regulation.

Section XII.G of this document provides a full summary of the Panel's activities and recommendations. This summary also describes each of the subsequent actions taken by the Agency, detailing how EPA eddressed each of the Panel's recommendations. EPA is interested in receiving comments on all aspects of today's proposal and its impacts on small entities.

C. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year.

Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative, if the Administrator publishes with the final rule an explanation why that alternative was not adopted.

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

EPA has determined that today's proposed regulations contain a Federal mandate that may result in expenditures of $100 million or more for the private sector in any one year. Accordingly, EPA has prepared the written statement required by section 202 of the UMRA. This statement is contained in the Economic Analysis and also the Benefits Analysis for the rule. These support documents are contained in the record. In addition, EPA has determined that the rules contain no regulatory requirements that might significantly or uniquely affect small governments. Thus, today's rules are not subject to the requirements of section 203 of the UMRA. Additional information that supports this finding is provided below.

A detailed discussion of the objectives and legal basis for the proposed CAFO regulations is presented in Sections I and III of the preamble. A consent decree with the Natural Resources Defense Council established a deadline of December 2000 for EPA to propose effluent limitations for this industry.

EPA prepared several supporting analyses for the final rules. Throughout this preamble and in those supporting analyses, EPA has responded to the UMRA section 202 requirements. Costs, benefits, and regulatory alternatives are addressed in the Economic Analysis and the Benefits Analysis for the rule. These analyses are summarized in Section X and Section XI of this preamble. The results of these analyses are summarized below.

EPA prepared a qualitative and quantitative cost-benefit assessment of the Federal requirements imposed by today's final rules. In large part, the private sector, not State, local and tribal governments, will incur the costs of the proposed regulations. Under the two-tier structure, total annualized compliance costs to industry are projected at $831 million (pre-tax)/$572 million (post-tax). The cost to off-site recipients of CAFO manure is estimated at $10 million per year. Under the three-tier structure, costs to industry are estimated at $930 million per year (pre-tax)/$658 million (post-tax), and the annual cost to off-site recipients of manure is estimated at $11 million. This analysis is summarized in Section X.E.1 of this preamble.

Authorized States are expected to incur costs to implement the standards, but these costs will not exceed the thresholds established by UMRA. Under the two-tier structure, State and Federal administrative costs to implement the permit program are estimated to be $6.2 million per year: $5.9 million for States and $350,000 for EPA. Under the three-tier structure, State and Federal administrative costs to implement the permit program are estimated by EPA at $7.7 million per year, estimated at $7.3 million for States and $416,000 for EPA. This analysis is summarized in Section X.G.1 of this preamble. More detailed information is provided in the Economic Analysis. The Federal resources (i.e., water pollution control grants) that are generally available for financial assistance to States are included in Section 106 of the Clean Water Act. There are no Federal funds available to defray the costs of this rule on local governments. Since these rules do not affect local or tribal governments, they will not result in significant or unique impacts to small governments.

Overall, under the two-tier structure, the projected total costs of the proposed regulations are $847 million annually. Under the three-tier structure, total social costs are estimated at $949 million annually.

The results of EPA's economic impact analysis show that the percentage of operations that would experience financial stress under each of the proposed tier structures represent 7 percent of all affected CAFOs (Section X.F.1). This analysis is conducted without taking into account possible financial assistance to agricultural producers that could offset the estimated compliance costs to CAFOs to comply with the proposed regulations, thus mitigating the estimated impacts to these operations. Federal programs, such as USDA's Environmental Quality Incentives Program (EQIP), and other State and local conservation programs provide cost-share and technical assistance to farmers and ranchers who install structural improvements and implement farm management practices, including many of the requirements that are being proposed today by EPA. EQIP funds are limited to livestock and poultry operations with fewer than 1,000 animal units (AUs), as defined by USDA, but could provide assistance to operations with less than 1,000 AU as well as to some larger operations in the poultry and hog sectors.

EPA also conducted an analysis that predicts and quantifies the broader market changes that may result due to compliance. This analysis examines changes throughout the economy as impacts are absorbed at various stages of the food marketing chain. The results of this analysis show that consumer and farm level price changes will be modest. This analysis is summarized in Section X.F.3.

EPA does not believe that there will be any disproportionate budgetary effects of the rules on any particular area of the country, particular types of communities, or particular industry segments. EPA's basis for this finding with respect to the private sector is addressed in Section 5 of the Economic Analysis based on an analysis of community level impact, which is summarized in Section X.G.2 of the preamble. EPA considered the costs, impacts, and other effects for specific regions and individual communities, and found no disproportionate budgetary effects. EPA's basis for this finding with respect to the public sector is available in the record.

The proposed mandate's benefits are primarily in the areas of reduced health risks and improved water quality. The Benefits Analysis supporting the rulemaking describes, qualitatively, many such benefits. The analysis then quantifies a subset of the benefits and, for a subset of the quantified benefits, EPA monetizes (i.e., places a dollar value on) selected benefits. EPA's estimates of the monetized benefits of the proposed regulations are estimated to range from $146 million to $165 million under the two-tier structure. Under the three-tier structure, estimated benefits range from $163 million to $182 million annually. This analysis is summarized in Section XI of this preamble.

EPA consulted with several States during development of the proposed rules. Some raised concerns that the national rule would have workload and cost implications for the State. Some States with implementation programs underway or planned want to have their programs satisfy the requirements of the proposed rule. Other States expressed concerns about the loss of cost-share funds to AFOs once they are designated as point sources. There were additional comments regarding inconsistencies with the Unifed Strategy. See Section IX.A for a discussion of alternative State programs, Section X.G for a discussion of State costs and the workload analysis, Sections III.D and VII.B for a discussion of consistency with the AFO Strategy, and Section IX.E for a discussion of cost-share funds.

For the regulatory decisions in today's rules (allowing for the options reflected by the co-proposal), EPA has selected alternatives that are consistent with the requirements of UMRA in terms of cost, cost-effectiveness, and burden. The proposal is also consistent with the requirements of the CWA. This satisfies section 205 of the UMRA. As part of this rulemaking, EPA had identified and considered a reasonable number of regulatory alternatives. (See Section VII for NPDES Scenarios and Section VIII for effluent guidelines technology options). Section X.E compares the costs across these alternatives. Section X.H provides a cost-effectiveness analysis that shows that the proposed BAT Option is the most cost-effective of these alternatives. Sections VII and VIII of the preamble are devoted to describing the Agency's rationale for each regulatory decision. Section IV of this document further summarizes EPA's rationale for revising the existing regulations.

D. Executive Order 13045: "Protection of Children from Environmental Health Risks and Safety Risks"

Executive Order 13045 (62 FR 19885, April 23, 1997) applies to any rule that: (1) Is determinad to be "economically significant" as defined under E.O. 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health and safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This proposed rule is subject to E.O. 13045 because it is an economically significant regulatory action as defined by E.O. 12866, and we believe that the environmental health or safety risks addressed by this action have or may have disproportionate effects on children. Accordingly, we have evaluated, to the extent possible, the environmental health or safety effects of pollutants from CAFOs on children. The results of this evaluation are contained in sections V.C and XI.B of the preamble as well as the Environmental Assessment and Benefits Assessment (these documents have been placed in the public docket for the rule).

The Agency believes that the following pollutants have or may have a disproportionate risk to children: nitrates, pathogens, trace metals such as zinc, arsenic, copper, and selenium, pesticides, hormones, and endocrine disruptors. These health risks are summarized in Section V.C and described in detail in the Environmental Assessment. With the exception of nitrates in drinking water, the Agency has very little of the detailed information necessary to conduct an assessment of these risks to children for these pollutants. The Agency solicits risk and exposure data and models that could be used to characterize the risks to children's health from CAFO pollutants.

There is evidence that infants under the age of six months may be at risk from methemoglobinemia caused by nitrates in private drinking water wells, typically when ingesting water with nitrate levels higher than 10 micrograms/liter. The Agency only has enough information to determine that a chronic dose of 10 micrograms/liter may cause an adverse health effect, but there is no dose-response function for nitrates, nor does the Agency have other information necessary to conduct a detailed health risk assessment (for example, the actual number of cases of methemoglobinemia are not reported and are thus highly uncertain). Instead, the Agency has estimated the reduction in the number of households that will be exposed to drinking water with nitrate levels above 10 micrograms/liter in Chapter 8 of the Benefits Assessment (noting that the Agency does not have information on the number of households exposed to nitrates that also have infants). The Agency assumes that nitrate levels lower than 10 micrograms/liter pose no risk of methemoglobinemia.

The Agency estimates that there are approximately 13.5 million households with drinking water wells in counties with animal feeding operations. Of these, the Agency estimates that approximately 1.3 million households are exposed to nitrate levels above 10 micrograms/liter. The Agency further estimates that approximately 166,000 households would have their nitrate levels brought below 10 micrograms/liter under the two-tier structure. Approximately 161,000 households would have their nitrate levels brought below 10 micrograms/liter under the three-tier structure. Furthermore, the Agency estimates that options more stringent than those proposed would have small incremental changes in pollutant loadings to groundwater (see the Technical Development Document). Thus, the Agency expects the number of additional households protected from nitrate levels greater than 10 micrograms/liter would be negligible under more stringent options. The Agency therefore does not believe that requirements more stringent than those proposed would provide meaningful additional protection of children's health risks from methemoglobinemia. Furthermore, the Agency is only able to regulate groundwater quality through NPDES permits if there is a direct hydrologic connection to surface water (see Section VII.C.2.j).

Methemoglobinemia is only one children's health risk caused by CAFO pollutants, as discussed above, in Section V.C, and elsewhere in the record. It was the only risk to children's health which the Agency was able to quantify (if incompletely) in any way. The options considered by the Agency, as well as the rationale for the proposed options, are discussed in detail in Sections VII and VIII of this preamble. To the extent possible under the authority of the CWA, EPA chose options that were protective of environmental and human health, including children's health. These option selections were based on the best risk assessments possible given the limited data available. The public is invited to submit or identify peer-reviewed studies and data, of which the Agency might not be aware that assessed results of early life exposure to nitrates or any other pollutant discharged by CAFOS.

E. Executive Order 13084: Consultation and Coordination With Indian Tribal Governments

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments, or EPA consults with those governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected and other representatives of Indian tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

Today's rule does not significantly or uniquely affect the communities of Indian tribal governments nor imposes substantial direct compliance costs on them. First, there are currently no tribal governments that have been authorized to issue NPDES permits. Thus, there will be no burden to tribal governments. Second, few CAFO operations are located on tribal land. Therefore, compliance costs to tribal communities will not be significant. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

However, EPA has let tribal communities know about this rulemaking through a presentation of potential rule changes at the National Environmental Justice Advisory Committee meeting in Atlanta in June, 2000 and through notices in tribal publications.

F. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* An Information Collection Request (ICR) document has been prepared by EPA (ICR No. 1989.01) and a copy may be obtained from Sandy Farmer by mail at Collection Strategies Division; U.S. Environmental Protection Agency (2822); 1200 Pennsylvania Ave., NW, Washington, DC 20460, by email at farmer.sandy@epamail.epa.gov, or by calling (202) 260–2740. A copy may also be downloaded off the internet at http://www.epa.gov/icr.

Today's proposed rule would require all animal feeding operations (AFOs) that meet the proposed CAFO definition to apply for a permit and develop a certified permit nutrient plan and to implement that plan. Implementation of the plan includes the cost of recording animal inventories, manure generation, field application of manure and other nutrients (amount, rate, method, incorporation, dates), manure and soil analysis compilation, crop yield goals and harvested yields, crop rotations, tillage practices, rainfall and irrigation, lime applications, findings from visual inspections of feedlot areas and fields, lagoon emptying, and other activities on a monthly basis. Records may include manure spreader calibration worksheets, manure application worksheets, maintenance logs, and soil and manure test results.

The average annual burden for this rule covering both the private and public sector for the three-tiered option is 1.6 million hours and $37 million annually; for the two-tiered option, burden is 1.2 million hours annually at $29 million annually. These values do not account for State programs that may already be requiring some of the recordkeeping and reporting requirements already. Thus, this burden would be an overestimate to the degree that some States already require such actions.

For the three-tiered structure, the average annual CAFO burden is estimated to be 80 hours with the frequency of responses based on requirements ranging from two times per year to once every five years. There are 19,519 likely CAFO respondents and 28 states. Under this scenario, the state annual average burden is estimated at 3,214 hours. The average annual operation and maintenance costs are estimated at $4.3 million for CAFOs and $60,000 for States; labor costs are estimated at $28.9 million for CAFOs and $2.6 million for States; capital costs are estimated at $1.6 million for CAFOs and $0.0 for States.

For the two-tiered structure, CAFO average annual burden per respondent is 81 hours and the State burden is 2,500 hours. There are 15,015 likely CAFO respondents and 28 states. The 28 state count is an average over three years assuming that half the delegated states will have a program established in year one, half in year 2 and all in year three. Average annual operation and maintenance costs are $3.3 million for CAFOs and $60,000 for States; labor costs are $22.6 million for CAFOs and $2.0 million for States; capital costs are $1.3 million for CAFOs and $0.0 for States.

The burden required for this rulemaking will allow EPA to determine whether a CAFO operator is monitoring his waste management system in an environmentally safe way. This data will be used to assess compliance with the rule and help determine enforcement cases. The Permit Nutrient Plan data requirements ensure that the CAFO owner has established the appropriate application rate for their fields on which they spread manure; is providing adequate operation and maintenance for the storage area and feedlot, and is meeting the requiremants to keep agriculture waste out of the Nation's waters. The information requested herein is mandatory (33 U.S.C. 1318 (Section 308 of the Clean Water Act)). Twqhe Agency is requesting comment in this proposal on how much, if any of this information should be confidential business information.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, disclose or provide information to or for a Federal agency. Burden estimates include the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. Additional burden has been estimated for off-site recipients who must certify that they are applying manure in an appropriate manner.

An Agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless the collection form displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15.

Comments are requested on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques. Send comments on the ICR to the Director, Collection Strategies Division; U.S. Environmental Protection Agency (2822); 1200 Pennsylvania Ave., NW, Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., N.W., Washington, DC 20503, marked "Attention: Desk Officer for EPA." Include the ICR number in any correspondence. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after [January 12, 2001 **Federal Register**], a comment to OMB is best assured of having its full effect if OMB receives it by February 12, 2001. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

G. Executive Order 13132: "Federalism"

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications." "Policies that have Federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

This proposed rule does not have Federalism implications. It will not have substantial direct effects on the States, on this relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. EPA estimates that the average annual impact on all authorized States together is $6.0 million. EPA does not consider an annual impact of $6 million on States a substantial effect. In addition, EPA does not expect this rule to have any impact on local governments.

Further, the revised regulations would not alter the basic State-Federal scheme established in the Clean Water Act under which EPA authorizes States to carry out the NPDES permitting program. EPA expects the revised regulations to have little effect on the relationship between, or the distribution of power and responsibilities among, the Federal and State governments. Thus, Executive Order 13132 does not apply to this rule.

In the spirit of Executive Order 13132, and consistent with EPA policy, EPA consulted with representatives of State and local governments in developing this proposed rule. EPA sent a summary package outlining the proposed changes to the State and local associations that represent elected officials including the National Governor's Association, National Conference of State Legislators, U.S. Conference of Mayors, Council of State Governments, International City/County Management Association, National Association of Counties, National Association of Towns and Townships, and County Executives of America. In addition, as discussed in Section XII.F., there was State representation on the CAFO Regulation Workgroup.

EPA received four responses from these national associations, the National Governor's Council, the National League of Cities, the National Council of State Legislators and the National Association of Conservation Districts. EPA also received a letter from the Governor of Delaware and the Delaware Congressional delegation. The National Governor's Association (NGA), the National League of Cities (NLC) and the National Association of Conservation Districts (NACD) disagree with EPA's assessment that the rule would have minimal impact on the States. Except for this issue, the NLC supported the rule package especially the coverage of poultry and immature animals, the clarification of stormwater runoff exemptions, the lower threshold, and the seven strategic issues EPA listed to address pollution from animal feeding operations. NLC encouraged EPA to exercise its authority to issue NPDES permits where a delegated State has not taken appropriate action.

NGA and Delaware want the flexibility to design functionally equivalent programs. NGA and NACD expressed concern regarding lowering the threshold as this would bring in more entities to be permitted and the States already have a permit backlog. In addition, they are concerned that 319 and EQIP funds will no longer be available to operations that are defined as CAFOs. Another concern is the elimination of the 25 year/24 hour exemption. NGA comments address the burden on the State permitting authority (backlog issue) and the unfairness of facilities that work with states to eliminate discharges would still have to get a permit. On the issue of adequate public involvement in general permits as well as the site specific requirements of the Effluent Limitation Guideline, NGA is concerned the advantage of general permits as a time saver for the states may be lost. In response to NGA's concerns, EPA met with NGA and discussed the package and its potential impacts. EPA, also upon request, met with the National Association of State Legislators to review the package and answer their questions. (See Section IX for discussion of alternative State programs. See Section VII.B for a discussion of rule scope. See Section X.G for costs to permitting authorities. See Section VII.C for discussion of the 25 year/24 hour storm exemption. See Section VII.E for discussion of public involvement.)

The primary concern raised by the States represented on the CAFO Regulation Workgroup was to clarify and simplify the rules to make them more understandable and easier to implement. Many of the proposed changes were made with this objective in mind. Also, the States wanted EPA to accept functionally equivalent State programs. To address this concern, as stated in the Joint Unified USDA/EPA AFO Strategy (see "Strategic Issue #3"), where a State can demonstrate that its program meets the requirements of an NPDES program consistent with 40 CFR Part 123, EPA is proposing to amend the current NPDES authorization to recognize the State program. In addition, States were concerned about the cost of implementing any changes to the program. EPA believes the costs to the States for implementing this proposed rule will not be high. EPA is assuming that all States will adopt the sample general permit. Some States already have a general permit that would just need to be modified.

In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

H. Executive Order 12898: "Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations"

The requirements of the Environmental Justice Executive Order are that* * *" EPA will * * * review the environmental effects of major Federal actions significantly affecting the quality of the human environment. For such actions, EPA reviewers will focus on the spatial distribution of human health, social and economic effects to ensure that agency decisionmakers are aware of the extent to which those impacts fall disproportionately on covered communities." EPA has determined that this rulemaking is economically significant. However, the Agency does not believethis rulemaking will have a disproportionate effect on minority or low income communities. The proposed regulation will reduce the negative affects of CAFO waste in our nation's waters to benefit all of society, including minority communities.

The National Environmental Justice Advisory Committee (NEJAC) submitted a set of recommendations to EPA regarding CAFOs that included recommendations to be addressed in revisions to EPA's regulations for CAFO's. Each recommendation is addressed below.

The NEJAC recommended that EPA "promulgate new, effective regulations that set uniform, minimum rules for all AFOs and CAFOs in the United States." In response, EPA believes that today's proposed rule revisions would represent new, uniform and effective requirements for CAFOs (AFOs by definition are not point sources and so would not be subject to today's proposed CAFO rules).

The Committee requested that EPA impose a zero discharge standard on runoff from land application of CAFO wastes. For the reasons described in section VIII. C.3., BAT Options Considered, of today's notice, EPA believes it is not appropriate to set a technology-based standard at this level with respect to land application runoff.

NEJAC requested that EPA prohibit or restrict the siting of facilities in certain areas such as flood plains. Siting of private industry is primarily a local issue and should be addressed at the local level. Discharge limitations proposed today should, however, discourage operators from locating in flood plains. Proposed requirements for swine, veal and poultry CAFOs would require no discharge under any circumstances. Beef and dairy CAFOs would have to comply with zero discharge except in the event of a chronic or catastrophic storm which exceeds the 25 year, 24 hour storm. If existing operations are located in flood plains it is in their best interest to divert uncontaminated storm water away from their production area to avoid inundation of the production area and potential breaching of their manure storage system during flood events. EPA proposes to prohibit manure application to crop or pasture land within 100 feet of surface waters, tile intake structures, agricultural drainage wells, and sinkholes which will also minimize the risk of discharge under flood conditions.

NEJAC requested monitoring requirements in the rule. EPA has proposed an appropriate set of monitoring requirements to be included in CAFO permits (See section XIII of today's notice).

NEJAC also requested public notification of the construction or expansion of CAFOs or issuance of permits. Under today's proposed rules, EPA would require individual permits, which are subject to individual public notice and comment, for facilities that are located in an environmentally sensitive area; have a history of operational or compliance problems; are an exceptionally large or significantly expanding facility; or where the Director is aware of significant public concern about water quality impacts from the CAFO. For all other facilities that are to be covered by general permits, for purposes of public notice, today's proposal would require the permitting authority to publish on a quarterly basis its receipt of Notices of Intent (NOIs) submitted by CAFOs.

NEJAC further recommended that EPA require States and tribes to develop inspection programs that allow unannounced inspections of all CAFOs and to make these programs available for public comment. This concern is already addressed by existing Clean Water Act requirements. Specifically, under the Act, EPA may conduct unannounced inspections, and States must have the authority to inspect to the same extent as EPA. Although there is no specific requirement that State inspection plans be made publicly available, they may be available under State law.

NEJAC requested that EPA require the adoption of non-lagoon technology. Section XIII of today's notice describes the control technologies that EPA has investigated and which ones EPA proposes to identify in these regulations as the best available technologies. As described in Section XIII, this proposal finds that it would not be appropriate to prohibit the use of lagoon technologies.

NEJAC recommended requiring States and tribes to implement remediation programs for phased-out CAFO operations. In today's proposed rule, EPA proposes to require a CAFO to remain under permit coverage until it no longer has the potential to discharge manure or associated wastewaters.

Finally, NEJAC recommended that EPA impose stringent penalties on violating facilities. The Clean Water Act provides authority to subject violators to substantial penalties. The issue of which penalties are appropriate to impose in individual situations is beyond the scope of this rulemaking.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) of 1995, (Pub. L. No. 104–113 Sec. 12(d) 15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standard bodies. The NTTAA directs EPA to provide Congress, through the Office of Management and Budget (OMB), explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This rulemaking involves technical standards. The rule requires operations defined as CAFOs in the beef and dairy subcategories to monitor groundwater for total dissolved solids (TDS), total chlorides, fecal coliform, total coliform, ammonia-nitrogen and TKN. EPA performed a search to identify potentially voluntary consensus standards that could be used to measure the analytes in today's proposed guideline. EPA's search revealed that consensus standards exist and are already specified in the tables at 40 CFR Part 136.3 for measurement of many of the analytes. All pollutants in today's proposed rule have voluntary consensus methods. EPA welcomes comments on this aspect of the proposed rulemaking and, specifically, invitas the pnblic to identify potentially-applicable voluntary consensus standards and to explain why such standards should be used in this regulation.

XIV. Solicitation of Comments

A. Specific Solicitation of Comment and Data

EPA solicits comments on all aspects of today's proposal. In addition, throughout this preamble, EPA has solicited specific comments and data on many individual topics. The Agency reiterates its interest in receiving comments and data on the following issues:

1. EPA solicits comment on the nse of a two tier strncture based on lowering the existing 1,000 animal unit threshold to 500 for determining which AFOs are defined as CAFOs, and the elimination of the existing 300 to 1,000 animal unit category. EPA also solicits comment on the effect of a 500 AU threshold on the horse, sheep, lamb and dnck sectors, as well as on the use of a 750 animal unit threshold for all sectors.

2. EPA solicits comment on the use of a three tier structure, including the proposed criteria that could result in an AFO in the middle Group being defined as a CAFO aod on whether to nse different criteria that provide more flexibility than those in today's proposal.

3. EPA solicits comment ou revising the reqnirements for designation to eliminate the direct contact and man-made device criteria from the designation requirements of the CAFO regnlations, and allow the designation of CAFOs by EPA in States with NPDES authorized programs. EPA also solicits comment on whether or not to eliminate the "on-site" requirement for conducting inspections and, instead, allow other forms of site-specific information gathering to be used.

4. EPA solicits comment on its proposal to clarify the definition of an AFO to clearly distinguish feedlots from pasture land and clarify coverage of winter feeding operations.

5. EPA solicits comment on eliminating the use of the term "animal unit" or AU and the mixed animal calculation in determining which AFOs are CAFOs.

6. EPA solicits comment on removiug the 25-year, 24-hour storm event exemption from the definition of a CAFO.

7. EPA solicits comment on the proposal to remove the limitation on the type of manure handling or watering system employed at poultry operations (i.e., subjecting dry poultry operations to the CAFO regulations). With regard to a two tier structure, EPA solicits comment on establishing the threshold for poultry operations at 50,000 birds or greater.

8. EPA solicits comment on including immature swine and dairy cattle, or heifers, when confined apart from the dairy, for purposes of defining potential CAFOs. With regard to a two tier structnre, EPA solicits comment on establishing the threshold limit for immature swine (weighing 55 pounds or less) at 5,000.

9. EPA solicits comment on requiring, nnder a two tier strncture, all CAFOs to apply for a NPDES permit and issuing permits to those operations that cannot demonstrate they have no potential to discharge pollutants.

10. EPA solicits comment on reqniring, under a three tier strncture, all AFOs from 300 AU to 1000 AU to certify they do not meet threshold conditions, receive a determination they have no potential to discharge, or apply for a permit.

11. EPA solicits comments on the proposed co-permitting provisions and the factors for determining substantial operational control. EPA solicits comment on whether there are additional factors that indicate substantial operational control which should be included in the regulatiou. EPA also reqnests comment on how to structure the co-permitting provisions of the rnlemaking to achieve the intended environmental outcome without causing negative impacts on growers. EPA requests comments on its cost passthrough assumptions in general and as they relate to the analysis of processor level impacts under the proposed co-permitting requirements.

12. EPA solicits comment on addressing discharges to ground water with a direct hydrological connection to surface water. EPA requests comment on how a permit writer might identify CAFOs at risk of discharging to snrface water via grouud water. EPA is also requesting comment on the proposal to place the burden on the permit applicant to provide a hydrologist's statement when rebutting the presumption that a CAFO has poteutial to discharge to snrface water via direct hydrological connection with ground water. EPA solicits comment on the assumption that 24 percent of the affected operations have a hydrologic connection to surface waters.

13. EPA solicits comment on the definition of CAFO including the production area and land application area, and on the proposed reqnirements that would subject land application to specified permit requirements.

14. EPA solicits comment on defining the agricultural storm water discharge exemption to apply only to those discharges which occurred despite the implementation of all the practices required by today's proposal at CAFO land application areas. EPA also reqnests comments on the alternative applications of the agricultural storm water discharge exemption discnssed.

15. EPA solicits comment on requiring a certification from off-site recipients of CAFO-generated manure that such manure is being land applied according to proper agricultural practices or, the alternative of tracking such off-site transfers through record keeping and providing information to tho recipients regarding proper management.

16. EPA solicits comment on restricting the land application of manure to those conditions where it serves an agricultural purpose and does not result in pollutant discharges to waters of the U.S. (potentially including prohibiting land application at certain times or using certain methods).

17. EPA solicits comment on reqniring CAFO operators to develop and implement a PNP for managing manure and wastewater at both the production area and land application area.

18. EPA invites comment on today's proposal to define PNPs as the effluent guideline subset of elements addressed in the CNMP. EPA is especially interested in knowing whether PNP is the best term to use to refer to the regulatory components of the CNMP, and whether EPA's explanation of both the differences and relationship between these two terms (PNP aud CNMP) is clear and unambiguous. EPA is also soliciting comments on whether a PNP with the addition of erosion control practices would be sufficient additional controls to prevent runoff. EPA further requests comment on the proposal to require that PNPs be developed, or reviewed and modified, by certified planners, as well as on conditions, such as no changes to the crops, herd or flock size, uuder which rewriting the PNP would not be necessary and therefore, would not reqnire the involvement of a certified planner.

19. EPA requests comment on the public availability of PNPs, including whether it is proper to determine that the PNPs must be publicly available nnder CWA Section 402(j) and under CWA Section 308 as "effluent data," or whether only a portion of PNP information should be publically

available. EPA solicits comment on today's proposal that the operator of a permitted CAFO must make a copy of the PNP cover sheet and executive summary available for public review. EPA is also requesting comment on whether CAFOs should be able to claim these elements of the PNP as confidential business information and withhold those elements of the PNP from public review on that basis, or alternately, that whether other portions of the PNP should be made available as well. EPA also requests comment on the proposal to require new facilities seeking coverage under a general permit, as well as applicants for individual permits, to submit a copy of the PNP to the permit authority along with the NOI or permit application, and whether, for individual permits, the PNP should be part of the public notice and comment process along with the permit.

20. EPA is requesting public comment on the suitability of requiring erosion control as a special condition of a NPDES permit to protect water quality from sediment eroding from fields where CAFO manure is applied to crops. If erosion control is desirable, EPA is soliciting comment as to which approach would be the most cost-efficient. EPA solicits comment and data on the costs and benefits of controlling erosion and whether erosion control should be a required component of PNPs.

21. EPA solicits comment on requiring an operator of a permitted CAFO that ceases to be a CAFO to maintain permit coverage until his or her facility is properly closed.

22. EPA requests comment on whether the procedures discussed regarding general permits are adequate to ensure public participation or whether individual permits should be required for any of the categories of facilities discussed above. Specifically, EPA requests comment on whether individual permits should be required for (a) Facilities over a certain size threshold; (b) all new facilities; (c) facilities that are significantly expanding; (d) facilities that have historical compliance problems; or (e) operations that are located in areas with significant environmental concerns.

23. EPA solicits comment on the applicability of the proposed revised effluent limitations guidelines, including the thresholds under the two tier and three tier structure, the inclusion of veal production as a new subcategory, and the changes regarding applicability to chickens, mixed animals, and immature swine and dairy. EPA also requests comment on another three-tier option for defining a CAFO under which the effluent guidelines proposed today would not be applicable to facilities with 1,000 AU or less.

24. EPA solicits comment on the proposed revised effluent limitations guidelines for CAFOs, specifically today's proposed requirements on the land application of manure and wastewater. EPA solicits comment on the proposal to allow States to establish the appropriate phosphorus-based method to be used as the basis for the land application rate at CAFOs.

25. EPA requests comment on its analysis and on its proposed determination that Option 3 is economically achievable as BAT for the beef and dairy sectors. In addition, consistent with its intention at the time of the SBREFA outreach process, EPA requests comment on retaining the 25-year, 24-hour storm design standard (and thus basing BAT on Option 2) for the swine, veal and poultry subcategories.

26. EPA solicits comment on the assumptions used for estimating the compliance cost impacts for feedlots to implement each of the model technologies considered for the proposed standards. EPA also solicits comment on the proposal's impact on small businesses.

27. EPA solicits comment on the new source option for dairies that would prohibit any wastewater discharge from the production area. Specifically whether this option is technically feasible, since it assumes that all animals in confinement will be maintained under roof.

28. EPA solicits comment on establishing BAT requirements on pathogens. Specifically on the appropriate technologies that will reduce pathogens and the estimated cost for these technologies.

B. General Solicitation of Comment

EPA encourages public participation in this rulemaking. EPA asks that comments address any perceived deficiencies in the record supporting this proposal and that suggested revisions or corrections be supported by data.

EPA invites all parties to coordinate their data collection activities with the Agency to facilitate mutually beneficial and cost-effective data submissions. Please refer to the **FOR FURTHER INFORMATION** section at the beginning of this preamble for technical contacts at EPA.

List of Subjects

40 CFR Part 122

Administrative practice and procedure, confidential business information, Hazardous substances, Reporting and recordkeeping requirements, water pollution control.

40 CFR Part 412

Environmental protection, Feedlots, livestock, waste treatment and disposal, Water pollution control.

Dated: December 15, 2000.

Carol M. Browner,

Administrator.

For the reasons set out in the preamble title 40, chapter I of the Code of Federal Regulations is proposed to be amended as follows:

PART 122—EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

1. The authority citation for part 122 continues to read as follows:

Authority: The Clean Water Act, 33 U.S.C. 1251 *et seq.*

2. Amend § 122.21 by adding paragraphs (i)(1)(iv) through (ix) to read as follows:

§ 122.21 Application for a permit (applicable to State programs, see § 123.25).

* * * * *

(i) * * *

(1) * * *

(iv) Either a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan that meet the criteria in 40 CFR 412.37(b) and is being implemented, or draft copies of these documents together with a statement on the status of the development of its Permit Nutrient Plan. If the CAFO is subject to 40 CFR part 412 and draft copies are submitted, they must, at a minimum, demonstrate that there is adequate land available to the CAFO operator to comply with the land application provisions of part 412 of this chapter, if applicable, or describe an alternative to land application that the operator intends to implement.

(v) Acreage available for application of manure and wastewater;

(vi) Estimated amount of manure and wastewater that the applicant plans to transfer off-site;

(vii) Name and address of any person or entity that owns animals to be raised at the facility, directs the activity of persons working at the CAFO, specifies how the animals are grown, fed, or medicated, or otherwise exercises control over the operations of the facility;

(viii) Indicate whether buffers, setbacks or conservation tillage are implemented at the facility to control runoff and protect water quality; and

(ix) Latitnde and longitude of the CAFO, to the nearest second.

3. Section 122.23 is revised to read as follows:

§ 122.23 Concentrated animal feeding operations (applicable to State NPDES programs, see § 123.25).

(a) *Definitions applicable to this section:* (1) For land on which manure from an animal feeding operation or concentrated animal feeding operation has been applied, the term "*agricultural storm water discharge*" means a discharge composed entirely of storm water, as defined in § 122.26(a)(13), from a land area upon which manure and/or wastewater has been applied in accordance with proper agricultural practices, including land application of manure or wastewater in accordance with either a nitrogen-based or, as required, a phosphorus-based manure application rate.

(2) An *animal feeding operation or AFO* is a facility where animals (other than aquatic animals) have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period. Animals are not considered to be stabled or confined when they are in areas such as pastures or rangeland that sustain crops or forage growth during the entire time that animals are present. Animal feeding operations include both the production area and land application area as defined below.

Option 1 for Paragraph (a)(3)

(3) *Concentrated animal feeding operation or CAFO* means an AFO that either:

(i) Confines a number of animals equal to or greater than the number specified in any one or more of the following categories. For the purposes of determining the nnmber of animals at an operation, two or more AFOs under common ownership are considered to be a single AFO if they adjoin each other or if they use a common area or system for the disposal of wastes. Once an operation is defined as a CAFO, the requirements of this section apply with respect to all animals in confinement at the operation and all wastes and waste waters generated by those animals, regardless of the type of animal.

(A) 350 mature dairy cattle;

(B) 500 veal;

(C) 500 cattle other than veal or mature dairy cattle;

(D) 1,250 swine each weighing over 25 kilograms (approximetely 55 pounds);

(E) 5000 swine each weighing less than 25 kilograms (approximately 55 pounds);

(F) 250 horses;

(G) 5,000 sheep or lambs;

(H) 27,500 turkeys;

(I) 50,000 chickens; or

(J) 2,500 ducks; or

(ii) Is designated as a CAFO under paragraph (b) of this section.

Option 2 for Paragraph (a)(3):

(3) *Concentrated animal feeding operation or CAFO* means an AFO which either is defined as a CAFO under paragraph (a)(3)(i) or (ii) of this section, or is designated as a CAFO under paragraph (b) of this section. Two or more AFOs under common ownership are considered to be a single AFO for the purposes of determining the number of animals at an operation, if they adjoin each other or if they use a common area or system for the disposal of wastes. Once an operation is defined as a CAFO, the reqnirements of this section apply with respect to all animals in confinement at the operation and all wastes and waste waters generated by those animals, regardless of the type of animal.

(i) Tier 1 AFOs. An AFO is a CAFO if more than the numbers of animals specified in any of the following categories are confined:

(A) 700 mature dairy cattle;

(B) 1,000 veal;

(C) 1,000 cattle other than veal or mature dairy cattle;

(D) 2,500 swine each weighing over 25 kilograms (approximately 55 pounds);

(E) 10,000 swine each weighing less than 25 kilograms (approximately 55 pounds);

(F) 500 horses;

(G) 10,000 sheep or lambs;

(H) 55,000 turkeys;

(I) 100,000 chickens; or

(J) 5,000 ducks.

(ii) Tier 2 AFOs. (A) If the number of animals confined at the operation falls within the following ranges for any of the following categories, the operation is a Tier 2 AFO. A Tier 2 AFO is a CAFO unless it meets all of the conditions in paragraph (a)(3)(ii)(B) of this section and its operator snbmits to the Director a certification that it meets those conditions. The certification shall take the form specified in section 122.22(d).

(*1*) 200 to 700 mature dairy cattle,

(*2*) 300 to 1,000 veal,

(*3*) 300 to 1,000 cattle other thau veel or mature dairy cattle,

(*4*) 750 to 2,500 swine each weighing over 25 kilograms (approximately 55 pounds),

(*5*) 3,000 to 10,000 swine each weighing less than 25 kilograms (approximately 55 pounds),

(*6*) 150 to 500 horses,

(*7*) 3,000 to 10,000 sheep or lambs,

(*8*) 16,500 to 55,000 turkeys,

(*9*) 30,000 to 100,000 chickens, or

(*10*) 1,500 to 5,000 ducks.

(B) A Tier 2 AFO is not a CAFO if it meets all of the following conditions and its operator submits to the Director a certification that it meets the following conditions:

(*1*) Waters of the United States do not come into direct contact with the animals confined in the operation;

(*2*) There is sufficient storage and containment to prevent all pollutants from the production area from entering waters of the United States as specified in 40 CFR Part 412.

(*3*) There has not been a discharge from the production area within the last five years;

(*4*) No part of the production area is located within 100 feet of waters of the United States;

(*5*) In cases where manure or process-generated wastewaters are land applied, they will be land applied in accordance with a Permit Nutrient Plan that includes the BMP requirements identified at 40 CFR 412.31(b) and 412.37; and

Option 2a for Paragraph (a)(3)(ii)(B)(*6*)

(*6*) With respect to the off-site transfer of manure or process-generated wastewaters to persons who receive 12 tons or more of mannre or wastewater in any year, the owner or operator will first obtain assnrances that, if the manure will be land applied, it will be applied in accordance with proper agricultnre practices, which means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least onca every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using one of the methods specified in 40 CFR 412.31(b)(1)(iv); adequate assurances include a certification from the recipient, the fact that the recipient has a permit, or the existence of a State program that requires the recipient to comply with requirements similar to 40 CFR 412.31(b). The owner or operator will provide the recipient of the manure with a brochure to he provided by the state permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management.

Option 2b for Paragraph (a)(3)(ii)(B)(*6*)

(*6*) With respect to manure or process-generated wastewaters that are transferred off-site, the owner or operator will first provide the recipient of the manure with an analysis of its content and a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management.

(4) The term *land application area* means any land under the control of the owner or operator of the production erea whether it is owned, rented, or leased, to which manure and process wastewater from the production area is or may be applied.

(5) The term *operator*, for purposes of this section, means:

(i) An operator as that term is defined in § 122.2; or

(ii) A person who the Director determines to be an operator on the basis that the person exercises substantial operational control of a CAFO. Whether a person exercises substantial operational control depends on factors that include, but are not limited to, whether the person:

(A) Directs the activity of persons working at the CAFO either through a contract or direct supervision of, or on-site participation in, activities at the facility;

(B) Owns the animals; or

(C) Specifies how the animals are grown, fed, or medicated.

(6) The term *production area* means that part of the AFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyard, exercisa yards, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, sheds, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms, and diversions which separate nncontaminated storm water Also included in the definition of production area is aoy eggwash or egg processing facility.

(b) *Designation as a CAFO.* The EPA Regional Administrator, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, may designate any AFO as a CAFO upon determining that it is a significant contributor of pollutants to the waters of the United States.

(1) In making this designation, the Director or the EPA Regional Administrator shall consider the following factors:

(i) The size of the AFO and the amonnt of wastes reaching waters of the United States;

(ii) The location of the AFO relative to waters of the United States;

(iii) The means of conveyance of animal wastes and process waste waters into waters of the United States;

(iv) The slope, vegetation, rainfall, and other factors affecting the likelihood or frequancy of discharge of animal wastes and process waste waters into waters of the United States; and,

(v) Other relevant factors.

Option 1 for Paragraph (b)(2)

(2) No AFO shall be designated under this paragraph (b) until the Director or the EPA Regional Administrator has conducted an on-site inspectiou of the operation and determinad that the operation should and could be regulated under the permit program; except that no inspection is reqnired to designate a facility that was previously defined or designated as a CAFO.

Option 2 for Paragraph (b)(2)

(2) No AFO shall be designated under this paragraph (b) until the Director or the EPA Regional Administrator has conducted an on-site inspection of the operation and determined that the operation should and could be regulated under the permit program; except that no inspection is required to designate a facility that was previously defined or designated as a CAFO. In addition, no AFO with less than 300 animal units may be designated as a concentrated animal feeding operation unless:

(i) Pollutants are discharged into waters of the United States through a manmade ditch, flnshing system, or other similar manmade device; or

(ii) Pollutants are discharged directly into waters of the United States which originate outside of the facility aud pass over, across, or through the facility or otherwise come into direct contact with the animals confined in the operation.

(c) *Who must apply for an NPDES permit?* (1) *All CAFOs must apply for a permit.* For all CAFOs, the CAFO owner or operator must apply for an NPDES permit, except as provided in paragraph (c)(2) of this section. Specifically, the CAFO owner or operator must either apply for an individual NPDES permit or submit a notice of intent for coverage under a CAFO general permit. If the Director has not made a general permit available to the CAFO, the CAFO owner or operator must apply for an individual permit.

(2) *Exception.* The CAFO owner or operator does not need to apply for an NPDES permit if the owner or operator has received from the Director a determination under paragraph (e) of this section that the CAFO has no potential to discharge.

(3) *Co-permitting.* Any person who is an "operator" of a CAFO on the basis that the person exercises substantial operational control of e CAFO (see § 122.23(a)(5)(ii)) must apply for a permit. Such operators may apply for an NPDES permit either alone or together as co-permittees with other owners or operators of the CAFO.

(d) *In which case will the Director not issue an NPDES permit?* The Director shall not issue an NPDES permit if the Director has determined that the CAFO has "no potential to discharge" pursnant to paragraph (e) of this section.

(a) *"No potential to discharge" determinations.* (1) *Determination by Director.* The Director, npon request, may make a case-specific determination that a CAFO has no potential to discharge pollntants to waters of the United States. In making this determination, the Director must consider the potential for discharges from both the production area and any land application areas, and must also consider any potential discharges via ground waters that have a direct hydrologic connection to surface waters. For purposes of this subsection, the term "no potential to discharge" means that there is no potential for any CAFO manure or waste waters to be added to waters of the United States, withont qnelification. For example, a CAFO may not claim that there is no potential to discharge aven if the only pollutants that the CAFO has a potential to discharge would be exempt from NPDES requirements. A CAFO has a potential to discharge if it has had a discharge within the preceding five years.

(2) *Supporting information.* In requesting a determination of no potential to discharge, the CAFO owner or operator must submit any supporting information along with the request. The Director has discretion to accept or reject any additional information that is submitted at a later date.

(3) *Requesting a "no potential to dischorge" determination does not postpone the duty to apply for a permit.* The owner or operator mnst apply for a permit according to the date specified in section (f) unless it has received a no potential to discharge determination before that date.

(4) *CAFO bears the risk of any actual dischorge.* Any unpermitted CAFO that discharges pollutants into the waters of the United States is in violation of the

Clean Water Act even if it has received a "no potential to discharge" determination from the Director.

(f) *By when must I apply for a permit for my CAFO?* (1) For all CAFOs, the owner or operator of the CAFO must apply for an NPDES permit no later than [insert date that is three years after the date of publication of the final rule], except as provided in paragraphs (f)(2) through (6) of this section.

(2) *Operations that are defined as CAFOs prior to [insert date that is three years after the date of publication of the final rule].* For operations that are CAFOs under regulations that are in effect prior to [insert date that is three years after the date of publication of the final rule], the owner or operator must apply for an NPDES permit under 40 CFR 122.21(a) within the time period specified in 40 CFR 122.21(c).

(3) *Operations that become CAFO new sources or new dischargers after [insert date that is three years after the date of publication of the final rule].* For operations that meet the criteria in 40 CFR 122.23 for being defined as a CAFO for the first time after [insert date that is three years after the date of publication of the final rule], the owner or operator must apply for an NPDES permit 180 days prior to the date on which they first meet those criteria.

(4) *Operations that are designated as CAFOs.* For operations for which EPA or the Director has issued a case-specific designation that the operation is a CAFO, the owner or operator must apply for a permit no later than 90 days after issuance of the designation.

(5) *Persons who are operators because they exercise "substantial operational control" over a CAFO.* Persons who the Director determines to be operators because they exercise substantial operational control over a CAFO must apply for a permit within 90 days of the Director's determination.

(6) *No potential to discharge.* Notwithstanding any other provision of this section, a CAFO that has received a "no potential to discharge" determination under paragraph (e) of this section is not required to apply for an NPDES permit.

(g) *Are AFOs subject to Clean Water Act requirements if they are not CAFOs?* AFOs that are neither defined nor designated as CAFOs are subject to NPDES permitting requirements if they discharge the following from a point source:

(1) *Non-wet weather discharges:* discharges from their production area or land application area that are not composed entirely of storm water as defined in § 122.26(b)(13).

(2) *Wet weather discharges:* discharges from their land application area that are composed entirely of storm water as defined in § 122.26(b)(13), if the discharge has been designated under § 122.26(a)(1)(v) as requiring an NPDES permit. Discharges may be designated under § 122.26(a)(1)(v) if they are not agricultural storm water discharges as defined in § 122.23(a)(1).

(h) *If I do not operate an AFO but I land apply manure, am I required to have a NPDES permit?* If you have not been designated by your permit authority, you do not need a NPDES permit to authorize the discharge of runoff composed entirely of storm water from your manure application area. The land application of manure that results in the point source discharge of pollutants to waters of the United States may be designated pursuant to § 122.26(a)(1)(v) as requiring a NPDES permit if the application is not in accordance with proper agriculture practices. Proper agricultural practices means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using one of the methods specified in 40 CFR 412.31(b)(1)(iv).

(i) *What must be required in NPDES permits issued to CAFOs.* Permits issued to CAFOs must require compliance with the following:

(1) All other requirements of this part.

(2) The applicable provisions of part 412.

(3) Duty to Maintain Permit Coverage. No later than 180 days before the expiration of the permit, the permittee must submit an application to renew its permit. However, the permittee need not reapply for a permit if the facility is no longer a CAFO (*e.g.*, where the numbers of confined animals has been reduced below the level that meets the definition of a CAFO) and the permittee has demonstrated to the satisfaction of the Director that there is no remaining potential for a discharge of manure or associated waste waters that were generated while the operation was a CAFO. With respect to CAFOs, this section applies instead of §§ 122.21(d) and 122.41(b).

(4) Co-permittees. In the case of a permit issued to more than one owner or operator of the CAFO, the permit may allocate to one of the permit holders the sole responsibility for any permit requirement, except that all permit holders must be jointly responsible for the management of manure in excess of what can be applied on-site in compliance with part 412

(5) Permits issued to CAFOs that meet the applicability requirements of Subpart C (Beef and Dairy) or Subpart D (Swine, Poultry and Veal) of 40 CFR Part 412 shall also require compliance with paragraph (j) of this section.

(6) Permits issued to CAFOs that do not meet the applicability requirements of Subpart C or Subpart D of 40 CFR Part 412 (including beef, dairy, swine, poultry or veal facilities not subject to those parts, and facilities with other types of animals) shall also require compliance with paragraph (k) of this section.

(j) *What must be required in NPDES permits issued to CAFOs that are subject to part 412, Subparts C (Beef and Dairy) and D (Swine, Poultry and Veal)?* Permits issued to CAFOs that meet the applicability requirements of Subpart C or Subpart D of 40 CFR Part 412 must require compliance with all of the following:

(1) Requirements to use the method in 40 CFR 412.31(b)(1)(iv) chosen by the Director to determine phosphorous field conditions and to determine appropriate manure application rates. The permit shall specify the factors to be considered and the analytical methods to be employed when determining those rates.

(2) Prohibitions against or restrictions on applying manure to land during times and using methods which, in light of local crop needs, climate, soil types, slope and other factors, would not serve an agricultural purpose and would be likely to result in pollutant discharges to waters of the United States.

(3) Requirement to notify the Director when the permittee's Permit Nutrient Plan has been developed or revised. Notification of the development of the permittee's initial Permit Nutrient Plan must be submitted no later than 90 days after the CAFO submits its NOI or obtains coverage under an individual permit. With the notice, the permittee shall provide a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan that has been developed under 40 CFR 412.37(b).

Option 1 for Paragraphs (j)(4) and (5)

(4) *Transfer of manure to other persons.* The Director may waive the requirements of this paragraph if an enforceable state program subjects the recipient of CAFO wastes to land application requirements that are equivalent to the requirements in 40 CFR 412.31(b). The requirements of paragraph (f) of this section apply only to transfers to persons who receive 12

tons or more of wastes from the CAFO in any year. Prior to transferring manure and other wastes to other persons, the permittee shall:

(i) Obtain from each intended recipient of the CAFO waste (other than haulers that do not land apply the waste) a certification that the recipient will do one of the following. The certification must contain a statement that the recipient understands that the information is being collected on behalf of the U.S. Environmental Protection Agency or State and that there are penalties for falsely certifying. The permittee is not liable if the recipient violates its certification;

(A) Land apply the wastes in accordance with proper agriculture practices, which means that the recipient shall determine the nutrient needs of its crops based on realistic crop yields for its area, sample its soil at least once every three years to determine existing nutrient content, and not apply the manure in quantities that exceed the land application rates calculated using the method specified in 40 CFR 412.31(b)(1)(iv) chosen by the Director;

(B) Land apply the wastes in compliance with the terms of an NPDES permit that addresses for discharges from the land application area; or

(C) Use the manure for purposes other than land application.

(ii) Obtain from any commercial waste hauler the name and location of the recipient of the wastes, if known;

(iii) Provide the recipient of the manure with an analysis of its content; and

(iv) Provide the recipient of the manure with a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilitias for appropriate manure management.

(5) *Record keeping requirements.* Requirements to keep, maintain for five years and make available to the Director or the Regional Administrator:

(i) Records of the inspections and of the manure sampling and analysis required by 40 CFR 412.37(a);

(ii) Records required by 40 CFR 412.37(e) related to the development and implementation of Permit Nutrient Plans required by 40 CFR 412.37(b); and

(iii) Records of each transfer of wastes to a third party, including date, recipient name and address, quantity transferred, an analysis of manure content and a copy of the certifications required by paragraph (j)(4) of this section. If the waste is transferred to a commercial waste hauler, records of where the hauler indicated it would take the waste, if known. If the waste is to be packaged as fertilizer, incinerated or used for a purpose other than direct land application, records of the analysis of the manure are not required.

Option 2 for Paragraphs (j)(4) and (5):

(4) *Transfer of manure to other persons.* Prior to transferring manure and other wastes to other persons, the permittee shall:

(i) Provide the recipient of the manure with an analysis of its content;

(ii) Provide the recipient of the manure with a brochure to be provided by the State permitting authority or EPA that describes the recipient's responsibilities for appropriate manure management; and

(iii) Obtain from any commercial waste hauler the name and location of the recipient of the wastes, if known.

(5) *Record keeping requirements.* Requirements to keep, maintain for five years and make available to the Director or the Regional Administrator:

(i) Records of the inspections and of the manure sampling and analysis required by 40 CFR 412.37(a);

(ii) Records required by 40 CFR 412.37(e) related to the development and implementation of Permit Nutrient Plans required by 40 CFR 412.37(b); and

(iii) Records of each transfer of wastes to a third party, including date, recipient name and address, quantity transferred, and an analysis of manure content. If the waste is transferrad to a commercial waste hauler, records of where the hauler indicated it would take the waste, if known. If the waste is to be packaged as fertilizer, incinerated or used for a purpose other than direct land application, records of the analysis of the manure are not required.

(6) For CAFOs subject to 40 CFR 412.43 (existing swine, poultry and veal facilities), the Director must determine based on topographical characteristics of the region whether there is a likalihood that a CAFO may discharge from the production area via ground water that has a direct hydrologic connection to waters of the United States. If the Director finds there is such a likelihood, and the Director determines there is the potential for an excursion of State water quality standards due to such discharge, the Director must impose any water quality-based effluent limits necessary to comply with § 122.44(d). The Director may omit such water quality-based effluent limits from the permit if the permittee has provided a hydrologist's statement that demonstrates to the Director's satisfaction that there is no direct hydrologic connection from the production area to waters of the United States.

(k) *What additional terms and conditions must be required in NPDES permits issued to CAFOs that are not subject to part 412, Subparts C and D?*

(1) *All CAFOs not subject to part 412.* In cases where a CAFO has fewer than the number of animals necessary to make it subject to the requirements 40 CFR Part 412, and the Director is establishing effluent limitations on a case-by-case basis based on best professional judgment under section 402(a)(1)(B) of the Act, the Director shall consider the need for the following effluent limitations:

(i) Limits on the discharge of process wastewater pollutants from the production area, including limits based on the minimum duration and intensity of rainfall events for which the CAFO can design and construct a system to contain all process-generated wastewaters from such event;

(ii) Limits on discharges resulting from the application of manure to land, including restrictions on the rates of application of nitrogen and phosphorous;

(iii) Requirements to implement best management practices to ensure the CAFO achieves limitations under paragraphs (k)(1)(i) and (k)(1)(ii) of this section;

(iv) Requirements to develop and implement a Permit Nutrient Plan that addresses requirements developed under paragraphs (k)(1)(i), (ii), and (iii) of this section; and

(v) If the CAFO is in an area with topographic characteristics that indicate a likelihood that ground water has a direct hydrologic connection to waters of the United States, requirements necessary to comply with § 122.44, unless the permittee submits a hydrologist's statement that the production area is not connected to surface waters through a direct hydrologic connection.

(2) *CAFOs subject to part 412, Subparts A and B.* In addition to the applicable effluent limitations, when developing permits to be issued to CAFOs with horses, shaep or ducks subject to Subparts A and B of 40 CFR 412, the Director shall consider the need for effluent limitations for wastestreams not covered by Subparts A and B, including the need for the requirements described in paragraphs (k)(1)(ii) through (v) of this section.

(l) *How will the public know if a CAFO is implementing an adequate permit nutrient plan?*

(1) The Director shall make publicly available via the worldwide web or other publicly available source, and update every 90 days:

(i) A list of all CAFOs that have submitted a notice of intent for coverage under a general permit, and

(ii) A list of all CAFOs that have submitted a notice that their permit nutrient plan has been developed or revised.

(2) The Director shall make publicly available the notices of intent, notice of plan development, and the cover sheet and executive summary of the permittee's Permit Nutrient Plan. If the Director does not have a copy of the cover sheet and executive summary of the permittee's current Permit Nutrient Plan and the cover sheet and executive summary are not publicly available at the CAFO or other location, the Director shall, upon request from the public, obtain e copy of the cover sheet and executive summary. Until required by the Director, the CAFO operator is uot required to submit cover sheet or executive summary to the Director.

(3) *Confidential business information.* The information required to be in Permit Nutrient Plan cover sheet and executive summary, and required soil sampling data, may not be claimed as confidential. Any claim of confidentiality by a CAFO in connection with the remaiuing information in the Permit Nutrient Plan will be subject to the procedure in 40 CFR Part 2.

4. Section 122.28 is amended by:

a. Removing the word "or" at the end of peragraph (a)(2)(i) and adding the word "or" at the end of paragraph (a)(2)(ii)(D).

b. Adding paragraph (a)(2)(iii).

c. Adding two sentences to the end paragraph (b)(2)(ii)

d. Redesignating paragraph (b)(3)(i)(C) as paragraph (b)(3)(i)(H) and adding a new paragraph (b)(3)(i)(C).

e. Adding paragraph (b)(3)(vi).

The additions read as follows:

§ 122.28 General permits (applicable to State NPDES programs, see § 123.25).

(a) * * *

(2) * * *

(iii) Concentrated animel feeding operetions.

* * * * *

(b) * * *

(2) * * *

(ii) * * * Notices of intent for coverage under a general permit for confined animal feeding operations must include: a topographic map as described in § 122.21(f)(7); name and address of any other entity with substantial operational control; a statement whether the owner or operator has developed and is implementing its Permit Nutrient Plan and, if not, the status of the devolopment of its Permit Nutrient Plan. New sources subject to 40 CFR Part 412 shall also provide a copy of a draft plan that, at a minimum, demonstrates that there is adequate land available to the CAFO operator to comply with the land application provisions of 40 CFR Part 412 or describes an alternative to land application that the operator intends to implement.

* * * * *

(3) * * *

(i) * * *

(G) The discharge is from a CAFO. In addition to the other criteria in paragreph (b)(3) of this section, the Director shall consider whether generel permits are appropriate for the following CAFOs:

(*1*) CAFOs located in an environmentally or ecologically sensitive erea;

(*2*) CAFOs with a history of operational or compliance problems;

(*3*) CAFOs that are exceptionally large operation as determined by the Director; or

(*4*) Significantly expending CAFOs.

* * * * *

(vi) Prior to issning any generel permits for CAFOs, the Director, after considering input from the public, shall issue a written statement of its policy on which CAFOs will be eligible for general permits, including a statement of how it will apply the criteria in paragraph (b)(3)(i)(G) of this sectiou.

Appendix B to Part 122 [Removed and Reserved]

6. Remove and reserve Appendix B to part 122.

9. Pert 412 is revised to read es follows:

PART 412—CONCENTRATED ANIMAL FEEDING OPERATIONS (CAFOs) POINT SOURCE CATEGORY

Sec.

412.0 General applicability.
412.1 General definitions.
412.2 General pretreatment standards.

Subpart A—Horses and Sheep

412.10 Applicability.
412.11 Special definitions.
412.12 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).
412.13 Effluent limitations attainable by the application of the best available control technology economically achievable (BAT).
412.15 New source performance standards (NSPS).

Subpart B—Ducks

412.20 Applicability.
412.21 Special definitions.
412.22 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).
412.25 New source performance standards (NSPS).
412.26 Pretreatment standards for new sources (PSNS).

Subpart C—Beef and Dairy

412.30 Applicability.
412.31 Effluent limitations attainable by the application of best practicable control technology currently available (BPT).
412.32 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).
412.33 Effluent limitations attainable by the application of the best available control technology economically achievable (BAT).
412.35 New source performance standards (NSPS).
412.37 Additional measures.

Subpart D—Swine, Veal and Poultry

412.40 Applicability.
412.41 Effluent limitations attainable by the application of best practicable control technology currently available (BPT).
412.42 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).
412.43 Effluent limitations attainable by the application of the best available control technology economically achievable (BAT).
412.45 New source performance standards (NSPS).

Authority: 33 U.S.C. 1311, 1314, 1316, 1317, 1318, 1342 and 1361.

§ 412.0 General applicability.

This part applies to process wastewater discharges resulting from concentrated animal feeding operations (CAFOs). Manufacturing activities which mey be subject to this part are generally reported under one or more of the following Standard Industrial Classification (SIC) codes: SIC 0211, SIC 0213, SIC 0241, SIC 0259, or SIC 3523 (1987 SIC Manual).

§ 412.1 General Definitions.

As used in this part:

(a) The general definitions and abbreviations at 40 CFR part 401 shall apply.

(b) *Concentrated Animal Feeding Operation (CAFO)* is defined at 40 CFR 122.23(a)(3).

(c) *Fecal coliform* means the becterial count (Parameter 1) at 40 CFR 136.3 in Table 1A, which also cites the approved methods of analysis.

(d) *Process wastewater* means water directly or indirectly used in the operation of the CAFO for any or all of the following: spillage or overflow from animal or poultry watering systems; washing, cleaning, or flushing pens, barns, manure pits, or other CAFO facilities; direct contact swimming, washing or spray cooling of animals; litter or bedding; dust control; and stormwater which comes into contact with any raw materials, products or by-products of the operation.

(e) *Certified specialist* shall mean someone who has been certified to prepare Comprehensive Nutrient Management Plans (CNMPs) by USDA or a USDA sanctioned organization.

(f) *Land application area* means any land under the control of the CAFO operator, whether it is owned, rented, or leased, to which manure and process wastewater is or may be applied.

(g) *New source* means a source that is subject to subparts C or D of this part and, not withstanding the criteria codified at 40 CFR 122.29(b)(1): Is constructed at a site at which no other source is located; or replaces the housing including animal holding areas, exercise yards, and feedlot, waste handling system, production process, or production equipment that causes the discharge or potential to discharge pollutants at an existing source; or constructs a production area that is substantially independent of an existing source at the same site. Whether processes are substantially independent of an existing source, depends on factors such as the extent to which the new facility is integrated with the existing facility; and the extent to which the new facility is engaged in the same general type of activity as the existing source.

(h) *Overflow* means the process wastewater discharge resulting from the filling of wastewater or liquid manure storage structures to the point at which no more liquid can be contained by the structure.

(i) *Production area* means that part of the CAFO that includes the animal confinement area, the manure storage area, the raw materials storage area, and the waste containment areas. The animal confinement area includes but is not limited to open lots, housed lots, feedlots, confinement houses, stall barns, free stall barns, milkrooms, milking centers, cowyards, barnyard, exercise yards, animal walkways, and stables. The manure storage area includes but is not limited to lagoons, sheds, under house or pit storage, liquid impoundments, static piles, and composting piles. The raw materials storage area includes but is not limited to feed silos, silage bunkers, and bedding materials. The waste containment area includes but is not limited to settling basins, and areas within berms, and diversions which separate uncontaminated stormwater. Also included in the definition of production area is any egg washing or egg processing facility.

(j) *Setback* means a specified distance from surface waters or potential conduits to surface waters where manure and wastewater may not be land applied. Examples of conduits to surface waters include, but are not limited to, tile line intake structures, sinkholes, and agricultural well heads.

(k) *Soil test phosphorus* is the measure of the phosphorus content in soil as reported by approved soil testing laboratories using a specified analytical method.

(l) *Phosphorus threshold or TH* level is a specific soil test concentration of phosphorus established by states. The concentration defines the point at which soluble phosphorus may pose a surface runoff risk.

(m) *Phosphorus index* means a system of weighing a number of measures that relate the potential for phosphorus loss due to site and transport characteristics. The phosphorus index must at a minimum include the following factors when evaluating the risk for phosphorus runoff from a given field or site:

(1) Soil erosion.
(2) Irrigation erosion.
(3) Run-off class.
(4) Soil phosphorus test.
(5) Phosphorus fertilizer application rate.
(6) Phosphorus fertilizer application method.
(7) Organic phosphorus application rate.
(8) Method of applying organic phosphorus.

(n) *Permit Nutrient Plan* means a plan developed in accordance with § 412.33 (b) and § 412.37. This plan shall define the appropriate rate for applying manure or wastewater to crop or pasture land. The plan accounts for soil conditions, concentration of nutrients in manure, crop requirements and realistic crop yields when determining the appropriate application rate.

(o) *Crop removal rate* is the application rate for manure or wastewater which is determined by the amount of phosphorus which will be taken up by the crop during the growing season and subsequently removed from the field through crop harvest. Field residues do not count towards the amount of phosphorus removed at harvest.

(p) *Ten(10)-year, 24-hour rainfall event and 25-year, 24-hour rainfall event* mean precipitation events with a probable recurrence interval of once in ten years, or twenty five years, respectively, as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May, 1961, or equivalent regional or State rainfall probability information developed from this source. The technical paper is available at *http://www.nws.noaa.gov/er/hq/Tp40s.html*.

(q) The parameters that are regulated or referenced in this part and listed with approved methods of analysis in Table 1B at 40 CFR 136.3 are defined as follows:

(1) *Ammonia (as N)* means ammonia reported as nitrogen.

(2) *BOD_5* means 5-day biochemical oxygen demand.

(3) *Chloride* means total chloride.

(4) *Nitrate (as N)* means nitrate reported as nitrogen.

(5) *Total dissolved solids* means non-filterable residue.

(r) The parameters that are regulated or referenced in this part and listed with approved methods of analysis in Table 1A at 40 CFR 136.3 are defined as follows:

(1) *Fecal coliform* means fecal coliform bacteria.

(2) *Total coliform* means all coliform bacteria.

§ 412.3 General pretreatment standards.

Any source subject to this part that introduces process wastewater pollutants into a publicly owned treatment works (POTW) must comply with 40 CFR part 403.

Subpart A—Horses and Sheep

§ 412.10 Applicability.

This subpart applies to discharges resulting from the production areas at CAFOs where sheep are confined in open or housed lots; and horses are confined in stables such as at racetracks. This subpart does not apply to such CAFOs with less than the following capacities:

APPLICABLE CAFOs

Livestock	Minimum capacity
Sheep	10,000
Horses	500

§ 412.11 Special definitions.

For the purpose of this subpart:

(a) *Housed lot* means totally roofed buildings, which may be open or completely enclosed on the sides, wherein animals are housed over floors of solid concrete or dirt and slotted (partially open) floors over pits or manure collection areas, in pens, stalls or cages, with or without bedding materials and mechanical ventilation.

(b) *Open lot* means pens or similar confinement areas with dirt, concrete paved or hard surfaces, wherein animals are substantially or entirely exposed to the outside environment, except where some protection is afforded by windbreaks or small shed-type shaded areas.

§ 412.12 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

(a) Except as provided in 40 CFR 125.30 through 125.32 and when the provisions of paragraph (b) of this section apply, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT: There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 10-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the overflow may be allowed to be discharged into U.S. waters.

§ 412.13 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

(a) Except as provided in 40 CFR 125.30 through 125.32 and when the provisions of paragraph (b) of this section apply, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT: There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the overflow may be allowed to be discharged into U.S. waters.

§ 412.15 New source performance standards (NSPS).

(a) Except as provided in paragraph (b) of this section, any new point source subject to this subpart must achieve the following performance standards: There must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the overflow may be allowed to be discharged into U.S. waters.

Subpart B—Ducks

§ 412.20 Applicability.

This subpart applies to discharges resulting from dry and wet duck feedlots with a capacity of at least 5000 ducks.

§ 412.21 Special definitions.

For the purpose of this subpart:

(a) *Dry lot* means a facility for growing ducks in confinement with a dry litter floor cover and no access to swimming areas.

(b) *Wet lot* means a confinement facility for raising ducks which is open to the environment, has a small number of sheltered areas, and with open water runs and swimming areas to which ducks have free access.

§ 412.22 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the application of BPT:

EFFLUENT LIMITATIONS

Regulated parameter	Maximum daily[1]	Maximum monthly avg.[1]	Maximum daily[2]	Maximum monthly avg.[2]
BOD_5	3.66	2.0	1.66	0.91
Fecal coliform	(3)	(3)	(3)	(3)

[1] Pounds per 1000 ducks.
[2] Kilograms per 1000 ducks.
[3] Not to exceed MPN of 400 per 100 ml at any time.

§ 412.25 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) Except as provided in paragraph (b) of this section, there must be no discharge of process wastewater pollutants into U.S. waters.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the point source, any process wastewater pollutants in the overflow may be allowed to be discharged into U.S. waters.

§ 412.26 Pretreatment standards for new sources (PSNS).

(a) Except as provided in 40 CFR § 403.7 and in paragraph (b) of this section, any new source subject to this subpart must achieve the following pretreatment standards: There must be no discharge of process wastewater pollutants into a POTW.

(b) Whenever rainfall events cause an overflow of process wastewater from a facility designed, constructed and operated to contain all process-generated wastewaters plus the runoff from a 25-year, 24-hour rainfall event at the location of the new source, the discharge of any process wastewater pollutants in the overflow may be allowed.

Subpart C—Beef and Dairy

§ 412.30 Applicability.

This subpart applies to concentrated animal feeding operations (CAFOs), as defined in 40 CFR § 122.23, and includes the following types of animals: Mature dairy cows, either milking or dry; and cattle other than mature dairy or veal.

§ 412.31 Effluent limitations attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR § 125.30 through § 125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT:

(a) For CAFO production areas:

(1) Except as provided in paragraph (a)(2) of this section, there must be no discharge of process wastewater pollutants into U.S. waters.

(2) Whenever reinfall causes an overflow of process wastewater, pollutants in the overflow may be discharged into U.S. waters during those periods subject to following conditions:

(i) The production area is designed and constructed to contain all process wastewaters including the runoff from a 25 year, 24 hour rainfall event; and

(ii) The production area is operated in accordance with the requirements of § 412.37(a)(1) through (3).

(b) For CAFO land application areas:

(1) Discharges resulting from the application of manure or process wastewater to land owned or under the control of the CAFO must achieve the following:

(i) Develop and implement a Permit Nutrient Plan (PNP) that includes the requirements specified at § 412.37; and establishes land application rates for manure in accordance with § 412.31 (b)(1)(iv).

(ii) The PNP must be developed or approved by a certified specialist.

(iii) The PNP must be written taking into account realistic yield goals based on historic yields from the CAFO, or county average data when historic yields are not appropriate. County average data may be used when a facility plants a crop that no yield data for that CAFO land application area has been obtained within the previous 10 years. CAFOs shall review the PNP annually and revise as necessary, and must rewrite the PNP at least once every five years.

(iv) Apply manure and process wastewater at a rate established in accordauce with one of the three methods defined in tables 1 through 3 of this section. State approved indices, thresholds, and soil test limits shall be utilized such that application does not exceed the crop and soil requirements for nutrients:

TABLE 1.—PHOSPHORUS INDEX

Phosphorus index rating	Manure and wastewater application rate
Low Risk	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
Medium Risk	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
High Risk	Application of phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
Very High Risk	No land application of manure or wastewater.

TABLE 2.—PHOSPHORUS THRESHOLD

Soil phosphorus threshold level	Manure and wastewater application rate
< ¾ TH application	Manure and wastewater may not exceed the nitrogen requirements of the crop.
> ¾ TH, < 2 TH application	Phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
> 2 TH application	No land application of manure or wastewater.

TABLE 3.—SOIL TEST PHOSPHORUS

Soil test phosphorus level	Manure and wastewatar application rate
Low	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
Medium	Application of manure and wastewater may not exceed the nitrogen requirements of the crop.
High	Application of phosphorus in manure and wastewater may not exceed the amount of phosphorus removed from the field with crop harvest.
Very High	No land application of manure and wastewater.

(2) Multi-year phosphorus applications are prohibited when either the P-Index is rated high, the soil phosphorus threshold is between ¾ and 2 times the TH value, or the soil test phosphorus level is high as determined in paragraph (b)(1) (iv) of this section unless:

(i) Manure application equipment designed for dry poultry manure or litter cannot obtain an application rate low enough to meet a phosphorus based application rate as determined by the PNP In the event a phosphorus application occurs during one given year which exceeds the crop removal rate for that given year, no additional manure or process wastewater shall be applied to the same land in subsequent years until all applied phosphorus has been removed from the field via harvest and crop removal.

(ii) [Reserved]

§ 412.32 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).

Except as provided in 40 CFR 125.30 through 125.32 and 412.41(2), any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BCT:

(a) For CAFO production areas: Discharges must achieve the same reqnirements as specified in § 412.31(a).

(b) For CAFO land application areas: Discharges resulting from the application of manure or process wastewater to crop or pasture lend owned or under the control of the CAFO must achieve the same requirements as specified in § 412.31(b) end § 412.37.

§ 412.33 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

Except es provided iu 40 CFR 125.30 through 125.32 and 412.33(a)(2), any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters, including any pollutants discharged to ground water which has a direct hydrologic connection to surface waters.

(2) Whenever rainfall causes an overflow of process wastewatar, pollutants in tha overflow may be discharged into U.S. waters during those periods when the following conditions are met:

(i) The production area is designed and constructed to contain all process wastewaters including the runoff from a 25 year, 24 hour rainfall event; and

(ii) The production area is operated in accordance with the requirements of § 412.37(a).

(3)(i) Tbe ground water beneath the prodnction area must be sampled twice annually to demonstrate compliance with the no discharge requirement unless the CAFO has determined to the satisfaction of the permitting authority that the ground water beneath the productiou area is not connected to surface waters through a direct hydrologic connection.

(ii) Ground water samples shall be collected up-gradient and down-gradient of the production area and analyzed for:

(A) Total coliforms.

(B) Fecal coliform.

(C) Total dissolved solids.

(D) Nitrates.

(E) Ammonia.

(F) Chloride

(b) For CAFO land application areas: Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in § 412.31(b) and § 412.37.

§ 412.35 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) For CAFO production areas: Subject to tha provisions of paragraph (c) of this section, discharges must achieve the same requirements as specified in § 412.33(a).

(b) For CAFO land application areas: Subject to the provisions of paragraph (c) of this section, discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in § 412.31(b) and § 412.37.

(c) Any new source subject to the provisions of this section that commenced discharging after [insert date 10 years prior to the date that is 60 days from the publication date of the final rule] and before [insert date that is 60 deys from the publication date of the final rule] must continue to achieve the standards specified in the 2000 version of § 412.15, provided that the new source was constructed to meet those standards. For toxic and nonconventional pollutants, those standards shall not apply after the expiration of the applicable time period specified in 40 CFR 122.29(d)(1); thereafter, the source must achieve the standards specified in paragraphs (a) and (b) of this section.

§ 412.37 Additional measures.

(a) Each CAFO subject to this subpart must implement the following raquirements:

(1) There must be routine visual inspections of the CAFO production area to check the following:

(i) Weekly inspectious of all stormwater diversion devices, such as roof gutters, to ensure they are free of debris that could interfero with the diversion of clean stormwater;

(ii) Weekly inspections of all stormwatar diversion devices which channel contaminated stormwater to the wastewater and manure storage and containment structure, to ensure that they are free of dabris that could interfere with ensuring this contaminated stormwater reaches the storage or containment structure;

(iii) Daily inspections of all water lines providing drinking water to the animals to ensure there are no leaks in these lines that could contribute unnecessary volume to liquid storage systems or cause dry mannre to become too wet;

(iv) Runoff divarsion structures and animal waste storage strnctures must be visually inspected for: seepage, erosion, vegetation, animal access, reduced fraeboard, and functioning rain gauges and irrigation equipment, on a weekly basis manure storaga area to ensure integrity of the structure. All surface impoundments must have a depth marker which indicates the design volume and clearly indicates the minimum freeboard necessary to allow for the 25 year 24 hour rainfall event. The inspection shall also note the depth of the manure and process wastewater in the impoundment as indicated by this depth marker.

(2) Any deficiencies found as a result of these inspections shall be corrected as soon as possible. Deficiencies and corrective action taken shall be documented.

(3) Mortalities may not be disposed of in any liqnid manure or stormwater storage or treatment system, and must be handled in such a way es to prevent discharge of pollutants to surfaco water.

(4) Land application of manure generated by the CAFO to land owned or controlled by the CAFO mnst be done in accordance with the following practices:

(i) Manure may not be applied closer than 100 feet to any surface water, tile line intake structure, sinkhole or agricultural well head.

(ii) The CAFO must take manure samples at least once per year and analyzed for uitrogen, phosphorus and potassium. Samples must be collected from all manure storage areas, both liquid and dry storage, as well as any wastewater or storm water storage. The CAFO must take soil samples once every threc years if they apply manure to crop or pasture land under their control, and analyze the soil sample for phosphorus. Samples shall ba collected in accordance with accepted Extension protocols and the analyses must be conducted in accordauce with the state nutrient management standard. These protocols shall be documented in the PNP.

(iii) Manure that is transported off-site must be sampled at least once a year for nitrogen, phosphorus and potassium. The results of these analyses must be provided to the recipient of the manure.

(iv) Manure application equipment must be calibrated prior to land application of manure and/or process wastewaters at a minimnm of once per year.

(b) Record keeping requirements: Each CAFO must maintain on its premises a complete copy of the current PNP and tha records specified in paragraphs (b)(1) through (12) of this section. The CAFO must make the PNP availahle to the permitting authority and the Regional Administrator, or his or her designee, for review upon request. Records must be maintained for 5 years from the date they are created.

(1) Cover Sheet which inclndes the following information:

(i) the name and location of the CAFO,

(ii) name and title of the owner or operator

(iii) name and title of the person who prepared the plan,

(iv) date the plan was prepared,

(v) date the plan was amended

(2) Executive Summary which includes the following information:

(i) Total average herd or flock size

(ii) Identification of manure collection, handling, storage, and treatment practices

(iii) Amount of manure generated annually

(iv) Identification of planned crops (rotation)

(v) Realistic yield goal as described in § 412.31(b)(1)(iii)

(vi) Field condition as determined by the phosphorus index, soil test phosphorus, or phosphorus threshold (for each field unit that will receive manure)

(vii) number of acres that will receive manure

(viii) amount of manure transported off-site

(ix) animal waste application rate (gallons or tons/acre)

(x) identification of watershed or nearest surface water body

(3) Records documenting the inspections required under paragraph (a)(1) of this section.

(4) Records tracking the repairs performed on drinking water lines, automated feeding equipment, feed storage and silos, manure storage, manure treatment facilities, as well as maintenance of berms and diversions that direct clean stormwater away from any manure and other process wastewater.

(5) Records documenting the following information about manure application and crop production.

(i) Expected crop yield based on historical data for the CAFO for its land application area, or county average yield data when the CAFO does not have a prior history of crop yields

(ii) The date(s) manure is applied,

(iii) Weather conditions at time of application and for 24 hours prior to and following application,

(iv) Results from manure and soil sampling,

(v) Test methods used to sample and analyze manure and soil,

(vi) Whether the manure application rate is limited to nitrogen, phosphorus, or some other parameter,

(vii) The amount of manure and manure nutrients applied,

(viii) The amount of any other nutrients applied to the field reported in terms of nitrogen, phosphorus and potassium (including commercial fertilizer, legume credits, and biosolids),

(ix) Calculations showing the total nutrients applied to land,

(x) Calibration of manure application equipment,

(xi) The rate of application of manure,

(xii) The method used to apply the manure, estimated nitrogen losses based on application method used, and the route of nitrogen loss,

(xiii) The field(s) to which manure was applied and total acreage receiving manure,

(xiv) What crop(s) was planted,

(xv) The date that crops were planted in the field, and

(xvi) The crop yields obtained.

(6) Records of the total volume or amount of manure and process wastewater generated by all animals at the facility during each 12 month period. This must include milk parlor washwater and egg washwater. The volume or amount may be determined through direct measurements or an estimated value provided all factors are documented.

(7) Records of rainfall duration, amount of rainfall, and the estimated volume of any overflow that occurs as the result of any catastrophic or chronic rainfall event.

(8) A copy of the emergency response plan for the CAFO.

(9) Records of how mortalities are handled by the CAFO.

(10) Name of state approved specialist that prepared or approved the PNP, or record and documentation of training and certification for owners or operator writing their own PNP.

Subpart D—Swine, Poultry and Veal

§ 412.40 Applicability.

This subpart applies to operations defined as concentrated animal feeding operations (CAFOs) under 40 CFR 122.23 and includes the following animals: Swine, each weighing 55 lbs. or more; swine, each weighing less than 55 lbs.; veal; cattle; chickens; and turkeys.

§ 412.41 Effluent limitation attainable by the application of the best practicable control technology currently available (BPT).

Except as provided in 40 CFR 125.30 through 125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BPT:

(a) For CAFO production areas: Discharges must achieve the same requirements as specified in § 412.31(a).

(b) For CAFO land application areas: Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in § 412.31(b) and § 412.37.

§ 412.42 Effluent limitations attainable by the application of the best control technology for conventional pollutants (BCT).

Except as provided in 40 CFR 125.30 through 125.32 , any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BCT:

(a) For CAFO production areas: The limitations are the same as specified in § 412.41(a).

(b) For CAFO land application areas: The limitations are the same as specified in § 412.41(b).

§ 412.43 Effluent limitations attainable by the application of the best available technology economically achievable (BAT).

Except as provided in 40 CFR 125.30 through 125.32, any existing point source subject to this subpart must achieve the following effluent limitations representing the application of BAT:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters.

(2) Any CAFO subject to this subpart must also comply with the requirements specified in § 412.37(a)(1) through (3).

(b) For CAFO land application areas: The limitations are the same as specified in § 412.41(b).

§ 412.45 New source performance standards (NSPS).

Any new source subject to this subpart must achieve the following standards:

(a) For CAFO production areas:

(1) There must be no discharge of process wastewater pollutants into U.S. waters, including any pollutants discharged to ground water which have a direct hydrological connection to surface waters.

(2) The ground water beneath the production area must be sampled twice annually to demonstrate compliance with the provisions of paragraph (a)(1) of this section, unless the CAFO has determined to the satisfaction of the permitting authority that the ground water beneath the production area is not connected to surface waters through a direct hydrologic connection. Ground water samples must be collected up-gradient and down-gradient of the production area, and analyzed for:

(i) Total coliforms

(ii) Fecal coliform

(iii) Total dissolved solids

(iv) Nitrates

(v) Ammonia

(vi) Chloride

(3) Any CAFO subject to this subpart must also comply with the requirements specified in § 412.37(a)(1) through (3).

(b) For CAFO land application areas: Discharges resulting from the application of manure or process wastewater to crop or pasture land owned or under the control of the CAFO must achieve the same requirements as specified in § 412.31(b) and § 412.37.

(c) Any new source subject to the provisions of this section that commenced discharging after [insert date 10 years prior to the date that is 60 days from the publication date of the final rule] and before [insert date that is 60 days from the publication date of the final rule] must continue to achieve the standards specified in § 412.15, provided that the new source was constructed to meet those standards. For "toxic" and nonconventional pollutants, those standards shall not apply after the expiration of the applicable time period specified in 40 CFR § 122.29(d)(1); thereafter, the source must achieve the standards specified in paragraphs (a) and (b) of this section.

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ATTACHMENT 3:

Natural Resources Conservation Service Conservation Practice Standard Code 635

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

(Ac.)

CODE 635

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

To improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

- Where a Vegetated Treatment Area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, compost areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.
- On small animal feeding operations where no NPDES permit or discharge certification is required (typically less than 300 animal units), as defined by the U.S. Environmental Protection Agency.

CRITERIA

Utilities and Permits. Vegetated treatment areas shall comply with all applicable laws, rules, regulations, and permit requirements including those applicable to the discharges of waters to the state.

The landowner shall be responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

The landowner shall obtain all necessary permissions from regulatory agencies, including the Illinois Department of Agriculture, US Army Corps of Engineers, US Environmental Protection Agency, Illinois Environmental Protection Agency and Illinois Department of Natural Resources – Office of Water Resources, or document that no permits are required.

Infiltration Area. Base the total treatment area for the VTA on the soil's capacity to infiltrate and retain runoff within the root zone and the vegetation's agronomic nutrient requirements. Use the soil's water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity to determine its ability to absorb and retain runoff. Base the infiltration determination on the most restrictive soil layer within the root zone regardless of its thickness. Soil infiltration rate shall be at least 1.0 inch per hour, and not greater than 6.0 inches per hour.

Design the VTA based on the need to treat the runoff volume from the 25-year, 24-hour storm event from the agricultural animal management facility. Infiltrate a portion or the entire volume of the design storm, based on management objectives. The portion of the design volume not infiltrated shall be stored for utilization or treatment unless discharge is permitted by applicable regulations.

The VTA area for runoff from feedlots or other contaminated areas shall be designed such that the infiltration capacity of the VTA will equal or exceed the volume of feedlot runoff to be infiltrated during a 1-year, 2-hour rainfall event.

Hydraulic Capacity. The VTA shall be designed to provide uniform sheet flow with a maximum 0.5 inch depth for the applied wastewater, at a velocity that will provide a minimum VTA contact time of 2 hours.

The VTA design flow rate shall be determined using the volume of runoff to be infiltrated and the design contact time.

The VTA shall have a minimum flow length of 100 feet and a minimum width of 20 feet. Maximum width of the VTA shall be 100 feet. The natural or constructed slope of the VTA shall be 0.3 to 6 percent. The entrance slope to the VTA shall not be flatter than 1 percent.

Nutrient Loading. Nutrient loading of the VTA shall be based on crop removal of the vegetation used in the VTA (See Table 1).

The VTA area for runoff from feedlots or other contaminated areas shall be designed such that the nitrogen uptake of the vegetation in the VTA is at least one third of the annual application of nitrogen from the settling basin discharge. The nitrogen from settling basin discharge may be estimated as follows:

- For cattle: 10 lb N per year per 1000 square foot feedlot
- For swine: 25 lb N per year per 1000 square foot feedlot

The VTA design for processed water shall be based on the nutrient contents of the processed water and the VTA's ability to hold and uptake the nutrients.

Table 1. Seed Mixtures

Species	Seeding Rate PLS/acre	Nitrogen Removed Per Ton Harvested (Lbs./ton)
Tall Fescue	24	30
Smooth Bromegrass	24	22.4
Orchard Grass Tall Fescue	6 20	25
Tall Fescue Smooth Bromegrass	12 12	25

Vegetation. Vegetation shall be able to withstand anticipated wetting and/or submerged conditions. Harvest VTA as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue.

Site preparation and seeding shall be done at a time and in a manner that best ensures survival and growth of the selected species. Species and seeding rates shall be selected from Table 1.

Location. Locate the VTA outside of floodplains. However, if site restrictions require location within a floodplain, the VTA shall be protected from inundation or damage from a 25-year flood event, or larger if required by regulation.

The water table shall be either naturally deep enough or artificially lowered so that the infiltrated runoff does not mingle with the ground water at the bottom of the root zone. Subsurface drainage shall not be provided within the VTA. Subsurface drainage may be used to lower the seasonal high water table to an acceptable level provided the subsurface drain lines are at least 10 feet away from the VTA.

Infiltration areas shall not be planned where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone, unless the soil moisture can be maintained to prevent drying and cracking.

Settling Facilities. A settling basin designed to meet NRCS Conservation Practice Standard 632 – Solid/Liquid Waste Separation Facility shall be provided between the waste source and filter strip to store 1,100 cu. ft. per acre- inch of runoff from a 2-year, 24-hour rainfall. Any basin outflow shall be disregarded in computing minimum storage.

Additional storage capacity, based on frequency of cleaning, shall be provided for manure and other solids settled within the basin. When the basin will be cleaned after every significant runoff event, additional storage equivalent to at least 0.5 in. from the concentrated waste area shall be provided. If only annual cleaning of the basin is planned, additional storage equivalent to at least 6 in. from the concentrated waste area shall be provided.

Effluent Transport and Distribution System. The transport and distribution system between the settling basin and the filter strip shall be designed to keep flow as uniform as possible to prevent solids deposition. Design velocity in the transport system shall be 2 feet per second or greater.

Discharge into and through treatment areas shall be applied as sheet flow. Where sheet flow is planned, some means, such as a ditch, curb, gated pipe, level spreader or a sprinkler system, shall be provided to disperse concentrated flow and ensure sheet flow across the treatment area. Land grading and structural components necessary to maintain sheet flow throughout the treatment area shall be provided as necessary.

The distribution system should uniformly spread effluent across the top of the VTA. Gravity flow distribution manifolds shall be less than 50 feet long each and at least 2 feet shorter than the width of the VTA.

The effluent transport and distribution system shall meet NRCS Conservation Practice Standard 634 – Manure Transfer. Minimum capacity of the transport and distribution system shall equal the design flow rate for the VTA.

Protection. Divert uncontaminated water from the treatment area to the fullest extent possible unless additional moisture is needed to manage vegetation growth in the treatment area. Diversions shall meet NRCS Conservation Practice Standard 362 – Diversion.

Exclude livestock access to the vegetated treatment area.

CONSIDERATIONS

Provide more than one treatment area to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.

Add a shallow furrow or rock check on the contour to re-establish sheet flow if rills or small channels develop along the length of the VTA.

A serpentine or switchback channel can be used to provide greater length of flow.

Use warm and cool season species in separate areas to ensure that plants are actively growing to maximize nutrient uptake during different times of the year.

Utilize inlet control structures to prevent undesirable debris from entering the VTA, to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.

Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.

Store seasonal contaminated water upstream of the VTA during excessively wet or cold climatic conditions.

Consider suspension of application to treatment area when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39^0 F. When soil temperatures are between 39^0 F and 50^0 F, consider reducing application rate and increasing application period while maintaining a constant hydraulic loading rate.

Manage the VTA to maintain effectiveness throughout the growing season. Time the harvest of the VTA plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.

Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Fences or other measures may be needed to exclude or minimize access to the VTA by humans or animals that would inhibit its function.

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard that describe the requirements for applying the practice to achieve its intended use.

Plans and Specifications will include:

- A plan view showing the location of the VTA,
- Details of the length, width, and slope of the treatment area to accomplish the planned purpose (length refers to flow length down the slope of the treatment area),
- Details of structural measures required for effluent transport and distribution, and clean water exclusion.
- Herbaceous species, seed selection, and seeding rates to accomplish the planned purpose,
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival, and
- Site preparation sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

The plan shall include the following as appropriate:

- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA.
- Avoid damaging the VTA with herbicides.
- Inspect and repair treatment areas after storm events or equipment damage to fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.
- Remove solids that accumulate in the settling facilities after each runoff event or when 2 to 4 inches accumulate. Remove solids from the effluent transport system regularly. Solids shall be stored in a separate stacking facility.
- Scrape feedlots regularly and store solid waste in a separate stacking facility to reduce the load of solids onto the VTA.
- Harvest vegetation when the forage is at the proper state of maturity for maximum quality. Refer to Conservation Practice Standard 511, Forage Harvest Management.
- Protect the VTA from damage by farm equipment, traffic and livestock. Livestock must be fenced out of the VTA.
- Apply supplemental nutrients and soil amendments as needed to maintain the desired species composition and stand density of herbaceous vegetation.
- Maintain or restore the treatment area as necessary by periodically grading when deposition jeopardizes its function, and then reestablishing to herbaceous vegetation.
- Inspect the distribution manifold and effluent transport pipes regularly. Relevel the distribution manifold each spring and restore transport pipes to design slope.
- Routinely de-thatch and/or aerate treatment areas used for treating runoff from livestock holding areas in order to promote infiltration.
- Conduct maintenance activities only when the surface layer of the VTA is dry enough to prohibit compaction.

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ATTACHMENT 4:

Nicholas Brozovic, "What are the economic impacts of proposed setbacks for livestock management or livestock waste handling facility siting?"
(Jan. 16, 2014)

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16 January 2014

To Whom It May Concern:

I am an Associate Professor of economics in the Department of Agricultural and Consumer Economics at the University of Illinois at Urbana-Champaign. My primary research focus is in the economics of managing natural resources and I work extensively on water management in agriculture.

I was asked by Prairie Rivers Network to consider the potential economic impacts of adopting proposed setback rules for siting of some kinds of new livestock facilities in Illinois (750 feet from surface waters and one quarter mile from designated surface drinking water supplies). Below, I provide a quick analysis explaining my opinions about the question. This is not a rigorous economic study, which would require significant time and effort. However, the ideas and methods described fall within standard microeconomic theory and econometric analysis, and have been described in a large number of previous studies. My intent is not to provide a precise quantification of expected impacts of the proposed rules, but rather to assess the likely sign and scope of impacts.

Sincerely,

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What are the economic impacts of proposed setbacks for livestock management or livestock waste handling facility siting?

The economic impacts of the proposed setbacks for siting new livestock management or livestock waste handling facilities fall into two categories.

First, there may be economic impacts of the setback rules on downstream water users, including municipal, industrial, rural residential, recreational, and other instream and offstream water uses. Adequate water quality provides economic benefits to a variety of water users in a watershed, and degraded surface water quality imposes costs on those users.

The benefits of water quality fall into a number of categories, and there is generally no market price for clean water as it is not a good traded in a traditional market setting. However, economists have developed a variety of methods to estimate the value of non-market goods. Representative examples of economic applications to water quality include Viscusi *et al*. (2008) and Kramer and Eisen-Hecht (2002). Ge *et al*. (2013) provide a comprehensive summary and meta-analysis of the state of economic research on valuing water quality. They find that estimates of the benefits of water quality vary between studies and based on the scale and methodology used, the region, and the specific kind of water body. However, studies are in agreement that an increase in water quality provides positive economic benefits to people in the watershed. Similarly, a decrease in water quality would impose economic losses on watershed residents.

The purpose of setback rules is to reduce the likelihood of release of livestock waste into surface waters. It is thus expected that setbacks would improve water quality relative to the situation where there were no setbacks in place. This means that the setbacks are expected to have a positive economic impact on water users within the regulated watershed.

Second, there may be economic impacts on livestock management or livestock waste handling facilities resulting from the setback rules. Note that there will be no economic impact on existing livestock facilities, as they would be grandfathered in under the rules. For new facilities, the relevant question is whether their costs of establishment would be increased as a result of the setback rules. The relevant cost is the cost to acquire land for facility construction. The total amount of land available for livestock management or livestock waste handling facility construction is very large compared to the area required for potential livestock facilities in the state of Illinois. As a result, land prices for the cropland and pasture primarily used for the construction of new livestock facilities are not controlled by the option to build livestock facilities. Instead, land prices are determined by other market factors such as commodity prices and proximity to cities. The amount of potential land that livestock facilities could be constructed on that would be removed from the supply of all land available as a result of the setback rules is negligible. In other words, introducing setback rules is not expected to change land prices for land on which livestock facilities could be constructed. As a result, it is anticipated that there will be no overall economic impact on livestock management facility costs from the setback rules. Finally, even in the event that land acquisition costs for new livestock facilities did increase as a direct result of setback rules, the economic gains from that increase would accrue to Illinois landowners selling their land for facility development and the net effect is likely to be negligible.

In conclusion, it is anticipated that the setback rules will have a strictly positive economic impact as a result of improved surface water quality and negligible or zero economic impact on operators on livestock management or livestock waste handling facilities.

References

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