BEFORE THE WATER QUALITY CONTROL COMMISSION
FOR THE STATE OF NEW MEXICO

In the Matter of:	)	
	)	**WQCC 12-09 (R) and**
PROPOSED AMENDMENT	)	**WQCC 13-08 (R)**
TO 20.6.6 NMAC (Dairy Rule)	)	
	)	

STIPULATION AMONG THE PARTIES REGARDING
PROPOSED AMENDMENTS TO THE DAIRY RULE AND HEARING

HISTORY OF THE PROCEEDINGS, TESTIMONIES AND EXHIBITS

1. On September 5, 2012, the Dairy Industry Group for a Clean Environment, Inc. ("DIGCE") submitted its Petition to Amend 20.6.6 NMAC and Request for Hearing ("Petition One") along with the language of DIGCE's proposed amendments to 20.6.6 NMAC.

2. On September 11, 2012, the Water Quality Control Commission ("Commission") granted DIGCE's request for a hearing on Petition One to be held on December 11, 2012.

3. On November 19, 2012, DIGCE filed a Notice of Intent to Present Technical Testimony in support of Petition One along with written technical testimony and exhibits ("DIGCE NOI No. 1").

4. On November 19, 2012, the Coalition filed a Notice of Intent to Present Technical Testimony in opposition to DIGCE's proposed amendments to 20.6.6 NMAC along with written technical testimony and exhibits ("Coalition NOI No. 1").

5. At its meeting on December 11, 2012, the Commission continued the hearing on Petition One until January 8, 2013. On January 3, 2013, the Hearing Officer granted DIGCE's unopposed motion to continue the hearing.

6. On July 5, 2013, the Hearing Officer granted an unopposed motion by DIGCE to continue the hearing on Petition One.

7. On August 5, 2013, DIGCE filed its Second Petition to Amend 20.6.6 NMAC (Dairy Rule) along with the language of DIGCE's proposed amendments to 20.6.6 NMAC ("Petition Two").

8. On August 9, 2013, the Hearing Officer granted another unopposed motion to continue the hearing on Petition One.

9. At its meeting on September 10, 2013, the Commission granted DIGCE's request for a hearing on Petition Two and set a hearing on the Petitions for March 11, 2014.

10. On February 5, 2014, the Commission Chair granted DIGCE's unopposed motion to further continue the hearing on the Petitions until after the New Mexico Environment Department ("Department") formed and convened a technical working group on the proposed amendments to 20.6.6 NMAC.

11. At its meeting on September 9, 2014, the Commission set a hearing on the Petitions for December 9-12, 2014 in Roswell, New Mexico and appointed the Hearing Officer.

12. On October 3, 2014, the Hearing Officer issued a Procedural Order governing the hearing proceedings.

13. On October 17, 2014, the Attorney General filed an Entry of Appearance.

14. On October 17, 2014, DIGCE filed its Notice of Intent to Present Technical Testimony along with written technical testimony and exhibits ("DIGCE NOI No. 2").

15. On October 17, 2014, the Coalition filed its Notice of Intent to Present Technical Testimony along with written technical testimony and exhibits ("Coalition NOI No. 2").

16. On October 17, 2014, the Department filed its Notice of Intent to Present Technical Testimony ("Department NOI No. 1").

17. On November 21, 2014, DIGCE filed its Notice of Intent to Present Testimony on Rebuttal along with written technical testimony and exhibits ("DIGCE NOI No. 3") and also filed an Unopposed Motion to Supplement the Record, which was granted by Order of the same date.

18. On November 21, 2014, the Coalition filed its Notice of Intent to Present Technical Rebuttal Testimony along with written technical testimony and exhibits ("Coalition NOI No. 3").

19. On November 21, 2014, the Department filed its Notice of Intent to Present Technical Rebuttal Testimony ("Department NOI No. 2").

20. On December 3, 2014, the Hearing Officer granted DIGCE's motion to continue the hearing.

21. At its meeting on January, 13, 2015, the Commission reset the hearing to begin on April 6, 2015 in Roswell, New Mexico.

22. On March 18, 2015, the Department filed a Motion for Leave to File Amended Notices of Intent to Technical and Rebuttal Testimony. The Motion was granted by the Hearing Officer by Order dated March 27, 2015, and as a result of the Order, the Amended Notices of Intent attached to the March 18 Motion replace the Department's NOIs Nos. 1 and 2, which are withdrawn. The Amended NOI's are identified for purposes of this Stipulation as Department's NOIs Nos. 3 and 4.

23. On April 1, 2015, the Department filed an unopposed Motion to Supplement the Record with NMED Exhibits 4-7.

24. DIGCE, the Coalition, the Department and the Attorney General have reached agreement to stipulate to the Commission's adoption of amendments to 20.6.6 NMAC as stated below. The Parties stipulate that this agreement provides final resolution of all matters, issues, and arguments raised in proceedings WQCC 12-09(R) and WQCC 13-08(R). In light of this agreement

the Parties have further agreed to stipulate to mutually waive cross-examination of their technical witnesses and for admission of exhibits in order to shorten and simplify the hearing of this matter.

DIGCE STIPULATIONS

25. DIGCE and each of its members stipulates that it will support the Commission's adoption of amendments to 20.6.6 NMAC in the form attached hereto as Exhibit "A" and stipulates to findings by the Commission that the amendments as presented in Exhibit "A" are supported by substantial evidence and their adoption would be in accord with applicable law.

26. In consideration of the Coalition's and the Department's stipulations to the amendments to 20.6.6 NMAC in the form attached as Exhibit "A," DIGCE waives cross-examination of the Coalition's and the Department's technical witnesses on the written testimony and exhibits presented in Coalition NOI's Nos. 1, 2 and 3 and Department NOI's Nos. 3 and 4 and waives presentation of additional testimony in response to the testimony and exhibits presented in Coalition NOI No. 3 and Department NOI No. 4 (surrebuttal), except as provided in paragraph 27 below.

27. DIGCE reserves the right to cross-examine the Coalition's and the Department's witnesses with regard to any testimony presented at the hearing of these matters that takes a position inconsistent with the Coalition's or Department's stipulations in paragraphs 31 and 36 below and to cross-examine the Coalition's and/or Department's witnesses on and present additional technical testimony in response to any new technical testimony presented at the hearing that is not contained in Coalition NOI's Nos. 1, 2 or 3 or the Department's NOI's Nos. 3 or 4 and Exhibits 4-7.

28. DIGCE withdraws the written direct testimony and exhibits of its witness Lonnie Burke as presented in DIGCE NOI No. 1, unless any other party opposes the amendments to 20.6.6 NMAC as contained in Exhibit "A" hereto relating to the topic of backflow prevention, in which

case DIGCE reserves the right to call Mr. Burke to adopt his testimony and make him available for cross-examination and questioning.

29. DIGCE will make available as a panel its witnesses Loney Ashcraft, Keith Gordon, Charles Fiedler, and Mark Turnbough to adopt the technical portions of their testimonies as presented in DIGCE NOI's Nos. 1, 2 and 3, to address their support for the amendments to 20.6.6 NMAC as presented in Exhibit "A", and for questioning by the Commission and as otherwise provided by the Water Quality Act and allowed by the Hearing Officer.

30. DIGCE stipulates to the admission as evidence of all exhibits presented in the Coalition's NOI's Nos. 1, 2 and 3 and the Department's NOI's Nos. 3 and 4 and NMED Exhibits 4-7.

COALITION STIPULATIONS

31. The Coalition and each of its members stipulate that they will not oppose the Commission's adoption of amendments to 20.6.6 NMAC in the form attached hereto as Exhibit "A" and stipulate to not opposing findings by the Commission that the amendments as presented in Exhibit "A" are supported by substantial evidence in the record of these matters and their adoption would be in accord with applicable law.

32. In consideration of the DIGCE's and the Department's stipulations to the amendments to 20.6.6 NMAC in the form attached as Exhibit "A," the Coalition waives cross-examination of DIGCE's and the Department's technical witnesses on the written testimony and exhibits presented in DIGCE NOI's Nos. 1, 2 and 3 and the Department's NOI Nos. 3 and 4 and NMED Exhibits 4-7, except as provided in paragraph 33 below.

33. The Coalition reserves the right to cross-examine DIGCE's and/or the Department's witnesses with regard to any testimony presented at the hearing of these matters that takes a position inconsistent with DIGCE's and the Department's stipulations in paragraphs 25 above and 36 below

and to cross-examine DIGCE's and/or the Department's witnesses on and to present technical testimony in response to new technical testimony presented at the hearing that is not contained in DIGCE NOI's Nos. 1, 2 or 3 or the Department's NOI's Nos. 3 and 4.

34. The Coalition will make available as a panel its witnesses William Olson and Kathy Martin to adopt the technical portions of their testimonies as presented in the Coalition's NOI's Nos. 1, 2 and 3, to address the Coalition's position of not opposing the amendments to 20.6.6 NMAC as presented in Exhibit "A", and for questioning by the Commission and as otherwise provided by the Water Quality Act and allowed by the Hearing Officer.

35. The Coalition stipulates to the admission as evidence of all exhibits presented in the DIGCE's NOI's Nos. 1, 2 and 3 and the Department's NOI's Nos. 3 and 4 and NMED Exhibits 4-7.

DEPARTMENT STIPULATIONS

36. The Department stipulates that it will support the Commission's adoption of amendments to 20.6.6. NMAC in the form attached hereto as Exhibit "A" and stipulates to findings by the Commission that the amendments as presented in Exhibit "A" are supported by substantial evidence in the record of these matters and their adoption would be in accord with applicable law.

37. In consideration of the DIGCE's and the Coalition's stipulation to the amendments to 20.6.6 NMAC in the form attached as Exhibit "A," the Department waives cross-examination of DIGCE's and the Coalition's technical witnesses on the written testimony and exhibits presented in DIGCE NOI's Nos. 1, 2 and 3 and the Coalition's NOI's Nos. 1, 2 and 3, except as provided in paragraph 38 below.

38. The Department reserves the right to cross-examine DIGCE's and the Coalition's witnesses with regard to any testimony presented at the hearing on the Petitions that takes a position inconsistent with DIGCE's or the Coalition's stipulations in paragraph 25 and 31 above and to cross-examine DIGCE's and/or the Coalition's witnesses on and to present technical testimony in

response to new technical testimony presented at the hearing that is not contained in DIGCE NOI's Nos. 1, 2 or 3 or the Coalition's NOI's Nos. 1, 2 or 3.

39. The Department will make available witness Trais Kliphuis to adopt the technical portions of her testimonies as presented in the Department's NOI Nos. 3 and 4, to address the Department's position to support the amendments to 20.6.6 NMAC as presented in Exhibit "A", and for questioning by the Commission and as otherwise provided by the Water Quality Act and allowed by the Hearing Officer.

40. The Department stipulates to the admission as evidence of all exhibits presented in the DIGCE's NOI's Nos. 1, 2 and 3 and the Coalition's NOI Nos. 1, 2 and 3.

ATTORNEY GENERAL STIPULATIONS

41. The Attorney General stipulates that it will support the Commission's adoption of amendments to 20.6.6 NMAC in the form attached hereto as Exhibit "A" and stipulates to findings by the Commission that the amendments as presented in Exhibit "A" are supported by substantial evidence in the record of these matters and their adoption would be in accord with applicable law.

42. In consideration of DIGCE's, the Coalition's and the Department's stipulations to support amendments to 20.6.6 NMAC in the form attached as Exhibit "A," the Attorney General waives cross-examination of DIGCE's, the Coalition's and the Department's technical witnesses on the written testimony and exhibits presented in DIGCE NOI's Nos. 1,2 and 3, the Coalition's NOI's Nos. 1, 2 and 3, and the Department's NOI's Nos. 3 and 4 and NMED Exhibits 4-7, except as provided in paragraph 43 below.

43. The Attorney General reserves the right to cross-examine DIGCE's and/or the Coalition's witnesses with regard to any testimony presented at the hearing of these matters that takes a position inconsistent with DIGCE's, the Coalition's and the Department's stipulations in paragraphs 25, 31 and 36 above or any technical testimony presented at the hearing that is not

contained in DIGCE NOI's 1, 2 or 3, the Coalition's NOI's 1, 2 or 3 or the Department's NOI's Nos. 3 and 4.

44. The Attorney General did not file any Notice of Intent to Present Technical Testimony and does not intend to call any technical witness at the hearing.

45. The Attorney General stipulates to the admission as evidence of all exhibits presented in DIGCE's NOI's Nos. 1, 2 and 3, the Coalition's NOI's Nos. 1, 2 and 3 and the Department's NOIs Nos. 3 and 4 and NMED Exhibits 4-7.

STIPULATION TO SUPPLEMENT THE RECORD WITH AN ADDITIONAL EXHIBIT

46. All Parties stipulate to the supplementation of the record and admission in evidence of Joint Exhibit 1, which is referenced in the proposed amendments to 20.6.6.17(D)(5) and 20.6.6.27(B)(2)(b)(ii) NMAC as contained in Exhibit "A" and is attached hereto as Exhibit "B."

PROPOSED ORDER OF HEARING

47. In light of the stipulations above, the Parties request that the order of hearing technical presentations be realigned as follows:

a. Opening statement by DIGCE counsel.

b. Presentation and questioning of DIGCE technical panel.

c. Opening statement by Coalition counsel.

d. Presentation and questioning of Coalition panel.

e. Opening statement by Attorney General.

f. Opening statement by the Department.

g. Presentation and questioning of the Department's witness.

h. Closing arguments in the order of DIGCE, Coalition, Attorney General and Department.

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EXHIBIT A
TO STIPULATION AMONG THE PARTIES REGARDING PROPOSED AMENDMENTS TO THE DAIRY RULE 20.6.6 NMAC

PROPOSED DAIRY RULE AMENDMENTS

KEY: Proposed elimination of language in current Dairy Rule shown by ~~strikeout.~~
Proposed new language to be inserted in current Dairy Rule shown by underline.

TITLE 20 ENVIRONMENTAL PROTECTION
CHAPTER 6 WATER QUALITY
PART 6 GROUND WATER PROTECTION - SUPPLEMENTAL PERMITTING REQUIREMENTS FOR DAIRY FACILITIES

20.6.6.1 ISSUING AGENCY: Water Quality Control Commission.
[20.6.6.1 NMAC - N, 01/31/2011]

20.6.6.2 SCOPE: All persons subject to the Water Quality Act, NMSA 1978, Sections 74-6-1 et seq and specifically to dairy facilities and their operations.
[20.6.6.2 NMAC - N, 01/31/2011]

20.6.6.3 STATUTORY AUTHORITY: Standards and regulations are adopted by the commission under the authority of the Water Quality Act, NMSA 1978, Sections 74-6-1 through 74-6-17.
[20.6.6.3 NMAC - N, 01/31/2011]

20.6.6.4 DURATION: Permanent.
[20.6.6.4 NMAC - N, 01/31/2011]

20.6.6.5 EFFECTIVE DATE: 01/31/2011, unless a later date is cited at the end of a section.
[20.6.6.5 NMAC - N, 01/31/2011]

20.6.6.6 OBJECTIVE: The purpose of 20.6.6 NMAC is to supplement the general permitting requirements of 20.6.2.3000 through 20.6.2.3114 NMAC to control discharges specific to dairy facilities and their operations.
[20.6.6.6 NMAC - N, 01/31/2011]

20.6.6.7 DEFINITIONS:

A. Terms defined in the Water Quality Act and 20.6.2.7 NMAC shall have the meanings as given in such.

B. As used in 20.6.6 NMAC, but not in other sections of 20.6.2 NMAC, a term defined in this part shall have the following meaning.

(1) "Adjacent" means lying near, but lacking actual contact along a boundary or at a point.

(2) "Applicant" means the person applying for a new, renewed or modified discharge permit.

(3) "Construction quality assurance" or "CQA" means a planned system of activities necessary to ensure that standards and procedures are adhered to and that construction and installation meet design criteria, plans and specifications. A CQA includes inspections, verifications, audits, evaluations of material and workmanship necessary to determine and document the quality of the constructed impoundment or structure, and corrective actions when necessary.

(4) "Construction quality control" or "CQC" means a planned system of operational techniques and activities used to preserve the quality of materials and ensure construction to specifications. Elements of a CQC include inspections, testing, data collection, data analysis and appropriate corrective actions.

(5) "Contiguous" means being in actual contact along a boundary or at a point.

(6) "CQA/CQC Report" means a report that summarizes all inspection, testing, data collection, data analysis and any corrective actions completed as part of CQA or CQC for a project.

(7) "Dairy facility" means the production area and the land application area, where the discharge and associated activities will or do take place.

(8) "Dairy rule" means 20.6.6 NMAC, as amended.

(9) "Date of postal notice" means the date when the United States postal service (USPS) first makes notice to the applicant or permittee of its possession of certified mail addressed to the applicant or permittee.

(10) "Discharge volume" means the measured daily volume of wastewater actually discharged within the production area. This definition does not include the volume of wastewater discharged to the land application area.

(11) "EPA" means the United States environmental protection agency.

(12) "Existing dairy facility" means a dairy facility that is currently discharging, or has previously discharged and has not been issued a notice from the department verifying that closure and post-closure monitoring activities have been completed.

(13) "Existing impoundment" means an impoundment that is currently receiving or has ever received wastewater or collected stormwater and that has not been closed pursuant to a discharge permit.

(14) "Expiration" means the date upon which the term of a discharge permit ends.

(15) "Field" means a unit of irrigated cropland within the land application area cultivated in the same manner to grow a specific crop for the uptake and removal of nutrients.

(16) "Flow meter" means a device used to measure the volume of water, wastewater or stormwater that passes a particular reference section in a unit of time.

(17) "Freeboard" means the vertical distance between the elevation at the lowest point of the top inside edge of the impoundment and the design high water elevation of the water level in the impoundment.

(18) "Impoundment" means any structure designed and used for storage or disposal by evaporation of wastewater, stormwater, or a combination of both wastewater and stormwater~~, or used for solids settling~~. A multiple-cell impoundment system having at least one shared berm or barrier whose smallest cells have a cumulative constructed capacity of 10 percent or less of the constructed capacity of the largest cell shall be considered a single impoundment for the purposes of the dairy rule. A wastewater or stormwater transfer sump or a solids settling separator is not an impoundment.

(19) "Land application area" means irrigated and cultivated fields collectively authorized by a discharge permit to receive wastewater or stormwater applications as a source of nutrients managed for crop production.

(20) "Land application data sheet" means a form used to report all nitrogen inputs applied to each field within the land application area, including the cropping status of the field at the time of application (i.e., fallow, corn, wheat, etc.).

(21) "Manure" means an agricultural waste composed of excreta of animals, and residual bedding materials, waste feed or other materials that have contacted excreta from such animals.

(22) "Maximum daily discharge volume" means the total daily volume of wastewater (expressed in gallons per day) authorized for discharge by a discharge permit. This definition does not include the volume of wastewater discharged to the land application area.

(23) "New dairy facility" means a dairy facility that has never before discharged wastewater.

(24) "Permittee" means a person who is issued or receives by transfer a discharge permit for a dairy facility or, in the absence of a discharge permit, a person who makes or controls a discharge at a dairy facility.

(25) "Production area" means that part of the animal feeding operation that includes the following: the animal confinement areas; the manure, residual solids and compost storage areas; the raw materials storage areas; and the wastewater and stormwater containment areas. The animal confinement areas include but are not limited to open lots, housed lots, feedlots, confinement barns, stall barns, free stall barns, milkrooms, milk centers, cowyards, barnyards, hospital pens and barns, and animal walkways. The manure, residual solids and compost storage areas include, but are not limited to, storage sheds, stockpiles, static piles, and composting piles. The raw materials storage areas include, but are not limited, to feed silos, silage storage areas, feed storage barns, and liquid feed tanks. The wastewater and stormwater containment areas include, but are not limited to, settling separators,

impoundments, sumps, runoff drainage channels, and areas within berms and diversions which prohibit uncontaminated stormwater from coming into contact with contaminants.

(26) "Spillway" means a structure used for controlled releases from an impoundment designed to receive stormwater, in a manner that protects the structural integrity of the impoundment.

(27) "Stormwater" means direct precipitation and runoff that comes into contact with water contaminants within the production area of a dairy facility.

(28) "Unauthorized discharge" means a release of wastewater, stormwater or other substances containing water contaminants not approved by a discharge permit.

(29) "Wastewater" means water, that has come into contact with water contaminants as a result of being directly or indirectly used in the operations of a dairy facility including, but not limited to, the following: washing, cleaning, or flushing barns or other roof-covered production areas; washing of animals; spray-cooling of animals (except in open lots); and cooling or cleaning of feed mills and equipment. Wastewater does not include overflow from the drinking water system or stormwater unless overflow or stormwater that is collected is comingled with wastewater, or it comes into contact with water contaminants as a result of being directly or indirectly used in dairy facility operations.

[20.6.6.7 NMAC - N, 01/31/2011]

20.6.6.8 REQUIREMENTS FOR DISCHARGING FROM DAIRY FACILITIES:

A. No person shall discharge from a dairy facility without a discharge permit. A person intending to discharge from a dairy facility shall submit an application for a discharge permit pursuant to 20.6.6.10 NMAC and remit fees pursuant to 20.6.6.9 NMAC.

B. Permittees, owners of record of a dairy facility and holders of an expired permit are responsible for complying with the dairy rule.

C. Unless otherwise noted in 20.6.6 NMAC, the requirements of 20.6.2.3101 through 20.6.2.3114 NMAC apply to a dairy facility.

D. Complying with the requirements of 20.6.6 NMAC does not relieve a dairy facility's owner, operator or permittee from complying with the requirements of other applicable local, state and federal regulations or laws.

[20.6.6.8 NMAC - N, 01/31/2011]

20.6.6.9 FEES: In lieu of paying fees under the requirements of 20.6.2.3114 NMAC, an applicant or permittee shall pay fees to the department pursuant to this section.

A. An applicant for a discharge permit or a discharge permit renewal for a dairy facility shall remit with the application to the department a filing fee in the amount of one hundred dollars ($100) and one-half of the applicable permit fee from table 1 of 20.6.2.3114 NMAC. The filing fee and the permit fee payment remitted with the application are not refundable and may not be applied toward future discharge permit applications. If the department issues a discharge permit, the permittee shall remit a permit fee payment equal to one-tenth of the applicable permit fee from table 1 of 20.6.2.3114 NMAC on the first occurrence of August 1 after the effective date of the discharge permit, and annually thereafter until the expiration or termination of the discharge permit.

B. An applicant for a discharge permit modification separate from a discharge permit renewal shall remit a filing fee of one hundred dollars ($100) and a permit modification fee with the application. The permit modification fee shall be equal to one-half of the applicable permit fee from table 1 of 20.6.2.3114 NMAC. The filing fee and the permit modification fee payment remitted with the application are not refundable and may not be applied toward future discharge permit applications. Payment of the permit modification fee shall not relieve a permittee from remitting the permit fee payments required by Subsection A of this section. If the discharge permit modification is required by the secretary outside the context of an enforcement action, a permit modification fee is not required.

C. A permittee requesting temporary permission to discharge pursuant to Subsection B of 20.6.2.3106 NMAC shall pay the fee specified in 20.6.2.3114 NMAC.

[20.6.6.9 NMAC - N, 01/31/2011]

20.6.6.10 GENERAL APPLICATION REQUIREMENTS FOR ALL DAIRY FACILITIES: This section specifies the general requirements for discharge permit applications for all types of dairy facilities.

A. In lieu of Subsection F of 20.6.2.3106 NMAC, a permittee shall submit an application for renewal of a discharge permit for a dairy facility to the department at least one year before the discharge permit expiration date, unless closure of the facility is approved by the department before that date. At least 180 days before the due

date for an application for renewal, a permittee may request a pre-application meeting with the department. The pre-application meeting shall be held in Santa Fe, unless otherwise agreed by the department. Requests shall be made in writing and submitted to the department by certified mail. If a permittee requests a pre-application meeting, the department shall contact the permittee to discuss and schedule a date for the pre-application meeting. The department shall respond to the permittee's request in writing by certified mail to confirm the pre-application meeting date. The pre-application meeting shall occur no less than 60 days before the application due date. If the permittee or his representative fails to participate in the scheduled pre-application meeting, the permittee forfeits the opportunity for a pre-application meeting.

B. For a dairy facility that has not been constructed or operated, a permittee shall submit to the department at least one year before the discharge permit expiration date an application for renewal pursuant to Subsection A of this section or a statement certifying that the dairy facility has not been and will not be constructed or operated and that no discharges have occurred or will occur. Upon the department's verification of the certification, the department shall terminate the discharge permit, if necessary, and retire the discharge permit number from use.

C. Instead of the information required by Subsection C of 20.6.2.3106 NMAC, an applicant:

(1) for a new discharge permit, shall provide the information and supporting technical documentation pursuant to this section and 20.6.6.11 NMAC;

(2) for a renewed or modified discharge permit, shall provide the information and supporting technical documentation pursuant to this section and 20.6.6.12 NMAC; or

(3) for a renewed discharge permit for closure, shall provide the information and supporting technical documentation pursuant to this section and 20.6.6.13 NMAC.

D. The department shall create a discharge permit application form for dairy facilities applying for a new discharge permit, for dairy facilities applying for a renewed, modified or renewed and modified discharge permit, and for dairy facilities applying for a discharge permit for closure to collect the information required by this section. The information requested on the form(s) shall be limited to the information required by this section. An applicant shall use the department's form to provide the information required by this section. An application shall consist of the appropriate form and required supporting documentation, regardless of previous submissions. The applicant shall attest to the truth of the information and supporting documentation in the application, and sign the form. The form shall be signed in the presence of a notary and notarized. The applicant shall provide to the department a hard copy (paper format) of the original signed and notarized completed application form and all supporting documentation. The applicant shall also provide an electronic copy of the original signed and notarized application and all supporting documentation in portable document format (PDF) on a compact disc (CD) or digital versatile disc (DVD).

E. If an applicant filing an application for a new discharge permit does not certify that the dairy facility complies with the setback requirements of 20.6.6.16 NMAC, as required by Subsection D of 20.6.6.11 NMAC, the department shall reject the application. The department shall provide notice of the rejection to the applicant by certified mail.

F. Within 60 days of the department's receipt of proof of notice pursuant to Subsection D of 20.6.2.3108 NMAC, the department shall review the application for technical completeness. If proof of notice is not submitted to the department pursuant to Subsection D of 20.6.2.3108 NMAC, the department shall notify the applicant by certified mail of the violation and provide 15 days from the date of postal notice for the applicant to submit the proof pursuant to Subsection D of 20.6.2.3108 NMAC. If proof of notice is not submitted to the department following the issuance of a notice of violation, the department may deny the application.

G. For an application to be deemed technically complete, an application shall include the information required by Subsection C of this section. Submittals or supporting documentation that require the certification of persons specified in the dairy rule are deemed technically complete if the documentation is prepared in accordance with the dairy rule and is certified by persons specified in the dairy rule. If the department determines that an application is not technically complete, the department shall provide notice of technical deficiency to the applicant by certified mail within 60 days of receipt of the applicant's proof of notice. The applicant shall have 60 days from the date of postal notice of the technical deficiency correspondence to provide the information required by this section.

(1) If an application is technically complete, the department shall make available a proposed approval of a discharge permit (i.e., draft discharge permit) or denial of a discharge permit application, pursuant to Subsection H of 20.6.2.3108 NMAC.

(2) If an applicant filing an application for a new discharge permit does not provide all information required by this section to the department within 60 days of the date of postal notice of the technical deficiency

correspondence, the department shall deny the application. The department shall provide notice of denial to the applicant by certified mail.

(3) If an applicant for a renewed or modified discharge permit does not provide all information required by this section to the department within 60 days of the date of postal notice of the technical deficiency correspondence, the department may deny the application or may propose a discharge permit for approval consistent with the requirements of the dairy rule. If the department denies the application, the department shall provide notice of denial to the applicant by certified mail.

H. The department may impose additional conditions on a discharge permit in accordance with Section 74-6-5 NMSA 1978. If the department proposes an additional condition in a discharge permit that is not included in the dairy rule, the department shall include a written explanation of the reason for the additional condition with the copy of the proposed approval sent to the applicant pursuant to Subsection H of 20.6.2.3108 NMAC. Written comments about the additional condition may be submitted to the department during the 30-day comment period provided by Subsection K of 20.6.2.3108 NMAC. A hearing may be requested about the additional condition as provided by 20.6.6.15 NMAC.

I. The secretary shall approve a discharge permit provided that it poses neither a hazard to public health nor undue risk to property, and:

(1) the requirements of the dairy rule are met;

(2) the provisions of 20.6.2.3109 NMAC are met, with the exception of Subsection C of 20.6.2.3109 NMAC; and

(3) denial of an application for a discharge permit is not required pursuant to Subsection E of 74-6-5 NMSA 1978.

[20.6.6.10 NMAC - N, 01/31/2011]

20.6.6.11 APPLICATION REQUIREMENTS FOR NEW DISCHARGE PERMITS:

A. An application for a new discharge permit shall include the information in this section.

B. Contact information. An application shall include:

(1) applicant's name, title and affiliation with the dairy facility, mailing address, and phone number;

(2) dairy facility manager's or operator's name, title and affiliation with the dairy facility, mailing address and phone number;

(3) application preparer's name, title and affiliation with the dairy facility, mailing address, phone number and signature; and

(4) mailing address and phone number of any consultants authorized to assist the dairy facility with compliance with the Water Quality Act and 20.6.2 and 20.6.6 NMAC.

C. Ownership and real property agreements.

(1) An application shall include the dairy facility owner's name, title, mailing address and phone number.

(a) If more than one person has an ownership interest in the dairy facility or a partnership exists, then the applicant shall list all persons having an ownership interest in the dairy facility, including their names, titles, mailing addresses and phone numbers.

(b) If any corporate entity, including but not limited to a corporation or a limited liability company, holds an ownership interest in the dairy facility, then the applicant shall also list the name(s), as filed with the New Mexico public regulation commission, of the corporate entity, and the corporate entity's registered agent's name and address.

(2) If the applicant is not the owner of record of the real property upon which the dairy facility is or will be situated, or upon which dairy operations and land application will occur, then the applicant shall submit a copy of any lease agreement or other agreement which authorizes the use of the real property for the duration of the term of the requested permit. Lease prices or other price terms may be redacted.

D. Setbacks. The applicant shall certify that the setback requirements of 20.6.6.16 NMAC are met. An application shall include a scaled map of the dairy facility layout demonstrating that the proposed layout of the dairy facility meets the setback requirements of 20.6.6.16 NMAC.

E. Dairy facility information and location. An application shall include:

(1) the dairy facility name, physical address and county; and

(2) the township, range and section for the entire dairy facility, which includes the production area and fields within the land application area.

F. Public notice preparation. An application shall include the name of a newspaper of general circulation in the location of the dairy facility for the future display advertisement publication, the proposed public

location(s) for posting of the 2-foot by 3-foot sign, and the proposed off-site public location for posting of the 8.5-inch by 11-inch flyer, as required by 20.6.2.3108 NMAC.

G. Pre-discharge total dissolved solids concentration in ground water. Pursuant to Paragraph (3) of Subsection C of 20.6.2.3106 NMAC, an application shall include the pre-discharge total dissolved solids concentration from analytical results of ground water obtained from the on-site test boring pursuant to Subsection X of 20.6.6.20 NMAC, if applicable, or from the nearest well within a one-mile radius of the dairy facility. A copy of the laboratory analysis stating the pre-discharge total dissolved solids concentration shall be submitted with the application.

H. Determination of maximum daily discharge volume. An application shall include the following information.

(1) The proposed maximum daily discharge volume and a description of the methods and calculations used to determine that volume.

(2) The identification of all sources of wastewater which may include, but are not limited to, hospital barns, maternity barns, bottle-washing operations and parlor/equipment washdown.

(3) The animal washing method(s) employed and the estimated daily wastewater volume generated by the method(s).

(4) Information regarding other wastewater discharges (i.e., domestic or industrial) at the dairy facility not generated by dairy operations. Permit identification numbers shall be submitted for those discharges that are already permitted.

I. Wastewater quality. An application shall include estimated concentrations of wastewater quality for total dissolved solids, chloride, total sulfur, nitrate as nitrogen, and total Kjeldahl nitrogen.

J. Identification and physical description of the dairy facility. An application shall include the following information.

(1) A scaled map of the entire dairy facility pursuant to Subsection U of 20.6.6.20 NMAC.

(2) The identification of each proposed impoundment, including information about its location, purpose (i.e., to store wastewater or stormwater, or dispose of it by evaporation), liner material and storage or evaporative disposal capacity.

(3) The identification of each field within the proposed land application area, including information about its location, acreage, proposed method of wastewater and stormwater application and proposed method of irrigation water application.

(4) The identification of proposed sumps and mix tanks, including information for each component regarding its location, purpose, construction material, dimensions and capacity.

(5) A description of the proposed method(s) employed to protect each area from stormwater runoff and run-on, and to minimize leachate.

K. Flow metering. An application shall describe a dairy facility's flow metering system pursuant to Subsections J, K, L, M, N and O of 20.6.6.20 NMAC and Subsections G and H of 20.6.6.21 NMAC, including:

(1) the identification of the method(s) (i.e., pumped versus gravity flow) of wastewater discharge, stormwater transfer, and wastewater and stormwater land application;

(2) the proposed flow measurement devices for each flow method; and

(3) the identification of flow meter locations.

L. Depth-to-most-shallow ground water and ground water flow direction. An application shall include the following information.

(1) The depth-to-most-shallow ground water pursuant to Subsection X of 20.6.6.20 NMAC.

(2) The ground water flow direction of the most-shallow ground water beneath the dairy facility based on the most recent regional water level data or published hydrogeologic information. Survey data from nearby monitoring wells and a ground water elevation contour map indicating the direction of ground water flow may be included. The sources of all information used to determine ground water flow direction shall be provided with the application.

M. Monitoring wells. An application shall include the proposed monitoring well locations pursuant to Subsections A and B of 20.6.6.23 NMAC.

N. Surface soil survey and vadose zone geology. An application shall include:

(1) the most recent regional soil survey map and associated descriptions identifying surface soil type(s); and

(2) if applicable, the lithologic log obtained from the on-site test boring pursuant to Subsection X of 20.6.6.20 NMAC to identify the geological profile of the vadose zone.

O. Location map. An application shall include a location map with topographic surface contours identifying all of the following features located within a one-mile radius of the dairy facility:

(1) watercourses, lakebeds, sinkholes, playa lakes and springs (springs used to provide water for human consumption shall be so denoted);

(2) wells supplying water for a public water system and private domestic water wells;

(3) irrigation supply wells; and

(4) ditch irrigations systems, acequias, irrigation canals and drains.

P. Flood zone map. An application shall include the most recent 100-year flood zone map developed by the federal emergency management administration, FEMA, documenting flood potential for the dairy facility, and a description of any engineered measures used for flood protection.

Q. Engineering and surveying. Pursuant to 20.6.6.17 NMAC an application shall include:

(1) plans and specifications for impoundments and associated liners;

(2) plans and specifications for a manure solids separator(s); and

(3) a grading and drainage report and plan.

R. Land application area. For a dairy facility with a land application area, an application shall include the following information.

(1) A nutrient management plan (NMP) pursuant to Subsections I and J of 20.6.6.21 NMAC.

(2) A written description of the wastewater sampling location(s) pursuant to Subsection C of 20.6.6.25 NMAC.

[20.6.6.11 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.12 APPLICATION REQUIREMENTS FOR DISCHARGE PERMIT RENEWAL OR MODIFICATION:

A. An application for a renewed or modified discharge permit shall include the information in this section.

B. Contact information. An application shall include the:

(1) applicant's name, title and affiliation with the dairy facility, mailing address, and phone number;

(2) dairy facility manager's or operator's name, title and affiliation with the dairy facility, mailing address and phone number;

(3) application preparer's name, title and affiliation with the dairy facility, mailing address, phone number and signature; and

(4) mailing address and phone number of any consultants authorized to assist the dairy facility with compliance with the Water Quality Act and 20.6.2 and 20.6.6 NMAC.

C. Ownership and real property agreements.

(1) An application shall include the dairy facility owner's name, title, mailing address and phone number.

(a) If more than one person has an ownership interest in the dairy facility or a partnership exists, then the applicant shall list all persons having an ownership interest in the dairy facility, including their names, titles, mailing addresses and phone numbers.

(b) If any corporate entity, including but not limited to a corporation or a limited liability company, holds an ownership interest in the dairy facility, then the applicant shall also list the name(s), as filed with the New Mexico public regulation commission, of the corporate entity and the corporate entity's registered agent's name and address.

(2) If the applicant is not the owner of record of the real property upon which the dairy facility is or will be situated, or upon which dairy operations and land application will occur, then the applicant shall submit a copy of any lease agreement or other agreement which authorizes the use of the real property for the duration of the term of the requested permit. Lease prices or other price terms may be redacted.

D. Dairy facility information and location. An application shall include:

(1) the dairy facility name, physical address and county;

(2) the discharge permit identification number as designated on the most recent discharge permit for the dairy facility;

(3) the township, range and section for the entire dairy facility, which includes the production area and fields within the land application area; and

(4) the date of initial discharge at the dairy facility.

E. Public notice preparation.

(1) An application for a modified or renewed and modified discharge permit shall include the name of a newspaper of general circulation in the location of the dairy facility for the future display advertisement publication, the proposed public location(s) for posting of the 2-foot by 3-foot sign, and the proposed off-site public location for posting of the 8.5-inch by 11-inch flyer, as required by Subsection B of 20.6.2.3108 NMAC.

(2) An application for a renewed discharge permit without modification shall include the name of a newspaper of general circulation in the location of the dairy facility for the future display advertisement publication as required by Subsection C of 20.6.2.3108 NMAC.

F. Pre-discharge total dissolved solids concentration in ground water. Pursuant to Paragraph (3) of Subsection C of 20.6.2.3106 NMAC, an application shall include the pre-discharge total dissolved solids concentration in ground water, sample source (e.g., upgradient monitoring well, on-site supply well, nearest well within a one-mile radius of the dairy facility) and a copy of the laboratory analysis.

G. Determination of maximum daily discharge volume. An application shall include the following information.

(1) The proposed maximum daily discharge volume and a description of the methods and calculations used to determine that volume.

(2) The identification of all sources of wastewater which may include, but are not limited to, hospital barns, maternity barns, bottle-washing operations and parlor/equipment washdown.

(3) The animal washing method(s) employed and the estimated daily wastewater volume generated by the method(s).

(4) Information regarding other wastewater discharges (i.e., domestic or industrial) at the dairy facility not generated by dairy operations. Permit identification numbers shall be submitted for those discharges that are already permitted.

H. Identification and physical description of dairy facility. An application shall include the following information.

(1) A scaled map of the entire dairy facility pursuant to Subsection U of 20.6.6.20 NMAC.

(2) The identification of each proposed, existing and closed impoundment, including information for each impoundment regarding its location, purpose (i.e., to store wastewater or stormwater, or dispose of it by evaporation), date of original construction, past and existing liner material, date of current liner installation and storage or evaporative disposal capacity.

(3) The identification of each existing, proposed, and previously used field within the land application area, including information for each field about its location, date of initial application of wastewater or stormwater, acreage, status with regard to having received wastewater or stormwater (i.e. never, inactive, active), current method of backflow prevention employed, current method of wastewater and stormwater application and current method of irrigation water application.

(4) The identification of sumps and mix tanks, including information for each component regarding its location, purpose, date of original construction, construction material, dimensions and capacity.

(5) The settled solids thickness measurements for each existing wastewater and combination impoundment pursuant to Subsection D of 20.6.6.20 NMAC.

(6) A description of proposed and existing method(s) of solids separation pursuant to Paragraph (5) of Subsection C of 20.6.6.17 NMAC and Subsection F of 20.6.6.20 NMAC.

(7) A description of the method(s) employed to protect each manure, silage and compost storage area from stormwater runoff and run-on, and to minimize leachate.

I. Flow metering. An application shall describe a dairy facility's flow metering system pursuant to Subsections J, K, L, M, N and O of 20.6.6.20 NMAC and Subsections G and H of 20.6.6.21 NMAC including:

(1) the identification of the method(s) (i.e. pumped versus gravity flow) of wastewater discharge, stormwater transfer and wastewater and stormwater land application;

(2) a description of the existing and proposed flow measurement devices for each flow method; and

(3) the identification of flow meter locations.

J. Depth-to-most-shallow ground water and ground water flow direction.

(1) An application for renewal or modification shall provide the depth-to-most-shallow ground water and indicate ground water flow direction beneath the dairy facility on a ground water elevation contour map. The ground water elevation contour map shall be developed based upon the most recent ground water levels obtained with a water level measuring device and survey data from on-site monitoring wells obtained from a survey, pursuant to 20.6.6.23 NMAC.

(2) If a dairy facility does not have a monitoring well intersecting most-shallow ground water, an applicant shall provide the following information.

(a) The depth-to-most-shallow ground water pursuant to Subsection X of 20.6.6.20 NMAC.

(b) The ground water flow direction of the most-shallow ground water beneath the dairy facility based upon the most recent regional water level data or published hydrogeologic information. Survey data from nearby monitoring wells and a ground water elevation contour map indicating the direction of ground water flow may be included. The sources of all information used to determine ground water flow direction shall be provided with the application.

K. Monitoring wells. An application shall include:

(1) the construction logs for all existing, on-site monitoring wells, which indicate the date of installation and well driller; and

(2) the identification of monitoring well locations, proposed and existing, pursuant to Subsections A and B of 20.6.6.23 NMAC.

L. Surface soil survey and vadose zone geology. An application shall include:

(1) the most recent regional soil survey map and associated descriptions identifying surface soil type(s);

(2) the lithologic logs from all existing, on-site monitoring wells, if available; and

(3) if applicable, where a dairy facility does not have a monitoring well intersecting most-shallow ground water, the application shall include the lithologic log obtained from the on-site test boring pursuant to Subsection X of 20.6.6.20 NMAC to identify the geological profile of the vadose zone.

M. Location map. An application shall include a location map with topographic surface contours identifying all of the following features located within a one-mile radius of the dairy facility:

(1) watercourses, lakebeds, sinkholes, playa lakes and springs (springs used to provide water for human consumption shall be so denoted);

(2) wells supplying water for a public water system and private domestic water wells;

(3) irrigation supply wells; and

(4) ditch irrigations systems, acequias, irrigation canals and drains.

N. Flood zone map. An application shall include the most recent 100-year flood zone map developed by the federal emergency management administration, FEMA, documenting flood potential for the dairy facility, and a description of any engineered measures used for flood protection.

O. Engineering and surveying. An application shall include the following information.

(1) Plans and specifications for new or improved structures and associated liners proposed by the applicant pursuant to 20.6.6.17 NMAC.

(2) Record drawings and final specifications for existing structures and associated liners. For existing impoundments where record drawings and final specifications do not exist, survey data and capacity calculations shall be submitted pursuant to Subsection C of 20.6.6.20 NMAC.

P. Land application area. For a dairy facility with a land application area, an application shall include the following information.

(1) Documentation confirming the existence of infrastructure necessary to distribute and apply wastewater and stormwater to the land application area pursuant to Subsection E of 20.6.6.21 NMAC.

(2) A nutrient management plan (NMP) pursuant to Subsections I and J of 20.6.6.21 NMAC.

(3) A written description of the wastewater sampling location(s) pursuant to Subsection C of 20.6.6.25 NMAC.

[20.6.6.12 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.13 APPLICATION REQUIREMENTS FOR A DISCHARGE PERMIT FOR CLOSURE: An application for a discharge permit for closure shall include the information required by Subsections B, C, D, E, F, J, K, L, M and N of 20.6.6.12 NMAC and Paragraphs (1), (2), (3) and (4) of Subsection H of 20.6.6.12 NMAC. For dairy facilities with or previously having a land application area, the application shall also include Paragraph (1) of Subsection P of 20.6.6.12 NMAC, specifically pertaining to the past method(s) of wastewater discharge and stormwater application to the land application area.

[20.6.6.13 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.14 ADDITIONAL PUBLIC NOTICE REQUIREMENTS FOR APPLICATIONS FOR NEW DISCHARGE PERMITS:

A. The requirements of this section shall apply to dairy facilities whose application for a new discharge permit is received by the department after the effective date of the dairy rule.

B. Instead of the requirement for public notice specified in Paragraph (2) of Subsection B of 20.6.2.3108 NMAC, the applicant shall provide written notice of the discharge and a copy of the map referenced in Subsection O of 20.6.6.11 NMAC by mail to owners of record of all properties within a one-mile distance from the boundary of the property where the discharge site is located. If there are no properties other than properties owned by the discharger within a one-mile distance of the boundary of the property where the dairy facility is located, the applicant shall provide notice to owners of record of the next nearest properties not owned by the discharger.

C. Proof of notice required by Subsection D of 20.6.2.3108 NMAC shall include an affidavit of mailing(s) and a list of property owner(s) notified pursuant to Subsection B of this section.

[20.6.6.14 NMAC - N, 01/31/2011]

20.6.6.15 PROCEDURES FOR REQUESTING PUBLIC HEARINGS ON PERMITTING ACTIONS FOR DAIRY FACILITIES:

A. Requests for a hearing from any person, including the applicant for a discharge permit, on the proposed approval of a discharge permit (i.e., a draft discharge permit) or denial of a discharge permit application shall be postmarked on or before the end of the comment period, and submitted to the department pursuant to Subsection K of 20.6.2.3108 NMAC. The secretary shall deny requests that do not meet the requirements of Subsection K of 20.6.2.3108 NMAC and this section. The secretary shall provide notice of hearing denial by certified mail to the person(s) requesting a hearing.

B. The secretary shall deny a request for a hearing on the proposed approval of a discharge permit for a dairy facility (i.e., a draft discharge permit) disputing conditions contained in the dairy rule. Requests for a hearing on the proposed approval of a discharge permit for a dairy facility shall identify the specific additional discharge permit conditions being disputed or requested and the reasons such additional discharge permit conditions are being disputed or requested. Hearings held upon the secretary's approval shall be limited in scope to the disputed or requested additional discharge permit conditions identified in the request for hearing. The secretary shall deny requests for a hearing that fail to identify disputed or requested additional discharge permit conditions and the reasons why the additional discharge permit conditions are disputed or requested. The secretary shall provide notice of hearing denial by certified mail to the person(s) requesting a hearing.

[20.6.6.15 NMAC - N, 01/31/2011]

20.6.6.16 SETBACK REQUIREMENTS FOR DAIRY FACILITIES APPLYING FOR NEW DISCHARGE PERMITS:

A. The setback requirements of this section apply to a dairy facility whose application for a new discharge permit is received by the department after the effective date of the dairy rule.

B. The setback requirements shall be measured as horizontal map distances.

C. The required setback distances shall be met as certified by the applicant as of the receipt date of the application.

D. If the setback requirements apply to a dairy facility, a permittee shall not propose or construct structures that violate the setback as determined as of the receipt date of the application for a new discharge permit by the department.

E. Production area setback requirements.

(1) The production area, excluding feed storage silos, feed storage barns and liquid feed tanks, shall be located:

(a) greater than 200 feet from the 100-year flood zone of any watercourse, or from the ordinary high-water mark of any watercourse for which no 100-year flood zone has been established (this setback distance shall not apply to ditch irrigations systems, acequias, irrigation canals and drains);

(b) greater than 200 feet (measured from the ordinary high-water mark) from a lakebed, sinkhole or playa lake;

(c) greater than 200 feet from any spring identified on a U.S. geological survey (USGS) topographic map and not identified as a supply of water for human consumption;

(d) greater than 350 feet from a private domestic water well or spring that supplies water for human consumption; and

(e) greater than 1000 feet from any water well or spring that supplies water for a public water system as defined by 20.7.10 NMAC, unless a wellhead protection program established by the public water system requires a greater distance.

(2) The requirements of Subparagraph (d) of Paragraph (1) of this subsection shall not apply to wells or springs that supply water to the dairy facility for human consumption and are located on the dairy facility.

(3) Setback distances for impoundments shall be measured from the top inside edge of the impoundment; distances for all other features shall be measured from the outer extent of the feature.

F. Land application area setback requirements.

(1) Any field within a land application area shall be located:

(a) greater than 100 feet from the 100-year flood zone of any watercourse, or from the ordinary high-water mark of any watercourse for which no 100-year flood zone has been established (this setback distance shall not apply to ditch irrigations systems, acequias, irrigation canals and drains);

(b) greater than 100 feet (measured from the ordinary high-water mark) from any lakebed, sinkhole or playa lake;

(c) greater than 100 feet from a private domestic water well or spring that supplies water for human consumption; and

(d) greater than 200 feet from any water well or spring that supplies water for a public water system as defined by 20.7.10 NMAC, unless a wellhead protection program established by the public water system requires a greater distance.

(2) The requirements of Subparagraph (c) of Paragraph (1) of this subsection shall not apply to wells or springs that supply water for human consumption to the dairy facility and are located on the dairy facility.

(3) Setback distances for fields shall be measured from the outer edge of the field.

[20.6.6.16 NMAC - N, 01/31/2011]

20.6.6.17 ENGINEERING AND SURVEYING REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Practice of engineering. All plans and specifications, supporting design calculations, record drawings, final specifications, final capacity calculations, grading and drainage reports and plans, and other work products requiring the practice of engineering shall bear the seal and signature of a licensed New Mexico professional engineer pursuant to the New Mexico Engineering and Surveying Practice Act, NMSA 1978, Sections 61-23-1 through 61-23-32, and the rules promulgated under that authority.

B. Practice of surveying. All surveys of wastewater, stormwater, and combination wastewater/stormwater impoundments, monitoring well locations and casing elevations, and other work products requiring the practice of surveying shall bear the seal and signature of a licensed New Mexico professional surveyor pursuant to the New Mexico Engineering and Surveying Practice, NMSA 1978, Sections 61-23-1 through 61-23-32, and the rules promulgated under that authority.

C. Engineering plans and specifications requirements.

(1) **Impoundment plans and specifications.** An applicant or permittee proposing or required to construct a new impoundment or to improve an existing impoundment, including relining of an existing impoundment, shall submit detailed and complete construction plans and specifications and supporting design calculations developed pursuant to this section and 20.6.6.20 NMAC. The applicant or permittee proposing or required to construct an impoundment shall document compliance with the requirements of the dam safety bureau of the state engineer pursuant to Section 72-5-32 NMSA 1978, and rules promulgated under that authority, unless exempt by law from such requirements. The construction plans and specifications for an improvement(s) to an existing impoundment shall address the management of wastewater or stormwater during preparation and construction of the improvements.

(a) Construction plans and specifications proposed by the applicant or permittee shall be submitted to the department with the application for a new, renewed or modified discharge permit.

(b) Construction plans and specifications not proposed by the applicant or permittee but required to achieve compliance with the dairy rule shall be submitted to the department within 90 days of the effective date of the discharge permit.

(2) **Impoundment CQA/CQC.** Construction of a new impoundment or improvement to an existing impoundment shall be done in accordance with a construction quality assurance/construction quality control (CQA/CQC) plan. A CQA/CQC plan shall be included as part of the design plans and specifications. The CQA/CQC plan shall outline the observations and tests to be used to ensure that construction of the impoundment meets, at a minimum, all design criteria, plans and specifications. All testing and evaluation reports shall be signed and sealed by a licensed New Mexico professional engineer experienced in lagoon construction and liner installation. The CQA/CQC plan shall include, at a minimum, the following elements.

(a) The identity of persons responsible for overseeing the CQA/CQC program. The person responsible for overseeing with the CQA/CQC plan shall be a licensed New Mexico professional engineer experienced in lagoon construction and liner installation.

(b) A discussion of how inspections will be performed.

(c) The location, availability, applicability and calibration of testing equipment and facilities, both field and laboratory.

(d) The procedures for observing and testing the liner material.

(e) The procedures for reviewing inspection test results and laboratory and field sampling test results.

(f) The actions to be taken to replace or repair liner material should deficiencies be identified.

(g) The procedures for seaming synthetic liners.

(h) The reporting procedures for all inspections and test data.

(3) **Impoundment improvement - wastewater/stormwater management.** An applicant or permittee proposing or required to improve an existing impoundment, including relining of an existing impoundment, shall submit a plan for managing wastewater or stormwater during the improvement as part of the design plans and specifications. The plan for wastewater or stormwater management shall include the following minimum elements and be implemented upon department approval.

(a) A description of how on-going wastewater discharges or stormwater collection will be handled and disposed of during improvement to the impoundment.

(b) A description of how solids and wastewater or stormwater within the impoundment will be removed and disposed of prior to beginning improvement to the impoundment.

(c) A schedule for implementation through completion of the project.

(d) If the plan proposes temporary use of a location for the discharge of wastewater not authorized by the effective discharge permit, the applicant or permittee shall request temporary permission to discharge from the department.

(4) **Manure solids separation plans and specifications - new wastewater system.** An applicant or permittee proposing or required to construct a new manure solids separator as a component of a newly designed wastewater storage or disposal system shall submit construction plans and specifications and supporting design calculations that include the separator, pursuant to this section.

(a) Construction plans and specifications proposed by the applicant or permittee shall be submitted to the department with the application for a new, renewed or modified discharge permit.

(b) Construction plans and specifications not proposed by the applicant or permittee but required to achieve compliance with the dairy rule shall be submitted to the department within 90 days of the effective date of the discharge permit.

(5) **Manure solids separation plans and specifications - existing wastewater system.** An applicant or permittee proposing or required to construct a new manure solids separator as a component of an existing wastewater storage or disposal system shall submit a scaled design schematic and supporting documentation, including design calculations. The separator shall be designed to accommodate, at a minimum, the maximum daily discharge volume authorized by the discharge permit, and the volume of manure solids associated with the wastewater discharge. Components of the separator that collect, contain or store manure solids prior to removal or land application shall be designed with an impervious material(s) to minimize generation and infiltration of leachate.

~~(a)~~ A scaled design schematic and supporting documentation for a proposed separator shall be submitted to the department with the application for a new, renewed or modified discharge permit.

~~(b) A scaled design schematic and supporting documentation for a separator not proposed by the applicant or permittee but required to achieve compliance with the dairy rule shall be submitted to the department within 90 days of the effective date of the discharge permit.~~

(6) **Grading and drainage report and plan.** An applicant shall submit with the application for a new discharge permit, a grading and drainage report and a grading and drainage plan, including supplemental information associated with the plan. The submittal shall include, at a minimum, the following information.

(a) A scaled map showing:

(i) the dairy facility and the property boundaries of the dairy facility;

(ii) all existing and proposed structures at the dairy facility, with the associated finished floor elevations;

(iii) existing and proposed ground surface contours at two foot vertical intervals; and

(iv) all existing and proposed stormwater management structures at the dairy facility including construction materials, size, type, slope, capacity and inlet and invert elevation of the structures, as applicable.

(b) A copy of the relevant federal emergency management administration, FEMA, flood insurance rate map (FIRM) or flood boundary and floodway map with the dairy facility clearly identified along with all flood zones.

(c) A description of existing drainage conditions at the dairy facility.

(d) A description of the proposed post-development drainage conditions.

(e) Supplemental information supporting the grading and drainage plan shall be submitted to the department with the plan and shall include, at a minimum, the following information:

(i) all hydrologic and hydraulic calculations for design storm events used;

(ii) hydraulic calculations demonstrating capacity or adequacy of existing and proposed stormwater impoundments;

(iii) hydraulic calculations demonstrating capacity of existing and proposed conveyance channels to contain and transport runoff to the stormwater impoundment(s); and

(iv) a description of computer software, documents, circulars, manuals, etc. used to develop the hydrologic and hydraulic calculations.

(7) **Flow metering plans [~~and specifications~~].** An applicant or permittee proposing or required to install a flow meter(s) shall submit documentation to support the selection of the proposed device as appropriate for the expected flow rate along with a description of the location and information on the installation or construction of each device.

(a) Such information proposed by the applicant or permittee shall be submitted to the department with the application for a new, renewed or modified discharge permit.

(b) Such information not proposed by the applicant or permittee but required to achieve compliance with the dairy rule shall be submitted to the department within 90 days of the effective date of the discharge permit.

D. Engineering design requirements.

(1) **Impoundment capacity requirements.** Impoundments designed to store wastewater prior to discharging to a land application area or to dispose of wastewater by evaporation shall meet the capacity requirements specified in the dairy rule. The dairy rule does not specify capacity requirements for the containment of stormwater. However, the dairy rule does not exempt a dairy facility from other applicable local, state and federal regulations or laws, including the EPA regulatory requirements for concentrated animal feeding operations pursuant to 40 Code of Federal Regulations, Parts 122 and 412, as amended.

(2) **Impoundment capacities - wastewater or wastewater/stormwater combination.**

(a) Capacity requirements for dairy facilities discharging wastewater to a land application area.

(i) The wastewater impoundments intended to store wastewater prior to discharging to a land application area shall be designed to contain the maximum daily discharge volume authorized by the discharge permit for a minimum period of ~~60~~21 days to accommodate periods when land application is not feasible, while preserving two feet of freeboard. This capacity requirement may be satisfied by a single wastewater impoundment or by the collective capacity of multiple impoundments intended to store wastewater.

(ii) The combination wastewater/stormwater impoundments intended to contain both wastewater and stormwater runoff for storage prior to discharging to a land application area shall be designed to contain the sum of the maximum daily discharge volume authorized by the discharge permit for a minimum period of ~~60~~21 days to accommodate periods when land application is not feasible and the additional volume intended for the containment of stormwater runoff and direct precipitation, while preserving two feet of freeboard. This capacity requirement may be satisfied by a single combination wastewater/stormwater impoundment or by the collective capacity of multiple impoundments intended to store wastewater or wastewater/stormwater.

(b) Capacity requirements for dairy facilities discharging to an evaporative wastewater or combination wastewater/stormwater disposal system.

(i) The wastewater impoundments intended to dispose of wastewater by evaporation shall be designed to contain the maximum daily discharge volume authorized by the discharge permit for disposal by evaporation, while preserving two feet of freeboard. This capacity requirement may be satisfied by a single wastewater impoundment or by the collective capacity of multiple impoundments intended to dispose of wastewater by evaporation.

(ii) The combination wastewater/stormwater impoundments intended to dispose of both wastewater and stormwater runoff by evaporation shall be designed for disposal by evaporation, the sum of the maximum daily discharge volume authorized by the discharge permit and the additional volume intended for the containment of stormwater runoff and direct precipitation while preserving two feet of freeboard. This capacity

requirement may be satisfied by a single combination wastewater/stormwater impoundment or by the collective capacity of multiple impoundments intended to dispose of wastewater or wastewater/stormwater by evaporation.

(c) An impoundment designed and used for solids settling shall not be used to satisfy the impoundment capacity requirements of this subsection.

(d) Notwithstanding Subparagraphs (a) and (b) of this paragraph, a wastewater impoundment or system of wastewater impoundments existing as of the effective date of the dairy rule may continue to be operated based upon the design capacity required under the applicable discharge permit as last issued or amended before the effective date of the dairy rule.

(3) **Stormwater conveyance channels.** Stormwater conveyance channels shall be designed in accordance with the grading and drainage report and plan required by this section.

(4) **Impoundment design and construction - general.** Impoundments required to be ~~synthetically~~ lined shall meet the following design and construction requirements.

(a) The inside slopes of an impoundment shall be a maximum of three (horizontal) to one (vertical), and a minimum of four (horizontal) to one (vertical).

(b) The outside slopes of an impoundment shall be a maximum of three (horizontal) to one (vertical).

(c) The sub-grade of an impoundment shall be compacted to a minimum of 90 percent of standard proctor density. If the existing material is unsuitable for compaction, a minimum depth of 18 inches of suitable material shall be used as sub-grade.

(d) The sub-grade of an impoundment shall provide a firm, unyielding surface with no sharp changes or abrupt breaks in grade.

(e) The minimum dike width of an impoundment shall be 12 feet to allow vehicle traffic for maintenance.

(5) **Impoundment design and construction – liner.** An applicant or permittee proposing or required to construct a new or to improve an existing impoundment liner, shall, at a minimum, use a synthetic liner or a two foot thick compacted clay liner with a maximum demonstrated hydraulic conductivity of 1×10^{-7} cm/sec and that is designed, constructed, installed and maintained in accordance with the Guide for Industrial Waste Management, Part IV: Protecting Ground Water, Chapter 7: Section B, Designing and Installing Liners, Technical Considerations for New Surface Impoundments, Landfills and Waste Piles (U.S. Environmental Protection Agency), incorporated herein by this reference. Synthetic impoundment liners shall include a liner component that is at least 60 mil HDPE or other materials having equivalent performance characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance and meet the following additional design and construction requirements.

(a) The liner shall be installed with sufficient slack in the liner material to accommodate shrinkage due to temperature changes. Folds in the liner material shall not be present in the completed liner.

(b) The sub-grade shall be free of sharp rocks, vegetation and stubble to a depth of at least six inches below the liner. The surface in contact with the liner shall be smooth to allow for good contact between liner and sub-grade. The surface shall be dry during liner installation. The liner installer shall provide the owner with a sub-grade acceptance certificate prior to installing the liner indicating acceptance of the earthwork.

(c) The liner shall be anchored in an anchor trench. The trench shall be a minimum of 12 inches wide, 12 inches deep and shall be set back at least 24 inches from the top inside edge of the impoundment.

(d) The liner panels shall be oriented such that all sidewall seams are vertical.

(e) If practicable, decomposing organic materials shall be removed from areas over which a liner will be installed. If such materials remain, a liner vent system shall be installed.

(f) Any opening in the liner through which a pipe or other fixture protrudes shall be sealed in accordance with the liner manufacturer's requirements. Liner penetrations shall be detailed in the construction plans and record drawings.

(g) The liner shall be installed by, or the installation supervised by, an individual that has the necessary training and experience as required by the liner manufacturer.

(h) Manufacturer's installation and field seaming guidelines shall be followed.

(i) Liner seams shall be field tested by the installer and verification of the adequacy of the seams shall be submitted to department along with the record drawings.

(j) Concrete slabs installed on top of a liner for operational purposes shall be completed in accordance with manufacturer and installer recommendations to ensure liner integrity.

(6) **Impoundment liner - wastewater or wastewater/stormwater combination.** An applicant or permittee proposing or required to construct a new or to improve an existing wastewater or combination wastewater/stormwater impoundment, shall, at a minimum, use a ~~single liner that is at least 60 mil HDPE~~ liner that meets the requirements of paragraph (5) of this subsection ~~or other materials having equivalent characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance~~.

(7) **Impoundment liner - stormwater.** Any applicant or permittee required to improve an existing stormwater impoundment pursuant to Subsection A or B of 20.6.6.27 NMAC shall, at a minimum, use a liner that ~~is at least 60 mil HDPE or other material having equivalent characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance~~meets the requirements in paragraph (5) of this subsection.

(8) **Separation between impoundments and ground water.** Impoundments shall not be constructed in a location where the vertical distance between the seasonal high ground water level and the finished grade of the floor of the impoundment is less than or equal to four feet as documented through the most recent ground water data obtained from an on-site test boring(s) or monitoring well(s).

(9) **Impoundment spillways.** Impoundments intended to contain only wastewater shall not be designed with a spillway.

[20.6.6.17 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.18 VARIANCES:

A. A petition for variance from the dairy rule shall be submitted in accordance with Subsection A of 20.6.2.1210 NMAC.

B. In addition to any other criteria offered by the petitioner, the commission may consider as an unreasonable burden upon the petitioner's activity that the requirements of the dairy rule are unnecessary to prevent ground water pollution due to site-specific conditions.

C. In addition to any other information required under Paragraph (7) of that subsection, the petition shall, if applicable, identify any alternative facility design, alternative measuring device, or other variation from the requirements of the dairy rule and describe why variation from the diary rule is warranted based upon site-specific conditions.

D. Notwithstanding Subsection C of 20.6.2.1210 NMAC, a variance from the requirements of the diary rule may be granted for a period of time in excess of five years through the period of the expected useful life of the feature for which a variance is granted.

E. The department may review a variance every five years in conjunction with the discharge permit renewal to determine whether the variance is achieving its designed purpose and whether the variance has caused an exceedance of the standards of 20.6.2.3103 NMAC. If a five year review demonstrates that the variance cannot meet these criteria, the department may request a hearing before the commission to revoke the variance.

[20.6.6.18 NMAC - N, 12/31/2011

20.6.6.19 [RESERVED]

20.6.6.20 OPERATIONAL REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Notice of presence of lactating cows and wastewater discharge. A permittee shall provide written notice to the department of the commencement, cessation, or recommencement of wastewater discharge or the placement, removal, or reintroduction of lactating cows as follows.

(1) **For new dairy facilities.**

(a) **Placement of lactating cows.** A permittee shall provide written notice to the department a minimum of 30 days before the placement of lactating cows at the dairy facility. A permittee shall provide written verification to the department of the actual date of placement of lactating cows within 30 days of placement.

(b) **Commencement of wastewater discharge.** A minimum of 30 days prior to the estimated initial wastewater discharge date a permittee shall provide written notice to the department indicating the date discharge is proposed to commence. A permittee shall provide written verification to the department of the actual date of discharge commencement within 30 days of commencement.

(2) **For existing dairy facilities.**

(a) **Removal or reintroduction of lactating cows.** A permittee shall provide written notice to the department indicating the date of removal of all lactating cows from the dairy facility or the date of

reintroduction of any lactating cows at the dairy facility, if all lactating cows were previously removed, within 30 days of lactating cow removal or reintroduction.

(b) **Cessation of wastewater discharge.** A permittee shall provide written notice to the department indicating the date wastewater discharge ceased at the dairy facility within 30 days of the cessation of discharge.

(c) **Recommencement of wastewater discharge.** Written notification shall be submitted to the department a minimum of 30 days prior to the date wastewater discharge is expected to recommence. A permittee shall provide written notice to the department of the actual date of discharge recommencement within 30 days of recommencement.

B. Authorized use of new and existing impoundments. Impoundments shall meet the liner, design, and construction requirements of Subsection D of 20.6.6.17 NMAC; except an impoundment in existence on the effective date of the dairy rule that does not meet the requirements of Paragraphs (4) through (9) of Subsection D of 20.6.6.17 NMAC may continue to receive wastewater or stormwater provided the requirements of Paragraphs (1) or (2) of this subsection are met. If the requirements of Paragraph (1) and (2) of this subsection are not met, such an impoundment may continue to receive wastewater or stormwater provided the requirements of Subsection B of 20.6.6.27 NMAC are met.

(1) The water contaminant concentration in a ground water sample and in any subsequent ground water sample collected from a monitoring well(s) intended to monitor the impoundment does not exceed any ground water standard of 20.6.2.3103 NMAC.

(2) The water contaminant concentration in a ground water sample and in any subsequent ground water sample collected from a monitoring well(s) intended to monitor the impoundment does not exceed the water contaminant concentration in a ground water sample collected from the upgradient monitoring well, if the water contaminant concentration associated with the upgradient monitoring well exceeds the ground water standard(s) of 20.6.2.3103 NMAC. For the purpose of this subsection, ground water samples obtained from the impoundment monitoring well and the upgradient monitoring well that are used for comparison of water contaminant concentrations shall be collected within two days of each other. In the event ground water quality data for the upgradient monitoring well are not submitted by the permittee, the ground water standard(s) of 20.6.2.3103 NMAC shall be the applicable standard(s) used to assess compliance with the requirements of this subsection.

C. Constructed capacity of existing impoundment - determination. If record drawings are unavailable or have not been completed for an impoundment constructed before the effective date of the dairy rule to indicate the impoundment capacity of each existing wastewater or combination wastewater/stormwater impoundment, the permittee shall complete an up-to-date survey and capacity calculation for each impoundment. The permittee shall submit the survey data and capacity calculations to the department with the application for a renewed or modified discharge permit.

D. Free-liquid capacity of existing impoundment - determination. An applicant or permittee shall measure the thickness of settled solids in each existing wastewater and combination wastewater/stormwater impoundment during the twelve-month period prior to the submission of an application for a renewed or modified discharge permit and in accordance with one of the following procedures.

(1) Measure settled solids when the impoundment contains water using the following method:

(a) The total surface area of the impoundment shall be divided into nine equal sub-areas.

(b) A settled solids measurement device shall be used to obtain one settled solids thickness measurement (to the nearest half-foot) per sub-area. The nine settled solids measurements shall be taken on the same day and the date shall be recorded and submitted to the department with the measurements.

(c) The nine settled solids measurements shall be averaged.

(d) The total volume of settled solids in the impoundment shall be estimated by multiplying the average thickness of the solids layer by the area of the top of the settled solids layer. The area shall be calculated using the impoundment dimensions corresponding to the estimated surface of the settled solids layer.

(e) The estimated volume of settled solids shall be subtracted from the design capacity of the impoundment (less two feet of freeboard) to estimate the actual free-liquid capacity.

(f) The settled solids measurements, calculations, estimation of total settled solids volume and volume of the actual free-liquid capacity for each impoundment shall be submitted to the department with the application for a renewed or modified discharge permit.

(2) Measure settled solids when the impoundment has been drained of water to its lowest seasonal level using the following method:

(a) Place a visible mark on each of the sidewalls of the pond showing the design depth allowed for sludge accumulation, or establish at least two vertical staff gauges marked to show the design depth allowed for

sludge accumulation. The design depth shall be determined based upon the design capacity approved in the most recent discharge permit.

(b) When the pond is drained to its lowest seasonal level, such that the marks showing the depths described above are visible (or would be visible except for sludge accumulation), photograph each of the markings and submit the photographs with the application.

E. Impoundment construction or improvement. Construction of a new impoundment or improvements to an existing impoundment, including relining of an existing impoundment, shall be performed in accordance with the construction plans and specifications and supporting design calculations submitted with the application for a new, renewed or modified discharge permit, or those submitted after issuance of a discharge permit to achieve compliance with the dairy rule. An applicant or permittee shall notify the department at least five working days before starting construction or improvement of an impoundment to allow for an inspection by department personnel. An applicant or permittee shall submit to the department a construction certification report bearing the seal and signature of a licensed New Mexico professional engineer verifying that installation and construction was completed pursuant to Subsection C of 20.6.6.17 NMAC. The construction certification report shall include: record drawings, final specifications, final capacity calculations and the CQA/CQC report.

(1) For new dairy facilities, impoundment construction shall be completed as follows.

(a) Wastewater impoundment construction shall be completed and the construction certification report shall be submitted to the department before discharging wastewater at the dairy facility.

(b) Combination wastewater/stormwater impoundment construction shall be completed and the construction certification report shall be submitted to the department before placing any livestock at the dairy facility.

(2) For existing dairy facilities, impoundment construction shall be completed:

(a) within one year of the effective date of the discharge permit, if construction of a new impoundment or improvement of an existing impoundment is required to achieve compliance with the dairy rule, or pursuant to the contingency timeframe specified in Subsection B of 20.6.6.27 NMAC when invoked after the effective date of a discharge permit issued pursuant to the dairy rule; and

(b) the construction certification report shall be submitted to the department within 90 days of completion of impoundment construction.

F. Manure solids separator installation – New Wastewater system. A permittee shall employ manure solids separation. ~~All wastewater discharges to an impoundment shall be made through a manure solid separator.~~ If a solid separator with a potential to contaminate ground water is proposed, such as a pond or settling basin, it shall be lined in accordance with Paragraph (5) of Subsection D of 20.6.6.17 NMAC.

~~(1)~~ A permittee installing a new wastewater storage or disposal system shall, before discharging to the new system, construct a manure solids separator(s) in accordance with the construction plans and specifications submitted with the application for a new, renewed or modified discharge permit, or those submitted after issuance of a discharge permit to achieve compliance with the dairy rule. Before discharging to the new system, the permittee shall submit to the department confirmation of solids separator construction, including separator type(s) and location(s).

~~(2) If an existing dairy facility does not employ manure solids separation, the permittee shall construct a manure solids separator(s) within 150 days of the effective date of the discharge permit. The permittee shall submit confirmation of solids separator construction, including separator type(s) and location(s), to the department within 180 days of the effective date of the discharge permit.~~

G. Grading and drainage report and plan - submittal and implementation. A permittee shall complete a new grading and drainage system, in accordance with the grading and drainage report and plan required by Subsection C of 20.6.6.17 NMAC and submitted with the application for a new discharge permit. A permittee shall submit a post-development drainage report, including record drawings, bearing the seal and signature of a licensed New Mexico professional engineer. The grading and drainage system shall be completed and the post-development drainage report shall be submitted to the department before placing any livestock at the dairy facility.

H. Stormwater conveyance. A permittee shall divert stormwater from the corrals and other applicable areas at the dairy facility (i.e., calf pens, alleys, feed storage and mixing, etc.) in accordance with the grading and drainage plan required by Subsection C of 20.6.6.17 NMAC. Stormwater shall be conveyed in a manner that minimizes ponding and infiltration of stormwater.

I. Stormwater management - unlined impoundment. A permittee shall transfer stormwater collected in an unlined impoundment(s) to the wastewater impoundment(s) or the distribution system for the land application area after a storm event to minimize the potential for movement to ground water. Operational pumps shall be available at the dairy facility at all times for the transfer of stormwater from stormwater impoundment(s) to

the wastewater impoundment(s) or the distribution system for the land application area, as authorized by a discharge permit.

J. Flow meter installation. A permittee shall employ a flow metering system that uses flow measurement devices (flow meters) to measure the volume of wastewater discharged at the dairy facility. Flow meters shall be installed in accordance with the plans submitted with the application for a new, renewed or modified discharge permit, or those submitted after issuance of a discharge permit to achieve compliance with the dairy rule, pursuant to this section, Subsection C of 20.6.6.17 NMAC, and Subsections G and H of 20.6.6.21 NMAC. Flow meters shall be ~~physically and permanently~~ labeled with the discharge permit number, meter identification nomenclature as specified in a discharge permit, and the month and year of meter installation. All flow meters shall be calibrated in accordance with the manufacturer's requirements prior to installation or reinstallation following repair. The permittee shall maintain copies of the manufacturer's certificate of calibration and the manufacturer's recommended maintenance schedule. Confirmation of installation shall include a description of the device type, manufacturer, meter identification, location, record drawings, and ~~the results of the initial field~~ a copy of the manufacturer's certificate of calibration and a copy of the manufacturer's recommended maintenance schedule ~~completed pursuant to Subsection E of 20.6.6.24 NMAC~~.

(1) An applicant or permittee for a new dairy facility shall install flow meters and submit confirmation of flow meter installation to the department before discharging at the dairy facility.

(2) An applicant or permittee for an existing dairy facility shall install flow meters within 150 days of the effective date of the discharge permit and submit confirmation of flow meter installation to the department within 180 days of the effective date of the discharge permit.

K. Flow metering methods. Flow metering shall be accomplished by the following methods.

(1) For pumped flow discharge or transfer situations, an applicant or permittee shall install a closed-pipe velocity sensing totalizing flow meter(s) on the pressurized discharge or transfer line(s).

(2) For gravity flow discharge or transfer situations, an applicant or permittee shall install a closed pipe totaling flow meter or an open-channel primary flow measuring device(s) (flume or weir), equipped with head sensing and totalizing mechanisms, on the discharge or transfer line(s).

(3) An applicant may propose and the department may accept a proposal to meter flows by metering the water supply. The proposal shall provide specific detail regarding the flow meter to be used and the relationship between the volume of water supplied and wastewater volume.

L. Flow meter locations. An applicant or permittee shall identify flow meter locations in the application for a new, renewed or modified discharge permit. All flow meters shall be located pursuant to this section and Subsections G and H of 20.6.6.21 NMAC, and indicated on the scaled map required by Subsection U of this section.

M. Authorized use of existing flow meters. An applicant or permittee proposing to use an existing flow meter(s) shall submit documentation demonstrating that the existing flow meter(s) is installed consistent with this section, and Subsections G and H of 20.6.6.21 NMAC, as appropriate. The proposal shall be submitted with an application for a new, renewed and modified discharge permit and shall include the following documentation.

(1) The location of each existing flow meter indicated on the scaled map required by Subsection U of this section and the identification of the wastewater discharge, or wastewater or stormwater application it is intended to measure.

(2) A copy of the record drawings or manufacturer plans and technical specifications specific to each existing flow meter, if available.

~~(3) A field calibration report for each existing flow meter, completed pursuant to Subsection E of 20.6.6.24 NMAC.~~

N. Flow metering - wastewater to impoundment. A permittee shall install flow meters to measure the volume of wastewater discharged from all wastewater sources to the wastewater or combination wastewater/stormwater impoundment(s). The flow meter(s) shall be installed on the discharge line(s) from all wastewater sources to the wastewater impoundment(s). Meter installation and confirmation of meter installation shall be performed pursuant to this section. Alternatively, a dairy existing on the effective date of the dairy rule that does not utilize flow meters meeting the requirements of the preceding sentence may install a flow meter(s) on the water supply line(s) that serves all wastewater sources. Readings from flow meter(s) on water supply lines shall be used to estimate wastewater volumes discharged to wastewater or combination wastewater/stormwater impoundment(s) without adjustments or deductions to the meter readings.

O. Flow meter inspection and maintenance. A permittee shall visually inspect flow meters on a weekly basis for evidence of malfunction. If a visual inspection indicates a flow meter is not functioning to measure

flow, the permittee shall initiate repair or replacement of the meter within ~~30~~ seven days of discovery. The repaired or replaced flow meter shall be installed and calibrated pursuant to ~~the dairy rule~~ subsection J of this section.

(1) For repaired meters, the permittee shall submit a report to the department with the next quarterly monitoring report following the repair that includes a description of the malfunction; a statement verifying the repair, and a copy of the manufacturer's or repairer's certificate of calibration~~; and a flow meter field calibration report completed pursuant to Subsection E of 20.6.6.24 NMAC~~.

(2) For replacement meters, the permittee shall submit a report to the department with the next quarterly monitoring report following the replacement that includes plans for the device pursuant to Subsection C of 20.6.6.17 NMAC, a copy of the manufacturer's certificate of calibration, and a copy of the manufacturer's recommended maintenance schedule ~~and a flow meter field calibration report completed pursuant to Subsection E of 20.6.6.24 NMAC~~.

P. Impoundment inspection and maintenance. A permittee shall maintain impoundments to prevent conditions which could affect the structural integrity of the impoundments and associated liners. Such conditions include, but are not limited to, erosion damage; animal burrows or other animal damage; the presence of vegetation including aquatic plants, weeds, woody shrubs or trees growing within five feet of the top inside edge of a sub-grade impoundment, within five feet of the toe of the outside berm of an above-grade impoundment, or within the impoundment itself; evidence of seepage; evidence of berm subsidence; and the presence of large debris or large quantities of debris in the impoundments. A permittee shall inspect impoundments and surrounding berms on a monthly basis to ensure proper condition and control vegetation growing around the impoundments in a manner that is protective of the liners. Within 24 hours of discovery, a permittee shall report to the department any evidence of damage that threatens the structural integrity of a berm or liner of an impoundment or that may result in an unauthorized discharge. A permittee is not required to report routine berm maintenance to the department.

Q. Pipe and fixture inspection and maintenance. A permittee shall maintain pipes and fixtures used for the conveyance or distribution of wastewater or stormwater at the dairy facility to prevent the unauthorized release of wastewater or stormwater. The permittee shall visually inspect pipes and fixtures on a weekly basis for evidence of leaks or failure, and shall maintain written records at the dairy facility of all such inspections including repairs to the pipes and fixtures. Where pipes and fixtures cannot be visually inspected because they are buried, the permittee shall inspect the area directly surrounding the features for evidence of leaks or failure (e.g., saturated surface soil, surfacing wastewater, etc.). If there is evidence an unauthorized discharge has resulted from damaged or faulty pipe(s) or fixture(s), the permittee shall repair or replace the pipe(s) or fixture(s) within 72 hours of discovery. The permittee shall report the unauthorized discharge to the department pursuant to 20.6.2.1203 NMAC.

R. Leachate management - manure solids separation system. A permittee shall manage the solids captured by and removed from the manure solids separation system(s) and stored at the dairy facility before removal or land application to minimize generation and infiltration of leachate. The manure solids removed from the manure solids separation system and leachate generated from those solids shall be collected and contained on an impervious surface before disposal.

S. Leachate management - manure and compost storage. Unless land application of manure solids and composted materials is authorized by a discharge permit, a permittee shall remove manure solids and composted material from the dairy facility. A permittee shall minimize the generation and infiltration of leachate from stockpiled manure solids and composted material before removal from the dairy facility by diverting stormwater run-on and run-off, and preventing ponding within areas used for manure and compost stockpiling.

T. Leachate management - silage storage. A permittee shall minimize the generation and infiltration of leachate from silage storage areas and prevent ponding within silage storage areas. Leachate generated from the silage storage areas shall be collected and contained on an impervious surface or the stormwater impoundment before disposal.

U. Scaled map of dairy facility. An applicant or permittee shall submit a scaled map of the dairy facility to the department with an application for a new, renewed or modified discharge permit. The map shall be clear and legible, and drawn to a scale such that all necessary information is plainly shown and identified. The map shall show the scale in feet or metric measure, a graphical scale, a north arrow, and the effective date of the map. Multiple maps showing different portions of the facility may be provided using different scales as appropriate to represent the facility. Documentation identifying the means used to locate the mapped objects (i.e., global positioning system (GPS), land survey, digital map interpolation, etc.) and the relative accuracy of the data (i.e., within a specified distance expressed in feet or meters) shall be included with the map. Any object that cannot be directly shown due to its location inside of existing structures, or because it is buried without surface identification, shall be identified on the map in a schematic format and identified as such. The map shall include the following objects:

(1) the overall dairy facility layout (barns, feed storage areas, pens, etc.);
(2) the location of all sumps;
(3) the location of all manure solids separators;
(4) the location of all wastewater, stormwater, and combination impoundments;
(5) the location of all mix tanks;
(6) the location and acreage of each field within the land application area;
(7) the location of all monitoring wells;
(8) the location of all irrigation wells;
(9) the location of all meters measuring wastewater discharges to and from impoundments;
(10) the location of all meters measuring stormwater applied to the land application area;
(11) the location of all fixed pumps for discharge and transfer of wastewater or stormwater;
(12) the location of all wastewater and stormwater distribution pipelines;
(13) the location of each ditch irrigation system, acequia, irrigation canal and drain;
(14) the location of all backflow prevention methods or devices;
(15) all wastewater sampling locations, with the exception of impoundments for disposal by evaporation; and
(16) location of all septic tanks and leachfields.

V. Scaled map of dairy facility - updates. Following completion of additions or changes to the dairy facility layout which affects items required by Subsection U of this section, a permittee shall update and resubmit to the department the dairy facility map required by this section within 90 days of any additions or changes to the dairy facility layout which affects items required by Subsection U of this section.

W. Animal mortality management. All animal mortalities that may legally be disposed of (buried or composted) on a dairy facility shall be managed in accordance with the following requirements.

(1) Only mortalities originating at the dairy facility may be disposed of at the dairy facility.

(2) Mortalities shall not be stored or buried within 200 feet (measured as horizontal map distance) from private or public wells, or any watercourse.

(3) Mortalities shall not be stored or buried within 100 feet (measured as horizontal map distance) from the 100-year flood zone of any watercourse, as defined by the most recent federal emergency management administration, FEMA, map.

(4) Stormwater run-on to disposal areas shall be prevented by use of berms or other physical barriers.

(5) Mortalities disposed of by burial shall be placed in a pit(s) where the vertical distance between the seasonal high ground water level and the floor of the pit(s) is greater than 30 feet as documented through the most recent ground water data obtained from an on-site test boring(s) or monitoring well(s).

X. Determination of ground water conditions. An applicant or permittee for a dairy facility without a monitoring well from which depth-to-most-shallow ground water can be measured in accordance with the procedure required by Paragraph (1) of Subsection F of 20.6.6.23 NMAC shall evaluate ground water conditions by the following methods.

(1) The applicant or permittee shall obtain records from the office of the state engineer for all wells on file with the office of the state engineer located within one mile of the boundary of the dairy facility. The applicant or permittee shall submit to the department in tabular format the following information obtained from the office of the state engineer records: the well identification information; location of each well by latitude/longitude and township, range, and section; use of each well; depth to ground water in each well; and total depth of each well.

(2) If any well record information submitted pursuant to Paragraph (1) of this subsection indicates that depth to ground water is less than 100 feet, or in lieu of the requirement of Paragraph (1) of this subsection, the applicant or permittee shall conduct the following activities.

(a) The applicant or permittee shall drill one site-specific test boring to the depth of most-shallow ground water or a depth of 75 feet (measured from the ground surface), whichever is encountered first. The test boring shall be drilled in an area of low elevation within the production area outside of an existing or proposed impoundment.

(b) The applicant or permittee shall describe the lithology from the ground surface to the completed borehole depth and document the depth of most-shallow ground water or the absence of ground water within 75 feet of the ground surface. If ground water is encountered within 75 feet of the ground surface, the depth of most-shallow ground water shall be measured immediately upon ceasing drilling of the boring and again 24 hours following ceasing drilling. Lithology shall be characterized pursuant to American society of testing and materials (ASTM) test method D 2487 or D 2488 or characterized using standard visual geologic or soils descriptions that shall include lithology, grain size, color (Munsell soil color charts may be used), texture, sorting, percent gravel and

degree of induration. The lithologic log and most-shallow ground water information shall be submitted to the department with the application for a new, renewed or modified discharge permit.

(c) Upon completion of ground water measurements, unless the borehole is completed as a monitoring or production well, the borehole shall be immediately abandoned by emplacing neat cement grout, bentonite based plugging material, or other sealing material approved by the state engineer in accordance with 19.27.4 NMAC in the borehole from the bottom of the borehole to the ground surface. A written record of borehole abandonment shall be submitted to the department with the application for a new, renewed or modified discharge permit and shall describe the type of grout used and the depth interval sealed with grout. If a monitoring well is constructed in the borehole, the monitoring well shall be constructed in accordance with Subsection D of 20.6.6.23 NMAC, and a construction log including well record information specified by 19.27.4 NMAC shall be submitted to the department with the application for a new, renewed or modified discharge permit.

Y. Domestic wastewater. Domestic wastewater shall not be commingled with wastewater or stormwater generated at a dairy facility. Domestic wastewater shall be treated or disposed of pursuant to 20.7.3 NMAC or a discharge permit issued solely for the discharge of domestic wastewater, as appropriate.
[20.6.6.20 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.21 ADDITIONAL OPERATIONAL REQUIREMENTS FOR DAIRY FACILITIES WITH A LAND APPLICATION AREA:

A. Impoundment storage capacity management - wastewater and wastewater/stormwater combination. A permittee shall operate and maintain a wastewater or combination wastewater/stormwater impoundment(s) or a tank for the purpose of storing wastewater prior to discharging to the land application area. A permittee shall manage wastewater or combination wastewater/stormwater impoundments to maintain the capacity and two feet of freeboard required by Subsection D of 20.6.6.17 NMAC.

B. Authorized land application of wastewater and stormwater. A permittee shall apply wastewater and stormwater to fields within the land application area, up to the maximum acreage of irrigated cropland specifically authorized by a discharge permit. Wastewater and stormwater shall be distributed uniformly over the field at the planned rate consistent with the nutrient management plan (NMP); ponding shall be minimized.

C. Land application area - fresh irrigation water required. Wastewater shall only be applied to fields within the land application area receiving fresh irrigation water. Fresh irrigation water shall be used as the primary source to meet the water consumptive needs of the crop to support crop production and nutrient removal. Wastewater and stormwater are intended as sources of crop nutrients and shall not be used as a primary source to meet the water consumptive needs of the crop. An applicant may propose and the department may accept a proposal to apply wastewater to crops or grazing land without using fresh water for irrigation if the proposal demonstrates to the department's satisfaction that crops or plants to be grazed can be successfully maintained without fresh irrigation water.

D. Wastewater/irrigation water blending. Wastewater may be blended in-line (i.e., fresh irrigation water supply lines) when fresh water irrigation lines are equipped with backflow prevention that is installed, operated, inspected and maintained in accordance with Subsections L and M of this Section.~~a reduced pressure principle backflow prevention assembly (RP)~~. Wastewater may also be blended in a mix-tank(s), applied alternately in the same irrigation line which has been physically disconnected from supply wells, or applied in a separate line, as authorized by a discharge permit. Wastewater may be blended with fresh water in a wastewater impoundment prior to land application so long as:

(1) the permittee maintains an accurate written record of the volume of fresh water added to the wastewater and that volume is accounted for in determining the volumes of wastewater applied for purposes of the nutrient management plan;

(2) fresh water is introduced in a safe manner to prevent scouring of the liner;

(3) the impoundment capacity requirements of this rule are met.

E. Land application area - existing infrastructure. An applicant or permittee shall submit documentation for the existing infrastructure necessary to transfer, distribute and apply wastewater or stormwater to fields within the land application area that will receive wastewater or stormwater to the department with the application for a new, renewed or modified discharge permit. The documentation shall consist of a narrative statement and photographic documentation that confirm the existing land application distribution system including the type(s) and location(s) of the systems, and the method(s) of backflow prevention employed.

F. Land application area - new infrastructure. Before the initial application of wastewater or stormwater to any field within the land application area that has not previously received wastewater or stormwater, an applicant or permittee shall install a land application distribution system to distribute wastewater and stormwater

to those fields. The land application distribution system shall be used to distribute and apply wastewater and stormwater to fields within the land application area to meet the requirements of this section. Before the initial application of wastewater or stormwater to any field within the land application area, an applicant or permittee shall submit documentation confirming installation of the land application distribution system. The documentation shall consist of a narrative statement and photographic documentation that confirms the new land application system including the type(s) and location(s) of the system(s), and the method(s) employed for backflow prevention.

G. Flow metering - wastewater to land application area. A permittee shall install flow meters to measure the volume of wastewater discharged from the wastewater or combination wastewater/stormwater impoundments to the land application area. The flow meter(s) shall be installed on the discharge line(s) from the wastewater impoundment(s) or tank to the distribution system for the land application area. Meter installation and confirmation of meter installation shall be performed pursuant to Subsections J, K and M of 20.6.6.20 NMAC.

H. Flow metering - stormwater to land application area. For a dairy facility transferring stormwater from a stormwater impoundment directly to a distribution system for the land application area, a permittee shall install flow meters to measure the volume of stormwater applied directly to the land application area. The flow meter(s) shall be installed on the transfer line(s) from the stormwater impoundment(s) to the distribution system for the land application area. Meter installation and confirmation of meter installation shall be performed pursuant to Subsections J, K and M of 20.6.6.20 NMAC.

I. Nutrient management plan. Nutrients and other constituents required to be monitored under Subsection C of 20.6.6.25 NMAC and present in wastewater and stormwater shall be applied to irrigated cropland under cultivation in accordance with the requirements of a nutrient management plan (NMP) submitted to the department with the application for a new, renewed, or modified discharge permit. The NMP shall provide for development of a nutrient budget for nitrogen on an annual basis that accounts for the amount of nitrogen from all combined nitrogen sources, including but not limited to wastewater, stormwater, manure solids, composted material, irrigation water and other additional fertilizer(s), along with residual soil nitrogen and nitrogen credits from leguminous crops and that considers estimated and measured nitrogen removal by harvested crops and other losses, considering the monitoring data required to be collected under section 20.6.6.25 NMAC. The NMP shall describe how planned total nitrogen application rates shall be determined each year based upon realistic yield goals for the planned crops. The information used to set the crop yield goals shall be identified in the NMP. The NMP shall address how nitrogen application rates will be adjusted based upon the results of soil tests required by Subsections K and L of 20.6.6.25 NMAC, consistent with applicable Natural Resource Conservation Service guidance for normal, high and excessive soil nitrogen levels. The NMP shall specify the maximum application rates for wastewater applied through irrigation so as not to exceed the soil intake/infiltration rate.~~, shall be applied to~~ The application of nitrogen to each field within the land application area shall be in accordance with the NMP, and any departures from the NMP due to growing conditions or other factors shall be addressed in the update to the NMP for the following year. ~~The NMP shall be developed through utilization of the U.S. department of agriculture natural resources conservation service (USDA-NRCS) national comprehensive nutrient management plan development templates as adopted by the New Mexico office of the USDA-NRCS and in accordance with the USDA-NRCS *conservation practice standard for New Mexico, nutrient management - code 590*. The NMP shall be developed, signed and dated annually by an individual certified by the American society of agronomy as a certified crop advisor (CCA) or certified professional agronomist (CPAg) and by an individual certified by the New Mexico office of the USDA-NRCS as a nutrient management planner.~~ Plant material and soil sampling protocols in the NMP shall be, at a minimum, equivalent to the requirements of Subsections I, K and L of 20.6.6.25 NMAC. The NMP shall identify the method(s) of crop removal to be employed. The NMP shall be developed for the term of the discharge permit,and updated annually~~, and implemented pursuant to the dairy rule~~. The NMP shall be developed, signed and dated annually by an individual certified by the American society of agronomy as a certified crop advisor (CCA) or certified professional agronomist (CPAg) or by an individual certified by the New Mexico office of the USDA-NRCS as a nutrient management planner. The permittee may elect to submit an NMP meeting the requirements of this subsection that is incorporated into a broader plan, such as a comprehensive nutrient management plan or a nutrient management plan prepared to meet the requirements of a permit issued by EPA, in which case only the portions of such plan required by this subsection and section 20.6.6.25 NMAC shall be considered for purposes of the dairy rule. For a renewed permit where the NMP was not submitted in an application,~~T~~the permittee shall submit the initial NMP by May 1 of the first year the permit is in effect, and the permittee shall submit annual updates to the NMP to the department in the monitoring reports due by May 1 of each year.

J. Crop removal - mechanical or grazing. A permittee shall remove crops from fields within the land application area by mechanical harvest ~~unless an alternative proposal for the use of~~or grazing ~~is submitted with the application for a new, renewed, or modified discharge permit. If grazing is the method proposed for crop~~

~~removal, the nutrient management plan (NMP) prepared pursuant to Subsection [K] I of this section shall include a proposal for the use of grazing for crop removal by means of an actively managed rotational grazing system which promotes uniform grazing and waste distribution throughout the field(s) (and pastures within the field). Proposals shall quantify the degree of nitrogen removal expected to be achieved by grazing, and shall provide scientific documentation supporting the estimated nitrogen removal and justification for the selection of input parameters used in calculations or computer modeling. The NMP proposing grazing for crop removal shall be implemented in its entirety. Annual updates to the NMP shall include updates to the grazing plan as well as a report of actual weight gains, actual nitrogen uptake of the crop, and estimated crop and nutrient removal from the previous season.~~ An NMP which proposes grazing for crop removal shall also include, at a minimum, estimated values for the following elements.

(1) The length of the grazing season.

(2) The size and number of animals to be grazed.

(3) The estimated weight gain of animals to be grazed, or estimated intake for maintenance or milk production.

(4) The calculations to determine stocking rates, total acreage needed and residency period.

(5) The plant species used to establish pastures and the pasture renovation practices to be employed.

(6) The yield of plant species grown in each pasture and the forage supplied on a monthly basis.

(7) The grazing management system employed and a map indicating key features of the system including water tanks, fencing, and pasture layout with numbering system and acreage of each pasture.

~~**K. Crop removal - changes to method(s).** If a permittee proposes to change the method(s) (i.e., mechanical versus grazing) of crop removal on any field within the land application area authorized by the discharge permit, the permittee shall apply to modify the discharge permit. The permittee shall submit an application which includes the proposed change(s) pursuant to Subsection I and J of this section. The permittee shall not implement the changes unless the department issues a modified permit approving the changes.~~

~~L~~**K. Irrigation ditches - inspection and maintenance.** Irrigation ditches used to land apply wastewater or stormwater at a dairy facility shall be concrete-lined and shall be maintained in good repair. The permittee shall visually inspect the ditch system on a monthly basis to ensure proper maintenance. Any damage to a lined ditch shall be repaired within a reasonable time period. A log shall be kept on-site documenting the inspection findings and repairs made, and the log shall be made available to the department upon request.

~~M~~**L. Backflow prevention.** A permittee shall protect all water wells used within the land application distribution system from contamination by wastewater or stormwater backflow by installing and maintaining backflow prevention methods or devices. Backflow prevention shall be achieved by a total disconnect (physical air gap separation of at least two times the pipe diameter or complete piping separation when wastewater is being pumped) or by the installation of, at a minimum ~~a reduced pressure principal backflow prevention assembly (RP)~~ an air/vacuum relief valve and a low pressure drain valve located immediately upstream of a check valve between the ~~fresh irrigation water supply~~ discharge head of the well pump and wastewater and stormwater delivery systems.

(1) A permittee for a new dairy facility shall install backflow prevention methods or devices and submit written confirmation of installation to the department before discharging at the dairy facility.

(2) A permittee for an existing dairy facility that lacks backflow protection as required by this subsection shall install backflow prevention methods or devices within 90 days of the effective date of the discharge permit. The permittee shall submit written confirmation of installation to the department within 180 days of the effective date of the discharge permit.

~~N~~**M. Backflow prevention by ~~reduced pressure principle~~ check valve backflow prevention ~~assembly~~device - inspection and maintenance.** A permittee shall inspect each check valve device at least monthly when the well is operating. ~~have each reduced pressure principle backflow prevention assembly (RP) inspected and tested by a person qualified by the manufacturer at the time of installation, repair, or relocation, and at least on an annual schedule thereafter.~~ A malfunctioning ~~RP~~ check valve device shall be repaired or replaced within 30 days of discovery, and use of all wastewater supply lines associated with the ~~RP~~ check valve device shall cease until repair or replacement has been completed. Copies of the inspection and maintenance records ~~and test results~~ for each ~~RP~~ check valve device associated with the backflow prevention program for the previous year shall be submitted to the department annually in the monitoring reports due by May 1.

~~O~~**N. Supply well protection.** With the exception of monitoring wells, all wells located within the land application area of a dairy facility shall have a surface pad constructed in accordance with the recommendations of Subsection G of 19.27.4.29 NMAC and a permanent well cap or cover pursuant to Subsection I of 19.27.4.29 NMAC.

[20.6.6.21 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.22 ADDITIONAL OPERATIONAL REQUIREMENTS FOR DAIRY FACILITIES DISCHARGING TO AN EVAPORATIVE WASTEWATER DISPOSAL SYSTEM: Impoundment evaporative capacity - wastewater and wastewater/stormwater combination. A wastewater or combination wastewater/stormwater impoundment shall be operated and maintained for the purpose of disposing of wastewater or both wastewater and stormwater by evaporation. A permittee shall manage wastewater or combination wastewater/stormwater impoundments to maintain the capacity and two feet of freeboard as required by Subsection D of 20.6.6.17 NMAC.
[20.6.6.22 NMAC - N, 01/31/2011]

20.6.6.23 GROUND WATER MONITORING REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Monitoring wells - required locations. A permittee shall install a sufficient number of monitoring wells at appropriate depths and locations to monitor ground water quality upgradient of the dairy facility and hydrologically downgradient of each source of ground water contamination: wastewater, stormwater, and combination wastewater/stormwater impoundments, and fields within the land application area. Monitoring wells shall be located pursuant to this section in a location that is protective of the well and to detect an exceedance(s) or a trend towards exceedance(s) of the ground water standards at the earliest possible occurrence, so that source control or abatement may be implemented ~~as soon as possible~~.

(1) **Ground water monitoring – installation schedule ~~wastewater impoundments.~~** ~~A minimum of one monitoring well shall be located hydrologically downgradient and within 75 feet (measured as horizontal map distance) of the top inside edge of each wastewater impoundment. For existing dairy facilities, this ground water monitoring requirement additionally applies to wastewater impoundments that received wastewater as authorized by the most recent discharge permit issued prior to the effective date of the dairy rule but are not proposed for use under the first discharge permit renewal following the effective date of the dairy rule.~~

(a) For a new dairy facility, monitoring wells shall be installed before discharging at the dairy facility.

(b) For an existing dairy facility, any new monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.

~~(c) A permittee constructing a new impoundment at an existing dairy facility shall install the monitoring well(s) required to monitor ground water hydrologically downgradient of the impoundments before discharging wastewater to the impoundment or within 120 days of the completion of the impoundment, whichever occurs first.~~

~~(2) **Ground water monitoring - combination wastewater/stormwater impoundments.** A minimum of one monitoring well shall be located hydrologically downgradient and within 75 feet (measured as horizontal map distance) of the top inside edge of each combination wastewater/stormwater impoundment. For existing dairy facilities, this ground water monitoring requirement additionally applies to combination wastewater/stormwater impoundments that received wastewater or stormwater as authorized by the most recent discharge permit issued prior to the effective date of the dairy rule but are not proposed for use under the first discharge permit renewal following the effective date of the dairy rule.~~

~~(a) For a new dairy facility, monitoring wells shall be installed before placing any livestock at the dairy facility.~~

~~(b) For an existing dairy facility, monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.~~

~~(c) A permittee constructing a new impoundment at an existing dairy facility shall install the monitoring well(s) required to monitor ground water hydrologically downgradient of the impoundment before discharging wastewater to the impoundment, before collecting stormwater in the impoundment or within 120 days of the completion of the impoundment, whichever occurs first.~~

~~(3) **Ground water monitoring - stormwater impoundments.** A minimum of one monitoring well shall be located hydrologically downgradient and within 75 feet (measured as horizontal map distance) of the top inside edge of each stormwater impoundment. For existing dairy facilities, this ground water monitoring requirement additionally applies to stormwater impoundments that received stormwater as authorized by the most recent discharge permit issued prior to the effective date of the dairy rule but are not proposed for use under the first discharge permit renewal following the effective date of the dairy rule.~~

(a) For a new dairy facility, monitoring wells shall be installed before placing any livestock at the dairy facility.

(b) For an existing dairy facility, monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.

(c) A permittee constructing a new impoundment at an existing dairy facility shall install the monitoring well(s) required to monitor ground water hydrologically downgradient of the impoundment before collecting stormwater in the impoundment(s) or within 120 days of the completion of the impoundment, whichever occurs first.

(4) **Ground water monitoring - land application area.** Monitoring wells intended to monitor ground water hydrologically downgradient of fields within the land application area shall be installed as follows.

(a) **Flood irrigation.** Ground water monitoring shall be performed hydrologically downgradient of each flood irrigated field or grouping of contiguous flood irrigated fields. For every 40 acres or less of a single flood irrigated field or a single grouping of contiguous flood irrigated fields, a minimum of one monitoring well shall be located hydrologically downgradient and within 50 feet (measured as horizontal map distance) of the downgradient boundary of the single field or single grouping of contiguous fields. Flood irrigated fields separated by ditch irrigation systems, acequias and drains shall be considered contiguous for the purpose of this subsection. For existing dairy facilities, this ground water monitoring requirement additionally applies to single fields or single groupings of contiguous flood irrigated fields that received wastewater or stormwater as authorized by the most recent discharge permit issued prior to the effective date of the dairy rule but are not proposed for use under the first discharge permit renewal following the effective date of the dairy rule.

(i) For a new dairy facility, monitoring wells shall be installed before placing livestock at the dairy facility.

(ii) For an existing dairy facility, monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.

(iii) A permittee activating a new flood irrigated field at an existing dairy facility shall install the monitoring well(s) required to monitor ground water hydrologically downgradient of the field before applying wastewater or stormwater to the field.

(b) **Sprinkler or drip irrigation.** Ground water monitoring shall be performed hydrologically downgradient of each sprinkler or drip irrigated field, or grouping of contiguous sprinkler or drip irrigated fields. For every 160 acres or less of a single sprinkler or drip irrigated field, or a single grouping of 160 contiguous acres of sprinkler or drip irrigated fields, a minimum of one monitoring well shall be located hydrologically downgradient and within 50 feet (measured as horizontal map distance) of the downgradient boundary of the single field or single grouping of contiguous fields. Sprinkler or drip irrigated fields separated by ditch irrigation systems, acequias and drains shall be considered contiguous for the purpose of this subsection. For existing dairy facilities, this ground water monitoring requirement additionally applies to single fields or single groupings of contiguous sprinkler or drip irrigated fields that received wastewater or stormwater as authorized under the most recent discharge permit issued prior to the effective date of the dairy rule but are not proposed for use under the first discharge permit renewal following the effective date of the dairy rule.

(i) For a new dairy facility, monitoring wells shall be installed before placing livestock at the dairy facility.

(ii) For an existing dairy facility, monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.

(iii) A permittee activating a new sprinkler or drip irrigated field at an existing dairy facility shall install the monitoring well(s) required to monitor ground water hydrologically downgradient of the field before applying wastewater or stormwater to the field.

(c) **Crop harvest by grazing.** Notwithstanding the requirements of Subparagraphs (a) and (b) of this paragraph, a minimum of one monitoring well(s) shall be located hydrologically downgradient and within 50 feet (measured as horizontal map distance) of the downgradient boundary of each field where grazing is proposed in a nutrient management plan (NMP) as an alternative to, or in conjunction with, crop removal by mechanical harvest.

(5) **Ground water monitoring - upgradient.** A minimum of one monitoring well shall be located hydrologically upgradient of all ground water contamination sources at a dairy facility in order to establish ground water quality conditions at a location not likely to be affected by contamination sources at the dairy facility.

~~(a) For a new dairy facility, monitoring wells shall be installed before placing livestock at the dairy facility.~~

~~(b) For an existing dairy facility, monitoring wells shall be installed within 120 days of the effective date of the discharge permit, provided that the department may grant a one-time extension of 60 days for good cause shown.~~

(2)~~(6)~~ **Use of existing monitoring wells.** A monitoring well in existence before the effective date of the dairy rule, properly constructed in accordance with department guidelines applicable when the well was constructed, and operating as approved in a previous discharge permit, shall be approved for ground water monitoring at a dairy facility ~~provided all of the following requirements are met~~.

~~(a) The monitoring well is located at the location previously approved by the department.~~

~~(b) The monitoring well:~~

~~(i) if intended to monitor ground water quality near a contamination source, is located downgradient of the source based on current hydrologic conditions and is located no more than 100 feet hydrologically downgradient (measured as a horizontal map distance) from the contamination source; or~~

~~(ii) if intended to monitor ground water quality at a location not likely to be affected by contamination sources, is located hydrologically upgradient of sources at the dairy facility.~~

~~(c) The monitoring well is constructed with a screen length consistent with the construction requirements of this section or an alternative screen length previously approved by the department, and the screened interval intersects with the most shallow ground water, and~~

~~(i) the alternative screen length is no greater than 30 feet; or~~

~~(ii) the monitoring well has a water column within the screened interval of no more than 25 feet in length based upon the most recent ground water level obtained with a water level measuring device pursuant to 20.6.6.23 NMAC.~~

~~(d) The monitoring well construction log, the scaled dairy facility map and the ground water elevation contour map, and a copy of the department's written approval of an alternate screen length or recent ground water level data, as appropriate, is submitted with the application for a renewed or renewed and modified discharge permit verifying that the requirements of Subparagraphs (a), (b), and (c) of this paragraph are met.~~

(3)~~(7)~~ **Exceptions to monitoring well requirements.** When appropriate, based on the documented ground water flow direction, one monitoring well may be authorized by a discharge permit to monitor ground water hydrologically downgradient of more than one contamination source under any of the following circumstances.

(a) Contiguous impoundments are oriented along a line that is parallel or approximately parallel to the direction of ground water flow beneath the impoundments.

(b) Adjacent impoundments are oriented along a line that is parallel or approximately parallel to the direction of ground water flow beneath the impoundments and separated by a distance of 50 feet or less as measured from the top inside edge of one impoundment to the nearest top inside edge of the adjacent impoundment.

~~(c) Adjacent or adjacent groupings of contiguous sprinkler or drip irrigated fields are oriented along a line that is parallel or approximately parallel to the direction of ground water flow beneath the fields and the average depth to most shallow ground water measured in on-site monitoring wells pursuant to Subsection F of this section is 300 feet or greater. Where monitoring wells do not exist, depth to most shallow ground water shall be determined pursuant to Subsection X of 20.6.6.20 NMAC. A monitoring well(s) installed hydrologically downgradient of a sprinkler or drip irrigated field or a grouping of sprinkler or drip irrigated fields pursuant to Paragraph (4) of this subsection may be authorized by a discharge permit to monitor ground water hydrologically downgradient of not more than two adjacent sprinkler or drip irrigated fields or adjacent groupings of sprinkler or drip irrigated fields.~~

~~(8) **Requirement for third monitoring well.** If fewer than three monitoring wells are needed to satisfy the ground water monitoring requirements of Paragraphs (1) through (7) of this subsection, a third monitoring well shall be installed within 75 feet of the contamination source and in a location alternate to the downgradient monitoring well required by this subsection. The third monitoring well shall be installed in an alternative location that allows for the determination of ground water flow direction pursuant to this section.~~

B. Monitoring wells - location proposals. An applicant or permittee shall identify monitoring well locations in the application for a new, renewed or modified discharge permit pursuant to Subsection A of this section, and shall include the following information.

(1) The location of each monitoring well relative to the contamination source it is intended to monitor shall be indicated on the scaled map required by Subsection U of 20.6.6.20 NMAC.

(2) A written description of the specific location for each monitoring well including the horizontal map distance (in feet) and compass bearing of each monitoring well from the top inside edge of the impoundment berm or edge of the field it is intended to monitor.

(3) The ground water flow direction beneath the dairy facility used to determine the monitoring well location(s), including supporting documentation used to determine ground water flow direction.

C. Monitoring wells - identification tags. A permittee shall identify all monitoring wells required by the dairy rule with a well identification tag. For above-grade wells, the tag shall be affixed to the exterior of the steel well shroud ~~using rivets, bolts or a steel band~~. For wells finished below-grade, the tag shall be placed inside the well vault next to the well riser. The tag shall be printed adhesive or metal:

(1) if metal, made of aluminum;

(2) at least two inches by four inches in size;

(3) for monitoring wells installed after the effective date of the dairy rule, the tag shall ~~be engraved with~~ include:

(a) the discharge permit number;

(b) the well identification nomenclature specified in a discharge permit;

(c) the name and New Mexico well driller license number of the well driller who drilled the well; and

(d) the month and year of well installation; and

(4) for monitoring wells installed before the effective date of the dairy rule and satisfying the requirements of Paragraph (6) of Subsection A of this section, the tag shall ~~be engraved with~~ include:

(a) the discharge permit number;

(b) the well identification nomenclature specified in a discharge permit; and

(c) if available, the name and New Mexico well driller license number of the well driller who drilled the well, and the month and year of well installation.

D. Monitoring wells - construction and completion –new monitoring wells. A permittee shall construct monitoring wells pursuant to 19.27.4 NMAC and the following requirements.

(1) All well drilling activities shall be performed by an individual with a current and valid well driller license issued by the state of New Mexico pursuant to 19.27.4 NMAC.

(2) The well driller shall employ drilling methods that allow for accurate determinations of water table locations. All drill bits, drill rods, and down-hole tools shall be thoroughly cleaned immediately before drilling. The borehole diameter shall allow a minimum annular space of two inches between the outer circumference of the well materials (casing or screen) and the borehole wall to allow for the emplacement of sand and sealant.

(3) After completion, the well shall be allowed to stabilize for a minimum of 12 hours before development is initiated.

(4) The well shall be developed so that formation water flows freely through the screen and is not turbid, and all sediment and drilling disturbances are removed from the well.

(5) Schedule 40 (or heavier) polyvinyl chloride (PVC) pipe, stainless steel pipe, or carbon steel pipe shall be used as casing. The casing shall have an inside diameter not less than two inches. The casing material selected for use shall be compatible with the anticipated chemistry of the ground water and appropriate for the contaminants of interest at the dairy facility. The casing material and thickness selected for use shall have sufficient collapse strength to withstand the pressure exerted by grouts used as annular seals and thermal properties sufficient to withstand the heat generated by the hydration of cement-based grouts.

(6) Casing sections shall be joined using welded, threaded, or mechanically locking joints; the method selected shall provide sufficient joint strength for the specific well installation.

(7) The casing shall extend from the top of the screen to at least one foot above ground surface. The top of the casing shall be fitted with a removable cap, and the exposed casing shall be protected by a locking steel well shroud. The shroud shall be large enough in diameter to allow easy access for removal of the cap. Alternatively, monitoring wells may be completed below grade. In this case, the casing shall extend from the top of the screen to six to twelve inches below the ground surface; the monitoring wells shall be sealed with locking, expandable well plugs; a flush-mount, watertight well vault that is rated to withstand traffic loads shall be emplaced around the wellhead; and the cover shall be secured with at least one bolt. The vault cover shall indicate that the wellhead of a monitoring well is contained within the vault.

(8) A 20-foot section (maximum) of continuous well screen shall be installed across the water table. Screen shall consist of continuous-slot, machine slotted, or other manufactured schedule 40 (or heavier) PVC or stainless steel. Screens created by cutting slots into solid casing with saws or other tools shall not be used. The

screen material selected for use shall be compatible with the anticipated chemistry of the ground water and appropriate for the contaminants of interest at the dairy facility. The screen slot size shall be selected to retain 90 percent of the filter pack.

(a) Requests for a 30-foot section of continuous well screen may be authorized by a discharge permit when the most recent two years of ground water level data demonstrates a declining water level trend of at least two feet per year. Data supporting ground water levels shall be specific to monitoring wells located at the dairy facility and obtained with a water level measuring device as required by Subsection F of this section.

(b) Requests for a 30-foot section of continuous well screen shall be submitted to the department in the application for a new, renewed or modified discharge permit.

(9) Screen sections shall be joined using welded, threaded, or mechanically locking joints. The method selected shall provide sufficient joint strength for the specific well installation and shall not introduce constituents that may reasonably be considered contaminants of interest at the dairy facility. A cap shall be attached to the bottom of the well screen. Sumps (i.e., casing attached to the bottom of a well screen) shall not be installed.

(10) The bottom of the screen shall be installed no more than 15 feet below the water table, or no more than 25 feet below the water table when additional screen length is authorized by a discharge permit. The top of the well screen shall be positioned not less than five feet above the water table. The well screen slots shall be appropriately sized for the formation materials.

(11) Casing and well screen shall be centered in the borehole by installing centralizers near the top and bottom of the well screen.

(12) A filter pack shall be installed around the screen by filling the annular space from the bottom of the screen to two feet above the top of the screen with clean silica sand. The filter pack shall be properly sized to exclude the entrance of fine sand, silt, and clay from the formation into the monitoring well. For wells deeper than 30 feet, the sand shall be emplaced by a ~~tremmie~~tremie pipe. The well shall be surged or bailed to settle the filter pack and additional sand added, if necessary, before the bentonite seal is emplaced.

(13) A bentonite seal shall be constructed immediately above the filter pack by emplacing bentonite chips or pellets (three-eighths inch in size or smaller) in a manner that prevents bridging of the chips/pellets in the annular space. The bentonite seal shall be three feet in thickness and hydrated with clean water. Adequate time shall be allowed for expansion of the bentonite seal before installation of the annular space seal.

(14) The annular space above the bentonite seal shall be sealed with cement grout or bentonite-based sealing material acceptable to the state engineer in accordance with 19.27.4 NMAC. A ~~tremmie~~tremie pipe shall be used to emplace the annular space seal (flow by gravity or pumping through the pipe) if the total depth of the well is greater than 20 feet from the land surface. Annular space seals shall extend from the top of the bentonite seal to the ground surface (for wells completed above grade) or to a level three to six inches below the top of casing (for wells completed below grade).

(15) A concrete pad (two-foot minimum radius, four-inch minimum thickness) shall be poured around the shroud or well vault and wellhead. The concrete and surrounding soil shall be sloped to direct rainfall and runoff away from the wellhead.

E. Monitoring wells - office of the state engineer requirements. Should a well permit for a monitoring well be required by the office of the state engineer, the permittee shall obtain the permit prior to well drilling.

F. Ground water sample collection procedure. A permittee shall perform all ground water sample collection, preservation, transport and analysis according to the following procedure.

(1) Depth-to-most-shallow ground water shall be measured from the top of well casing at point of survey to the nearest 0.01 feet using an electronic water level indicator consisting of dual conductor wire encased in a cable or tape graduated to 0.01 feet, a probe attached to the end of the conductor wire, and a visual or audible indicator.

(2) Monitoring wells shall be purged before sample collection by one of the following methods.

(a) Three well volumes of water shall be purged from the well before sample collection.

(b) The monitoring well shall be purged until measurements of indicator parameters (pH, specific conductance, and temperature) have stabilized. Indicator parameters shall be measured periodically during purging. A parameter stabilization log shall be kept during each sampling event for each monitoring well and include: date; water quality indicator parameter measurements; time for all measurements; and the purge volume extracted. Indicator parameters are considered stable when three consecutive readings made no more than five minutes apart fall within the following ranges: temperature plus or minus 10 percent; pH plus or minus 0.5 units; specific conductance plus or minus 10 percent.

(3) Following purging and immediately before sample collection the following field parameters shall

be measured and recorded: pH, specific conductance, and temperature.

(4) In-line flow-through cells shall be disconnected or by-passed during sample collection, if used during purging.

(5) Samples from the well shall be obtained, prepared, preserved and transported to an analytical laboratory for analysis pursuant to the methods authorized by Subsection B of 20.6.6.24 NMAC.

G. Ground water sampling and reporting - routine. A permittee shall collect ground water samples quarterly from all monitoring wells required by Subsection A of this section and Subsection C of 20.6.6.27 NMAC. Samples shall be analyzed for nitrate as nitrogen, total Kjeldahl nitrogen, chloride, sulfate and total dissolved solids pursuant to Subsection B of 20.6.6.24 NMAC. A permittee shall submit to the department in the quarterly monitoring reports the depth-to-most-shallow ground water, the field parameter measurements, the parameter stabilization log (if applicable), the analytical results (including the laboratory quality assurance and quality control summary report) and a map showing the location and number of each well in relation to the contamination source it is intended to monitor.

H. Ground water sampling - new monitoring wells. A permittee shall collect ground water samples from all newly installed monitoring wells. Samples shall be analyzed for nitrate as nitrogen, total Kjeldahl nitrogen, chloride, sulfate and total dissolved solids pursuant to Subsection B of 20.6.6.24 NMAC.

(1) Samples shall be collected from the newly installed monitoring wells at new dairy facilities before placing livestock at the dairy facility.

(2) Samples shall be collected from the newly installed monitoring wells at existing dairy facilities within 150 days of the effective date of the discharge permit.

(3) For dairy facilities installing a new monitoring well during the term of a discharge permit, during construction of a new impoundment, or as a result of required corrective actions, samples shall be collected from the newly installed monitoring wells within 30 days of well completion, provided the department may grant an extension for good cause shown.

I. Monitoring well survey and ground water flow determination. A permittee shall survey monitoring wells to a U.S. geological survey (USGS) benchmark and State Plane coordinates. Survey data shall include northing, easting and elevation to the nearest hundredth of a foot or shall be in accordance with the "Minimum Standards for Surveying in New Mexico", 12.8.2 NMAC. A survey elevation shall be established at the top-of-casing, with a permanent marking indicating the point of survey. The survey shall be completed and bear the seal and signature of a licensed New Mexico professional surveyor. Depth-to-most-shallow ground water shall be measured from the point of survey to the nearest hundredth of a foot in all surveyed wells pursuant to Subsection F of this section, and the data shall be used to develop a map showing the location of all monitoring wells and the direction and gradient of ground water flow at the dairy facility.

(1) For a new dairy facility, monitoring wells shall be surveyed before placing livestock at the dairy facility.

(2) For an existing dairy facility, monitoring wells not previously surveyed in a manner consistent with the requirements of this subsection and Subsection B of 20.6.6.17 NMAC shall be surveyed within 150 days of the effective date of the discharge permit.

J. Monitoring well completion report. A permittee shall submit to the department a monitoring well completion report pertaining to all monitoring wells. For a new dairy facility, the report shall be submitted before placing livestock at the dairy facility. For an existing dairy facility, the report shall be submitted within 180 days after the effective date of the discharge permit or within 60 days of completion as specified in a discharge permit. The report shall contain the following information.

(1) Construction and lithologic logs for the new monitoring wells including well record information specified by 19.27.4 NMAC.

(2) Depth-to-most-shallow ground water measured in each new and existing monitoring well.

(3) Survey data and a survey map showing the locations of each new and existing monitoring well and a ground water elevation contour map developed pursuant to Subsection L of this section.

(4) Analytical results of ground water samples collected from the new monitoring wells, including laboratory quality assurance and quality control summary reports, and field parameter measurements.

K. Monitoring well survey report - existing monitoring wells. For a dairy facility required to survey existing monitoring wells pursuant to this section a permittee shall submit the monitoring well survey report to the department within 180 days of the effective date of the discharge permit, provided the department may grant an extension for good cause shown. The report shall contain the depth-to-most-shallow ground water measured in each monitoring well, a surveyed map showing the locations of the monitoring wells, and the direction and gradient of ground water flow at the dairy facility.

L. Ground water elevation contour maps. A permittee shall develop ground water elevation contour maps on a quarterly basis using data associated with all monitoring wells used for ground water monitoring at the dairy facility. Top of casing elevation data, obtained from monitoring well surveys completed pursuant to this section and quarterly depth-to-most-shallow ground water measurements in monitoring wells, shall be used to calculate ground water elevations at monitoring well locations. Ground water elevations between monitoring well locations shall be estimated using common interpolation methods. Ground water elevations shall be expressed in feet. A contour interval appropriate to the data shall be used, but in no case shall the interval be greater than two feet. Ground water elevation contour maps shall depict the ground water flow direction, using arrows, based on the orientation of the ground water elevation contours, and the location and identification of each monitoring well, impoundment, and field within the land application area. A permittee shall submit ground water elevation contour maps to the department in the quarterly monitoring reports.

~~**M. Monitoring well inspection.** The department may perform downhole inspections of all monitoring wells. At least 60 days before the inspection, the department shall provide written notice to the permittee by certified mail stating the inspection date and identifying the monitoring wells to be inspected; the 60 day notification period shall start upon the date of postal notice. At least 48 hours before the department's inspection, the permittee shall remove all existing dedicated pumps to allow adequate settling time of sediment agitated from pump removal. If a permittee decides to install a dedicated pump in a monitoring well, the permittee shall notify the department so that the department may have the opportunity to perform a downhole well inspection before pump installation. Alternatively, a permittee may employ a third party to perform downhole monitoring well inspections, provided the department is given at least 60 days written notice by certified mail so that a department representative may be on site to observe the inspection.~~

~~(1) The third party shall make a video recording of the monitoring well inspection using a downhole camera and perform the inspection in accordance with the following requirements.~~

~~(a) Depth to most shallow ground water shall be obtained from the well using an electronic water level indicator pursuant to Subsection F of this section, prior to inspection with a downhole camera. Care shall be taken when obtaining this measurement so as to not disturb sediments in the well.~~

~~(b) If ground water sample collection is planned during the inspection event, the downhole camera shall be used to inspect a monitoring well prior to sampling the well.~~

~~(c) Prior to well inspection with a downhole camera, at the top of the well casing, the totalizing reading on the downhole camera shall be zeroed, or a value other than zero shall be recorded as an initial reading.~~

~~(d) All measurements and totalizing readings (with the exception of depth to most shallow ground water obtained pursuant to Subsection F of this section shall be obtained to the nearest 0.1 feet. Downhole cameras that use a measurement system other than 0.1 foot increments are authorized for use; however the permittee shall report the direct measurement/reading obtained and the calculated conversion in 0.1 feet on the written log.~~

~~(e) All measurements and totalizing readings shall be obtained at the top of the well casing.~~

~~(f) The downhole camera shall be lowered into the monitoring well at a consistent speed that allows for clear video capture and does not disturb sediments in the well.~~

~~(g) Lowering of the downhole camera shall be paused long enough to clearly identify totalizing readings at the following points: depth to most shallow ground water; depth of the top of the screened interval; depth of the bottom of screened interval; and the bottom of the well.~~

~~(2) The permittee shall submit written and video monitoring well camera logs for every monitoring well viewed with a downhole camera, along with a copy of an up to date facility map showing the location and identification of each monitoring well. The permittee shall submit the logs to the department within 60 days following the date of the well inspection.~~

~~(a) The written monitoring well camera log shall include the following general information: name of the dairy facility; discharge permit number; permittee's name; monitoring well identification; date and time of the monitoring well camera inspection; location of the monitoring well relative to a source or facility landmark; camera manufacturer and model; names of camera operator and any technical assistants; diameter of the casing (in inches); and a description of the physical condition of the well's concrete pad, shroud, casing and screened interval. The written log shall include measurements of distance from top of the well casing to the surface of the concrete pad; height from ground surface to the top of the concrete pad; and depth to most shallow ground water measured using an electronic water level indicator pursuant to Subsection F of this section. The written log shall also include totalizing readings obtained from the downhole camera including the initial reading at the top of the well casing; depth to most shallow ground water using the borehole camera; depth of the top of the screened interval; depth of the bottom of screened interval; and the bottom of the well (total depth). The length of the screened interval shall be~~

~~calculated by subtracting the depth of the top of the screened interval from the depth of the bottom of screened interval and recorded on the log.~~

~~(b) The video monitoring well camera log shall display the name of the dairy facility; discharge permit number; permittee's name; monitoring well identification; date and time of the monitoring well camera inspection; and the totalizing readings required by Subparagraph (g) of Paragraph (1) of this subsection. The permittee shall submit the video to the department in Motion Picture Experts Group (MPEG) video format on a compact disc (CD) or digital versatile disc (DVD).~~

~~N~~M. **Proposed location of monitoring wells - dispute resolution.** If the department provides a notice of technical deficiency pursuant to Subsection G of 20.6.6.10 NMAC due to a disagreement with the number or location of monitoring wells proposed in the application, or if the department notifies a permittee to replace a monitoring well pursuant to Subsection C of 20.6.6.27 NMAC, the applicant or permittee may notify the secretary by certified mail, sent within 30 days after the date of postal notice of the department's notice, that the applicant or permittee invokes dispute resolution under this subsection. Upon such notice, the department, as represented by the secretary, deputy secretary, or division director and the applicant or permittee shall meet in person within 30 days and shall attempt in good faith to resolve the dispute.

[20.6.6.23 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.24 MONITORING REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Monitoring reports - schedule of submittal. A permittee shall submit monitoring reports to the department on a quarterly schedule and shall contain monitoring data and information collected pursuant to the dairy rule. Quarterly monitoring reports shall be submitted according to the following schedule:

(1) January 1 through March 31 (first quarter) - report due by May 1;

(2) April 1 through June 30 (second quarter) - report due by August 1;

(3) July 1 through September 30 (third quarter) - report due by November 1; and

(4) October 1 through December 31 (fourth quarter) - report due by February 1.

B. Sampling and analysis methods. A permittee shall sample and analyze water pursuant to Subsection B of 20.6.2.3107 NMAC. Analysis of water for total sulfur shall be accomplished pursuant to environmental protection agency method 200.7 or equivalent. Sampling and analysis of soil shall be conducted in accordance with "*methods of soil analysis: part 1. physical and mineralogical methods,*" 1986 edition; "*methods of soil analysis: part 2. microbiological and biochemical properties*," 1994 edition; and *"methods of soil analysis: part 3. chemical methods*," 1996 edition, published by the American society of agronomy.

C. Wastewater volume measurement and reporting. A permittee shall measure the volume of all wastewater discharged to the wastewater or combination wastewater/stormwater impoundment(s) using flow meters. Meter readings shall be recorded at intervals not to exceed ~~seven days~~monthly. The average daily discharge volume for each recording interval shall be calculated by dividing the difference between the meter readings by the number of days between meter readings. The permittee shall provide the meter readings including the date, time and units of each measurement, and calculations for the average daily volumes of wastewater discharged to the impoundments, reported in gallons per day, in the quarterly monitoring reports submitted to the department.

D. Stormwater sampling and reporting. A permittee shall collect stormwater samples on a quarterly basis from each stormwater impoundment unless the stormwater will be transferred ~~. The samples shall be collected as soon as possible after a storm event and before transferring the stormwater~~ to a wastewater impoundment(s) ~~or~~before being sent to the land application area. The samples shall be analyzed for nitrate as nitrogen, total Kjeldahl nitrogen, chloride, total sulfur and total dissolved solids pursuant to this section. The permittee shall include analytical results, or a statement that stormwater runoff did not occur, in the quarterly monitoring reports submitted to the department.

~~**E. Flow meter field calibration.** All flow meters shall be capable of having their accuracy ascertained under actual working (field) conditions. A field calibration method shall be developed for each flow meter and that method shall be used to check the accuracy of each respective meter. Field calibrations shall be performed upon installation and, at a minimum, annually thereafter. Flow meters shall be calibrated to within plus or minus 10 percent of actual flow, as measured under field conditions. Field calibrations shall be performed by an individual knowledgeable in flow measurement and in the installation/operation of the particular device in use. The permittee shall submit the results of annual field calibrations to the department annually in the monitoring reports due by May 1. The flow meter calibration report shall include the following.~~

~~(1) The location and meter identification nomenclature identified by the department through a discharge permit.~~

~~(2) The method of flow meter field calibration employed.~~

~~(3) The measured accuracy of each flow meter prior to adjustment indicating the positive or negative offset as a percentage of actual flow as determined by an in-field calibration check.~~

~~(4) The measured accuracy of each flow meter following adjustment, if necessary, indicating the positive or negative offset as a percentage of actual flow of the meter.~~

~~(5) Any flow meter repairs made during the previous year or during field calibration.~~

[20.6.6.24 NMAC - N, 01/31/2011]

20.6.6.25 ADDITIONAL MONITORING REQUIREMENTS FOR DAIRY FACILITIES WITH A LAND APPLICATION AREA:

A. Volume of wastewater and wastewater/stormwater land applied - measurement and reporting. A permittee shall measure all wastewater discharges from a wastewater or combination wastewater/stormwater impoundment to each field within the land application area using flow meters. A permittee shall maintain a log recording the date and location of each discharge, flow meter readings immediately prior to and after each discharge, and the calculated total volume of each discharge reported in gallons and acre-feet. A permittee shall submit a copy of the log entries including units of measurement to the department in the quarterly monitoring reports.

B. Volume of stormwater land applied - measurement and reporting. A permittee shall measure all stormwater applications from a stormwater impoundment to each field within the land application area using flow meters. A permittee shall maintain a log recording the date and location of each application, flow meter readings immediately prior to and after each application, and the calculated total volume of each application reported in gallons and acre-feet. A permittee shall submit a copy of the log entries including units of measurement to the department in the quarterly monitoring reports.

C. Wastewater to be land applied - sampling and reporting. A permittee shall collect and analyze wastewater samples on ~~a quarterly~~an annual basis for nitrate as nitrogen, total Kjeldahl nitrogen, chloride, total sulfur and total dissolved solids pursuant to Subsection B of 20.6.6.24 NMAC. Representative samples shall be collected from the wastewater impoundments unless an alternative method is approved for good cause, including safety. The representative samples shall consist of eight samples taken from eight different locations evenly distributed throughout the impoundment or using an alternative method approved by the department for good cause. A permittee shall submit the analytical results to the department in the quarterly monitoring reports.

D. Manure solids - nitrogen content. The nitrogen content of the manure solids applied to each field within the land application area shall be estimated at 25 pounds of nitrogen per ton. Should a permittee choose to use actual nitrogen content values of on-site manure solids, the permittee shall collect a composite sample on an annual basis. The composite sample shall consist of a minimum of 30 sub-samples collected on the same day and thoroughly mixed. Manure samples shall be analyzed for total Kjeldahl nitrogen and moisture content. The permittee shall submit the analytical results to the department in the quarterly monitoring reports.

E. Irrigation water - sampling, volume applied, and reporting. A permittee shall monitor irrigation wells used to supply fresh water to the fields within the land application area to account for additional potential nitrogen supplied to the land application area in the following manner.

(1) Each irrigation well shall be identified in association with the field(s) to which it supplies fresh water.

(2) An annual sample of irrigation water supplied from each well or a group of physically connected wells shall be collected and analyzed for nitrate as nitrogen and total Kjeldahl nitrogen, pursuant to Subsection B of 20.6.6.24 NMAC. If the results are consistent for the first five years of annual sampling, sampling frequency may be reduced to once every other year.

(3) The annual volume of irrigation water applied to each field within the land application area shall be estimated for each well.

(4) The permittee shall submit the analytical results and the estimated annual volume of irrigation water applied from each well to each field within the land application area to the department in the monitoring reports due by May 1.

F. Fertilizer application reporting. A permittee shall maintain a log of all additional fertilizer(s) applied to each field within the land application area. The log shall contain the date of fertilizer application, the type and form of fertilizer, fertilizer analysis, the amount of fertilizer applied in pounds per acre to each field, and the amount of nutrients applied in pounds per acre to each field. The permittee shall submit a copy of the log entries to the department in the quarterly monitoring reports.

G. Land application data sheets. A permittee shall complete land application data sheets for each field within the land application area to document the crop grown and amount of total nitrogen applied from

wastewater, stormwater, manure solids, composted material, irrigation water and other additional fertilizer(s), and the residual soil nitrogen and nitrogen credits from leguminous crops. The permittee shall submit a land application data sheet or a statement that land application did not occur to the department in the quarterly monitoring reports. The land application data sheet shall include the following elements ~~from the previous six quarters~~.

(1) The total monthly volume, reported in acre-feet, of wastewater and stormwater applied to each field within the land application area. Total monthly volumes shall be obtained from flow meter readings of each application pursuant to Subsections A and B of this section.

(2) The total nitrogen concentration of wastewater and stormwater obtained from the corresponding quarterly analyses collected pursuant to Subsection C of this section and Subsection D of 20.6.6.24 NMAC.

(3) The total monthly volume, reported in tons per acre, of manure solids applied to each field within the land application area.

(4) The total nitrogen content of the manure solids estimated at 25 pounds of nitrogen per ton or determined from analysis of manure solids samples collected pursuant to Subsection D of this section.

(5) The total nitrogen concentration within the irrigation water and the amount of irrigation water applied pursuant to Subsection E of this section.

(6) The amount of nitrogen reported in pounds per acre from additional fertilizer(s) applied pursuant to Subsection F of this section.

(7) The amount of residual soil nitrogen and nitrogen from leguminous crops credited to each field within the land application area pursuant to Subsections K and L of this section.

H. Crop yield documentation. A permittee shall submit crop yield documentation and plant and harvest dates of each crop grown to the department in the quarterly monitoring reports. Crop yield documentation shall consist of copies of scale-weight tickets or harvest summaries based on scale-weights.

I. Nitrogen concentration of harvested crop. A permittee shall determine the total nitrogen concentration of each harvested crop. A composite sample consisting of 15 sub-samples of plant material shall be taken from each field during the final harvest of each crop grown per year. Samples shall be analyzed for percent total nitrogen and percent dry matter. A permittee shall submit the analytical reports to the department in the quarterly monitoring reports.

J. Nitrogen removal summary of harvested crop. A permittee shall develop a nitrogen removal summary to determine total nitrogen removed by each crop grown on each field within the land application area. Nitrogen removal shall be determined using crop yield and total nitrogen concentration information collected pursuant to Subsections H and I of this section. A permittee shall submit the summary to the department in the quarterly monitoring reports.

K. Soil sampling - initial event in a discharge permit term. A permittee shall collect composite soil samples from each field within the land application area for the first soil sampling event during the first year following the effective date of the discharge permit. Composite soil samples shall be collected ~~in the five-month period between September 1 and January 31~~ for all fields regardless of whether the field is cropped, remains fallow, or has received wastewater or stormwater. One surface composite soil sample (first-foot) and two sub-surface composite soil samples (second-foot and third-foot) shall be collected from each field. Composite soil samples shall be collected and analyzed according to the following procedure.

(1) Each surface and sub-surface soil sample shall consist of a single composite of 15 soil cores collected randomly throughout each field. Should a field consist of different soil textures (i.e., sandy and silty clay), a composite soil sample shall be collected from each soil texture within each field.

(2) Surface soil samples (first-foot) shall be collected from a depth of 0 to 12 inches.

(3) Each second-foot sub-surface soil sample shall be collected from a depth of 12 to 24 inches.

(4) Each third-foot sub-surface soil sample shall be collected from a depth of 24 to 36 inches.

(5) Each surface and sub-surface composite sample shall be analyzed for pH, electrical conductivity, total Kjeldahl nitrogen, nitrate as nitrogen, chloride, organic matter, potassium, phosphorus, sodium, calcium, magnesium, sulfate, soil texture, and sodium adsorption ratio.

(6) pH, electrical conductivity, sodium, calcium, magnesium, and sulfate shall be analyzed using a saturated paste extract in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Phosphorus shall be analyzed using the Olsen sodium bicarbonate method in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Nitrate as nitrogen shall be analyzed by a 2 molar KCl extract in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Total Kjeldahl nitrogen, chloride, organic matter, potassium, soil texture, and sodium adsorption ratio shall be analyzed in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC.

(7) The permittee shall submit the analytical results and a map showing the fields and the sampling locations within each field to the department in the monitoring report due by May 1 following the effective date of the discharge permit.

L. Soil sampling - routine. Beginning in the year following the initial soil sampling required by this section, the permittee shall collect annual soil samples from each field within the land application area that has received or is actively receiving wastewater or stormwater. ~~Composite soil samples shall be collected in the five-month period between September 1 and January 31.~~ For those fields that have never before received wastewater, the permittee shall collect soil samples immediately before initial wastewater application and annually thereafter. Once a field has received wastewater it shall be sampled annually regardless of whether the field is cropped, remains fallow, or has recently received wastewater or stormwater. One surface composite soil sample (first-foot) and two sub-surface composite soil samples (second-foot and third-foot) shall be collected from each field. Composite soil samples shall be collected and analyzed according to the following procedure.

(1) Each surface and sub-surface soil sample shall consist of a single composite of 15 soil cores collected randomly throughout each field. Should a field consist of different soil textures (i.e., sandy and silty clay), a composite soil sample shall be collected from each soil texture within each field.

(2) Surface soil samples (first-foot) shall be collected from a depth of 0 to 12 inches.

(3) Each second-foot sub-surface soil sample shall be collected from a depth of 12 to 24 inches.

(4) Each third-foot sub-surface soil sample shall be collected from a depth of 24 to 36 inches.

(5) Surface soil samples shall be analyzed for pH, electrical conductivity, nitrate as nitrogen, chloride, organic matter, potassium, phosphorus, sodium, calcium, magnesium, and sodium adsorption ratio.

(6) Sub-surface soil samples shall be analyzed for electrical conductivity, nitrate as nitrogen, and chloride.

(7) pH, electrical conductivity, sodium, calcium, and magnesium shall be analyzed using a saturated paste extract in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Phosphorus shall be analyzed using the Olsen sodium bicarbonate method in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Nitrate as nitrogen shall be analyzed by a 2 molar KCl extract in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC. Chloride, organic matter, potassium, and sodium adsorption ratio shall be analyzed in accordance with the analytical methodology required by Subsection B of 20.6.6.24 NMAC.

(8) The permittee shall submit the analytical results and a map showing the fields and the sampling locations within each field to the department in the monitoring report due by May 1.

[20.6.6.25 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.26 ADDITIONAL MONITORING REQUIREMENTS FOR DAIRY FACILITIES DISCHARGING TO AN EVAPORATIVE WASTEWATER DISPOSAL SYSTEM: Wastewater to be evaporated - sampling and reporting. A permittee shall collect a composite wastewater sample on a semi-annual (once every six months) basis from each wastewater or combination wastewater/stormwater impoundment used for disposal by evaporation. ~~The composite sample from each impoundment shall consist of a minimum of six sub-samples collected around the entire perimeter of each impoundment and thoroughly mixed.~~ Samples shall be analyzed for nitrate as nitrogen, total Kjeldahl nitrogen, chloride, total sulfur and total dissolved solids pursuant to Subsection B of 20.6.6.24 NMAC. A permittee shall submit the analytical results to the department in the monitoring reports due by May 1 and November 1.

[20.6.6.26 NMAC - N, 01/31/2011]

20.6.6.27 CONTINGENCY REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Exceedance of ground water standards - all monitoring wells ~~except impoundment monitoring wells~~. If the constituent concentration in a ground water sample and in the next ground water sample collected from the same monitoring well intended to monitor a contamination source ~~other than an impoundment~~ exceeds one or more of the ground water standards of 20.6.2.3103 NMAC and exceeds the concentration of such constituent(s) in a ground water sample collected from the upgradient monitoring well, or if the extent or magnitude of existing ground water contamination is significantly increasing, then the permittee shall take the following actions. For the purpose of this subsection, ground ~~well~~-water samples obtained from the source monitoring well and the upgradient monitoring well that are used for comparison of constituent concentrations shall be collected within two days of each other, provided that if there is sufficient ground water quality data to demonstrate that samples from different periods should be compared, the department may allow such a comparison. If ground water quality data for the upgradient monitoring well are not submitted by the permittee, the ground water standards of

20.6.2.3103 NMAC shall be the applicable standard used to determine if the requirements of this subsection must be met. The contingency requirements of Paragraphs (1) and (2) of this subsection shall not apply if corrective action previously has been taken to address ground water contamination and constituent concentrations have stabilized or improved, but this exception shall no longer apply if a constituent concentration increases for two consecutive sampling events and exceeds its standard or the upgradient concentration. Once enacted the contingency requirements of this subsection apply until the permittee has fulfilled the requirements of this subsection and ground water monitoring pursuant to 20.6.6.23 NMAC confirms for a minimum of eight consecutive ground water sampling events that the standards of 20.6.2.3103 NMAC are not exceeded and the total nitrogen concentration in ground water is less than or equal to 10 milligrams per liter or until the department requires an abatement plan pursuant to Paragraph (3) of this subsection.

(1) A corrective action plan shall be submitted within 120 days of the subsequent sample analysis date unless a petition for variance is filed in accordance with Paragraph (2) of this subsection. The corrective action plan shall describe any repairs made to address the cause of the exceedance, and propose source control measures and a schedule for implementation. The implementation schedule shall include a schedule of all proposed corrective action activities and the date that corrective action will be completed. The department shall approve or disapprove the corrective action plan within 60 days of receipt. Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. If the department does not approve the corrective action plan, the department shall notify the permittee of the deficiencies by certified mail. The permittee shall submit a revised corrective action plan to the department within 60 days of the date of postal notice of the notice of deficiency. The department shall approve or disapprove the corrective action plan within 60 days of receipt. If the department does not approve the revised corrective action plan, or if the permittee fails to submit a revised plan as required by this subsection, the department may pursue enforcement actions authorized by Section 74-6-10 NMSA 1978.

(2) The permittee may investigate potential sources of contamination that may have caused a standard(s) to be exceeded. If such an investigation indicates that the source of the contamination is not the source intended to be monitored by the well, the permittee may petition within 120 days of the subsequent sample analysis date for a variance from the requirements of this section in accordance with 20.6.2.1210 NMAC. It is the permittee's burden to prove any claim that the source of the contamination is not the source intended to be monitored by the well. If the petition is denied the permittee shall submit a corrective action plan meeting the requirements of Paragraph (1) of this subsection within 60 days of the denial.

(3) The permittee may be required to submit an abatement plan proposal pursuant to 20.6.2.4106 NMAC within 60 days of written notice from the department. Abatement shall be performed pursuant to 20.6.2.4101, 20.6.2.4103, 20.6.2.4104, and 20.6.2.4106 through 20.6.2.4115 NMAC.

B. Exceedance of ground water standards - impoundment monitoring well. If the constituent concentration in a ground water sample ~~and in the next ground water sample~~ collected from a monitoring well intended to monitor an impoundment(s) exceeds one or more of the ground water standards of 20.6.2.3103 NMAC and exceeds the concentration of such constituent(s) in a ground water sample collected from the upgradient monitoring well for four consecutive quarters, then ~~the permittee shall enact~~ the department may require the permittee, by written notice, to take one of the following measures. Before notifying the permittee that action is required under this subsection, the department shall take into consideration site-specific conditions including, but not limited to, geology, depth to ground water, threats to public health, and the trends in contamination at the site. For the purpose of this subsection, ground water samples obtained from the impoundment monitoring well and the upgradient monitoring well that are used for comparison of constituent concentrations shall be collected within two days of each other, provided that if there is sufficient ground water quality data to demonstrate that samples from different periods should be compared, the department may allow such a comparison. If ground water quality data for the upgradient monitoring well are not submitted by the permittee, the ground water standard(s) of 20.6.2.3103 NMAC shall be the applicable standard(s) used to determine if the requirements of this subsection must be met. The contingency requirements of Subparagraphs (a) through (c) of Paragraph (1) and Sub-subparagraphs (i) through (iii) of Sub-paragraph (a) of Paragraph (2) of this subsection shall not apply if corrective action previously has been taken to address ground water contamination and constituent concentrations have stabilized or improved, but this exception shall no longer apply if a constituent concentration increases for two consecutive sampling events and exceeds its standard or the upgradient concentration. Once enacted the contingency requirements of this subsection apply until the permittee has fulfilled the requirements of this subsection and ground water monitoring pursuant to 20.6.6.23 NMAC confirms for a minimum of eight consecutive ground water sampling events that the standards of 20.6.2.3103 NMAC are not exceeded and the total nitrogen concentration in ground water is less than or equal to 10

milligrams per liter or until the department requires an abatement plan pursuant to Subparagraph (d) of Paragraph (1) or Sub-subparagraph (iv) of Subparagraph (a) of Paragraph (2) of this subsection.

(1) **Clay liner or Pre-dairy rule liner not composed of 40/30-mil HDPE (minimum) or equivalent.** For impoundments using a clay liner or a liner installed prior to the effective date of the dairy rule and composed of a material that is not, at a minimum, 40-mil unreinforced HDPE, 30-mil reinforced HDPE, (or other material having equivalent characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance), the following actions shall be taken.

(a) A corrective action plan shall be submitted within 120 days of the ~~subsequent~~ sample analysis date of the fourth of the consecutive sampling events unless a petition for variance is filed in accordance with Subparagraph (c) of this paragraph. The corrective action plan shall describe any repairs or changes in practices made to address the cause of the exceedance, and propose source control measures and a schedule for implementation. The implementation schedule shall include a schedule of all proposed corrective action activities and the date that corrective action will be completed. The department shall approve or disapprove the corrective action plan within 60 days of receipt. If the corrective action plan proposes actions to correct deficiencies with the liner, the proposed actions shall include the following items.

(i) A proposal for reconstruction and relining of an existing impoundment, or construction and lining of a new impoundment utilizing a synthetic liner as specified in Paragraph (5) of Subsection D of 20.6.6.17 NMAC. Reconstruction or new construction shall be completed pursuant to 20.6.6.17 NMAC within one year of the date of postal notice from the department that action is required under this subsection ~~subsequent sample analysis date~~. If a new impoundment is constructed, the existing impoundment shall be permanently closed pursuant to 20.6.6.30 NMAC.

(ii) Reconstruction or construction plans and specifications for the impoundment shall be completed pursuant to 20.6.6.17 NMAC.

(b) Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. If the department does not approve the corrective action plan, the department shall notify the permittee of the deficiencies by certified mail. The permittee shall submit a revised correction action plan to the department within 60 days of the date of postal notice of the notice of deficiency. The department shall approve or disapprove the revised corrective action plan within 60 days of receipt. If the department does not approve the revised corrective action plan, or if the permittee fails to submit a revised plan as required by this subsection, the department may pursue enforcement actions authorized by Section 74-6-10 NMSA 1978.

(c) The permittee may investigate potential sources of contamination that may have caused a standard(s) to be exceeded. If such an investigation indicates that the source of the contamination is not the impoundment intended to be monitored by the well, the permittee may petition within 120 days of the date of postal notice from the department that action is required under this subsection~~subsequent sample analysis date~~ for a variance from the requirements of this section in accordance with 20.6.2.1210 NMAC. It is the permittee's burden to prove any claim that the source of the contamination is not the impoundment intended to be monitored by the well. If the variance is denied the permittee shall submit a corrective action plan meeting the requirements of Subparagraph (a) of this paragraph within 60 days of the denial.

(d) The permittee may be required to submit an abatement plan proposal pursuant to 20.6.2.4106 NMAC within 60 days of written notice from the department. Abatement shall be performed pursuant to 20.6.2.4101, 20.6.2.4103, 20.6.2.4104, and 20.6.2.4106 through 20.6.2.4115 NMAC.

(2) **Dairy rule liner or pre-dairy rule liner composed of 40/30-mil (minimum) HDPE or equivalent.** For impoundments using a liner installed after the effective date of the dairy rule and composed of a material that is, at a minimum, 60-mil HDPE (or other material having equivalent characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance), or impoundments using a liner installed prior to the effective date of the dairy rule and composed of a material that is, at a minimum, 40-mil unreinforced HDPE, 30-mil reinforced HDPE, (or other material having equivalent characteristics with regard to permeability, resistance to degradation by ultraviolet light, compatibility with the liquids anticipated to be collected in the impoundment, tensile strength, and tear and puncture resistance), the following actions shall be taken.

(a) **Initial liner.** For impoundments where the existing liner is the initial liner installed, the following actions shall be taken.

(i) A corrective action plan shall be submitted within 120 days of the date of postal notice from the department that action is required under this subsection~~subsequent sample analysis date~~ unless a

petition for variance is filed in accordance with Sub-subparagraph (iii) of this subparagraph. The corrective action plan shall describe any repairs or changes in practices made to address the cause of the exceedance, and propose source control measures and a schedule for implementation. The implementation schedule shall include a schedule of all proposed corrective action activities and the date that corrective action will be completed. The department shall approve or disapprove the corrective action plan within 60 days of receipt. If the corrective action plan proposes actions to correct deficiencies with the liner, the proposed actions shall include repair or replacement of the existing liner, or construction and lining of a new impoundment. If liner repair is practicable, repairs shall be made pursuant to 20.6.6.17 NMAC or using a material that is equivalent to the existing liner with respect to material thickness and composition. Repairs shall be completed within 240 days of the date of postal notice from the department that action is required under this subsection~~subsequent sample analysis date~~. If liner repair is not practicable, the corrective action plan shall propose reconstruction and synthetic relining of the impoundment pursuant to 20.6.6.17 NMAC or construction and synthetic lining of a new impoundment pursuant to 20.6.6.17 NMAC within one year of the subsequent sample analysis date. Reconstruction or construction plans and specifications for the impoundment shall be completed pursuant to 20.6.6.17 NMAC and submitted with the corrective action plan. If a new impoundment is constructed the existing impoundment shall be closed pursuant to 20.6.6.30 NMAC.

(ii) Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. If the department does not approve the corrective action plan, the department shall notify the permittee of the deficiencies by certified mail. The permittee shall submit a revised corrective action plan to the department within 60 days of the date of postal notice of the notice of deficiency. The department shall approve or disapprove the revised corrective action plan within 60 days of receipt. If the department does not approve the revised corrective action plan, or if the permittee fails to submit a revised plan as required by this subsection, the department may pursue enforcement actions authorized by Section 74-6-10 NMSA 1978.

(iii) The permittee may investigate potential sources of contamination that may have caused a standard(s) to be exceeded. If such an investigation indicates that the source of the contamination is not the impoundment intended to be monitored by the well, the permittee may petition within 120 days of the subsequent sample analysis date for a variance from the requirements of this section in accordance with 20.6.2.1210 NMAC. It is the permittee's burden to prove any claim that the source of the contamination is not the impoundment intended to be monitored by the well. If the variance is denied the permittee shall submit a corrective action plan meeting the requirements of Sub-subparagraph (i) of this subparagraph within 60 days of the denial.

(iv) The permittee may be required to submit an abatement plan proposal pursuant to 20.6.2.4106 NMAC within 60 days of written notification from the department. Abatement shall be performed pursuant to 20.6.2.4101, 20.6.2.4103, 20.6.2.4104, and 20.6.2.4106 through 20.6.2.4115 NMAC.

(b) **Replacement liner.** If source control measures have been previously implemented such that the existing liner replaced a previously installed liner in an impoundment and ground water standard(s) of 20.6.2.3103 NMAC continue to be exceeded, such impoundments are authorized to continue to receive wastewater or stormwater pursuant to the following requirements.

(i) The permittee may be required to submit an abatement plan proposal pursuant to 20.6.2.4106 NMAC within 60 days of written notice from the department if abatement has not been previously implemented. Abatement shall be performed pursuant to 20.6.2.4101, 20.6.2.4103, 20.6.2.4104, and 20.6.2.4106 through 20.6.2.4115 NMAC.

(ii) If the results of abatement activities indicate that the replacement liner does not successfully control the source of contamination, the department may modify the discharge permit pursuant to Subsection E of 20.6.2.3109 NMAC and include additional conditions pursuant to Subsection H of 20.6.6.10 NMAC. The additional conditions shall address, but are not limited to, further source control measures, which may include but are not limited to design, installation and construction of a composite liner system consistent with those described in the Guide for Industrial Waste Management, Part IV: Protecting Ground Water, Chapter 7: Section B, Designing and Installing Liners, Technical Considerations for New Surface Impoundments, Landfills and Waste Piles (U.S. Environmental Protection Agency), incorporated herein by this reference. The requirements of 20.6.6.15 NMAC shall apply to hearing requests on the proposed additional discharge permit conditions.

(3) If the department notifies a permittee that action is required under this subsection, the applicant or permittee may notify the secretary by certified mail, sent within 30 days after the date of postal notice of the department's notice, that the applicant or permittee invokes dispute resolution under this paragraph. Upon such notice, the department, as represented by the secretary, deputy secretary, or division director and the applicant or permittee shall meet in person within 30 days and shall attempt in good faith to resolve the dispute.

C. Monitoring well replacement. If information available to the department indicates that a monitoring well(s) required by 20.6.6.23 NMAC is not located hydrologically downgradient of the contamination source it is intended to monitor, is not completed pursuant to 20.6.6.23 NMAC or contains insufficient water to ~~effectively~~ monitor ground water quality effectively, a permittee shall install a replacement monitoring well(s). The replacement monitoring well(s) shall be installed within 120 days of the date of postal notice of notification from the department and a survey of the replacement monitoring well(s) shall be performed within 150 days of the date of postal notice of notification from the department, provided the department may grant an extension for good cause shown. The replacement monitoring well(s) shall be located, installed, completed, surveyed and sampled pursuant to 20.6.6.23 NMAC. The permittee shall develop a monitoring well completion report pursuant to Subsection J of 20.6.6.23 NMAC and submit it to the department within 180 days of the date of postal notice of notification from the department, provided the department may grant an extension for good cause shown.

D. Exceedances of permitted maximum daily discharge volume. If the maximum daily discharge volume authorized by the discharge permit is exceeded by more than ten percent for any four average daily discharge volumes within any 12-week period, the permittee shall submit within 60 days of the fourth exceedance: a corrective action plan for reducing the discharge volume; or an application for a modified or renewed and modified discharge permit pursuant to 20.6.6.10 NMAC. Within 30 days of postal notice of department approval, the permittee shall initiate implementation of the corrective action plan.

E. Insufficient impoundment capacity. If a survey, capacity calculations, or settled solids thickness measurements, indicate an existing impoundment is not capable of meeting the capacity requirements required by Subsection D of 20.6.6.17 NMAC, then within 90 days of the effective date of the discharge permit the permittee shall submit a corrective action plan for department approval. The plan may include, but is not limited to, proposals for constructing an additional impoundment, reducing the discharge volume, removing accumulated solids, changing wastewater or stormwater management practices, or installing an advanced treatment system. The corrective action plan shall include a schedule for implementation through completion of corrective actions. The corrective action plan schedule shall propose completion not to exceed one year from the submittal date of the initial corrective action plan. Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. Should the corrective action plan include removal of accumulated solids, solids shall be removed from the impoundment in a manner that is protective of the impoundment liner. The plan shall include the method of removal, and locations and methods for storage and disposal of the solids-slurry. If the plan proposes land application of the solids-slurry, the plan must also include the analytical results of total Kjeldahl nitrogen and chloride obtained from a representative sample of the solids-slurry to be applied. Notwithstanding Paragraph (6) of Subsection D of 20.6.6.17 NMAC, if a corrective action plan required under this subsection calls for construction of a new wastewater impoundment or improvement of an existing wastewater impoundment, and ground water quality standards have not been exceeded in monitoring wells installed to monitor the existing impoundment for the four quarters preceding submission of the corrective action plan, the permittee may propose and the department may approve a liner for the new wastewater impoundment or improvement of the existing impoundment consistent with the liner design approved by the department at the time of the last discharge permit issued by the department before the effective date of the dairy rule.

F. Inability to preserve required freeboard. If a minimum of two feet of freeboard cannot be preserved in the wastewater impoundment, the permittee shall submit a corrective action plan to the department for approval. The corrective action plan shall be submitted within 30 days of the date of the initial exceedance of the freeboard requirement. The plan may include, but is not limited to, proposals for constructing an additional impoundment, reducing the maximum daily discharge volume, changing wastewater management practices, or installing an advanced wastewater treatment system. The corrective action plan shall include actions to be immediately implemented to regain and maintain a minimum of two feet of freeboard until permanent corrective actions have been completed. The corrective action plan shall include a schedule for implementation through completion of corrective actions. The corrective action plan schedule shall propose completion not to exceed one year from the submittal date of the initial corrective action plan. Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. Notwithstanding Paragraph (6) of Subsection D of 20.6.6.17 NMAC, if a corrective action plan required under this subsection calls for construction of a new wastewater impoundment or improvement of an existing wastewater impoundment, and ground water quality standards have not been exceeded in monitoring wells installed to monitor the existing impoundment for the four quarters preceding submission of the corrective action plan, then the permittee may propose and the department may approve a liner for the new wastewater impoundment or improvement of the existing impoundment consistent with the liner design approved by the department at the time of the last discharge permit issued by the department before the effective date of the dairy rule.

G. Impoundment - structural integrity compromised. Within 24 hours of discovery, a permittee shall report to the department, any damage to the berms or the liner of an impoundment or any condition that exists that may compromise the structural integrity of the impoundment. Within 15 days of the reported discovery, the permittee shall submit to the department a corrective action plan describing any actions taken or proposed to be taken to repair the damage or condition. Within 30 days of receipt, the department shall respond to the proposed corrective action plan. Repairs to the impoundment liner or berms shall be completed pursuant to 20.6.6.17 NMAC. The corrective action plan shall include a schedule for implementation through completion of corrective actions. The corrective action plan schedule shall propose completion not to exceed one year from the submittal date of the initial corrective action plan. The schedule of corrective actions shall be commensurate to the magnitude and scope of the activities to be completed. Within 30 days of the date of postal notice of the department's approval of the corrective action plan, the permittee shall initiate implementation of the plan. Notwithstanding Paragraph (6) of Subsection D of 20.6.6.17 NMAC, if a corrective action plan required under this subsection calls for construction of a new wastewater impoundment or improvement of an existing wastewater impoundment, and ground water quality standards have not been exceeded ~~in monitoring wells installed to monitor the existing impoundment~~ for the four quarters preceding submission of the corrective action plan, then the permittee may propose and the department may approve a liner for the new wastewater impoundment or improvement of the existing impoundment consistent with the liner design approved by the department at the time of the last discharge permit issued by the department before the effective date of the dairy rule.

H. Unauthorized discharge - reporting and correction. In the event of a spill or release that is not authorized by the discharge permit, the permittee shall notify the department and take corrective actions pursuant to 20.6.2.1203 NMAC. Wastewater or stormwater shall be contained and pumped to a permitted sump, impoundment, or land application area pursuant to the dairy rule. Wastewater or stormwater applied to the land application area shall conform to the requirements of 20.6.6.21 and 20.6.6.25 NMAC. The permittee shall repair or replace failed components within 48 hours from the time of failure or as soon as practicable.
[20.6.6.27 NMAC - N, 01/31/2011; A, 12/31/2011]

20.6.6.28 [RESERVED]

20.6.6.29 ADDITIONAL CONTINGENCY REQUIREMENTS FOR DAIRY FACILITIES DISCHARGING TO AN EVAPORATIVE WASTEWATER DISPOSAL SYSTEM: Inability to maintain required freeboard. If a combination wastewater/stormwater impoundment used for disposal by evaporation does not have free capacity below the two-foot freeboard level required by Subsection D of 20.6.6.17 NMAC, then within seven days of the date of discovery of insufficient free capacity the permittee shall submit a corrective action plan for department approval. The plan shall include, but is not limited to, a request for temporary permission to discharge to allow immediate removal and disposal of combined wastewater and stormwater; a proposal for long-term corrective actions which may include constructing an additional impoundment; reducing the discharge volume; changing wastewater or stormwater management practices; or installing an advanced treatment system. The corrective action plan shall include schedule for implementation to complete corrective actions within one year from the submittal date of the initial corrective action plan. Upon department approval, the permittee shall initiate implementation of the corrective action plan.
[20.6.6.29 NMAC - N, 01/31/2011]

20.6.6.30 CLOSURE REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. Permanent closure of dairy facility or impoundments. The following closure actions shall be performed at dairy facilities.

(1) For permanent closure of a dairy facility.

(a) The department shall be notified no later than 30 days after wastewater discharge has permanently ceased at the dairy facility.

(b) Installation of ~~all~~ any additional monitoring wells shall be completed pursuant to 20.6.6.23 NMAC.

(c) All wastewater and combination wastewater/stormwater impoundments shall be emptied within six months of permanently ceasing wastewater discharge at the dairy facility; combination wastewater/stormwater impoundments may continue to receive stormwater after removal of the impounded wastewater/stormwater. All stormwater and combination wastewater /stormwater impoundments shall be emptied of stormwater within one year of ~~removing all livestock from the dairy facility~~cessation of wastewater discharge. Wastewater and stormwater removed from impoundments shall be applied to the designated land application area, as

authorized by a discharge permit. In the event that land application is not authorized by a discharge permit, a disposal plan shall be submitted for department approval and the plan implemented upon department approval.

(d) Manure solids and compost shall be removed from surface areas at the dairy facility and applied to the designated land application area, as authorized by a discharge permit, or transferred off-site for proper disposal ~~within one year of removing all livestock from the facility~~.

(e) Complete removal of manure solids from the wastewater impoundment(s) shall be achieved within two years of permanently ceasing wastewater discharge. Complete removal of manure solids from the stormwater and combination wastewater/stormwater impoundment(s) shall be achieved within two years of ~~removing all livestock from the dairy facility~~cessation of wastewater discharge. Manure solids shall be applied to the designated land application area, as authorized by a discharge permit. In the event that land application is not authorized by a discharge permit, a disposal plan shall be submitted for department approval and the plan implemented upon department approval.

(f) Impoundment liners shall be perforated or removed and the impoundments shall be re-graded with clean fill to blend with surface topography to prevent ponding within two years of permanently ceasing wastewater discharge ~~and removing all livestock from the facility~~.

(2) For closure of an impoundment at a facility not undergoing permanent closure (e.g., existing impoundment replaced with new impoundment).

(a) Impoundments shall be emptied of wastewater and stormwater within six months of ceasing receipt of wastewater or stormwater into the impoundments. Wastewater and stormwater removed from impoundments shall be applied to the designated land application area, as authorized by a discharge permit. If land application is not authorized by a discharge permit, a disposal plan shall be submitted for department approval and the plan implemented upon department approval.

(b) Complete removal of manure solids from impoundments shall be achieved within two years of ceasing receipt of wastewater or stormwater into the impoundments. Manure solids shall be applied to the designated land application area, as authorized by a discharge permit. If land application is not authorized by a discharge permit, a disposal plan shall be submitted for department approval and the plan implemented upon department approval.

(c) Liners in impoundments shall be perforated or removed and the impoundments shall be re-graded with clean fill to blend with surface topography to prevent ponding within two years of ceasing receipt of wastewater or stormwater into the impoundments.

B. Post-closure ground water sampling and reporting. Following completion and confirmation by the department of the requirements of Subsection A of this section, ground water monitoring shall continue pursuant to 20.6.6.23 NMAC until a minimum of eight consecutive ground water sampling events confirm that the standards of 20.6.2.3103 NMAC are not exceeded and the total nitrogen concentration in ground water is less than or equal to 10 milligrams per liter. If monitoring results show that one or more of the standards of 20.6.2.3103 NMAC is exceeded or the total nitrogen concentration in ground water is greater than 10 milligrams per liter, the permittee shall implement contingency requirements pursuant to 20.6.6.27 NMAC. Upon notification from the department that post-closure ground water monitoring may cease, the permittee shall abandon all monitoring wells and submit a report to the department pursuant to Subsection C of this section.

C. Monitoring well abandonment. Upon notification from the department, the permittee shall abandon monitoring wells pursuant to 19.27.4 NMAC and the following requirements.

(1) The well casing shall be removed and neat cement grout, bentonite based plugging material, or other sealing material approved by the state engineer in accordance with 19.27.4 NMAC shall be placed from the bottom of the borehole to the ground surface using a ~~tremmie~~tremie pipe.

(2) If the casing cannot be removed, neat cement grout, bentonite based plugging material, or other sealing material approved by the state engineer in accordance with 19.27.4 NMAC shall be emplaced in the well using a ~~tremmie~~tremie pipe from the bottom of the well to the ground surface.

(3) A well abandonment report shall be prepared by the permittee and shall provide information equivalent to the plugging record requirements of 19.27.4 NMAC. The well abandonment report shall be submitted to the department within 60 days of completion of well plugging activities.

~~**D. Discontinuance of ground water monitoring - former impoundments.** Ground water monitoring conducted at previously used impoundments pursuant to Subsection A of 20.6.6.23 NMAC may be discontinued following closure of the impoundment pursuant to Subsection A of this section. Upon the achievement of a minimum of eight consecutive ground water sampling events following completion of closure confirming the conditions of Paragraphs (1) and (2) of this subsection, the permittee may request approval to discontinue ground~~

~~water monitoring at previously used impoundments. Upon approval from the department, the permittee shall abandon the monitoring wells pursuant to Subsection C of this section.~~

~~(1) Ground water samples from the monitoring wells used to monitor the former impoundments confirm that the standards of 20.6.2.3103 NMAC are not exceeded.~~

~~(2) The total nitrogen concentration in ground water samples from monitoring wells used to monitor the former impoundments confirm that the total nitrogen concentration in ground water does not exceed 10 milligrams per liter.~~

~~**E. Discontinuance of ground water monitoring - former fields.** Ground water monitoring conducted at previously used fields within a land application area pursuant to Subsection A of 20.6.6.23 NMAC may be discontinued following cessation of land application of wastewater or stormwater to the field(s). Upon the achievement of a minimum of eight consecutive ground water sampling events following cessation of land application of wastewater or stormwater confirming the conditions of Paragraphs (1) and (2) of this subsection, the permittee may request approval to discontinue ground water monitoring at previously used fields. Upon approval from the department, the permittee shall abandon the monitoring wells pursuant to Subsection C of this section.~~

~~(1) Ground water samples from the monitoring wells used to monitor the former fields confirm that the standards of 20.6.2.3103 NMAC are not exceeded.~~

~~(2) The total nitrogen concentration in ground water samples from monitoring wells used to monitor the former fields confirm that the total nitrogen concentration in ground water does not exceed 10 milligrams per liter.~~

[20.6.6.30 NMAC - N, 01/31/2011]

20.6.6.31 [RESERVED]

20.6.6.32 [RESERVED]

20.6.6.33 RECORD RETENTION REQUIREMENTS FOR ALL DAIRY FACILITIES:

A. A permittee shall retain a written record at the dairy facility of all data and information related to field measurements, sampling, and analysis conducted pursuant to the dairy rule and the discharge permit. The following information shall be recorded and shall be made available to the department upon request.

(1) The dates, exact place and times of sampling or field measurements.

(2) The name and job title of the individuals who performed each sample collection or field measurement.

(3) The date of the analysis of each sample.

(4) The name and address of the laboratory and the name and job title of the person that performed the analysis of each sample.

(5) The analytical technique or method used to analyze each sample or take each field measurement.

(6) The results of each analysis or field measurement, including raw data.

(7) The results of any split, spiked, duplicate or repeat sample.

(8) A description of the quality assurance and quality control procedures used.

B. A permittee shall retain a written record at the dairy facility of any spills, seeps, or leaks of effluent, and of leachate or process fluids not authorized by the discharge permit. Records shall be made available to the department upon request.

C. A permittee shall retain a written record at the dairy facility of the operation, maintenance, and repair of all features/equipment used to treat, store or dispose of wastewater, measure flow rates, monitor water quality, or collect other data. Records shall include repair, replacement or calibration of any monitoring equipment and repair or replacement of any equipment used in the waste or wastewater treatment and disposal system. Records shall be made available to the department upon request.

D. A permittee shall retain records of all monitoring information at the dairy facility, including all calibration and maintenance records, copies of all reports, and the application for the discharge permit. Records shall be retained for a period of at least 10 years from the date of the sample collection, measurement, report or application.

[20.6.6.33 NMAC - N, 01/31/2011]

20.6.6.34 TRANSFER OF DAIRY DISCHARGE PERMITS:

A. Transfer of discharge permits for dairy facilities shall be made pursuant to 20.6.2.3111 NMAC and this section.

B. The transferee(s) shall notify the department, in writing, of the date of transfer of ownership and provide contact information for the new owner(s) pursuant to Subsection B of 20.6.6.11 NMAC and Subsection B of 20.6.6.12 NMAC. Notification shall be submitted to the department of the transfer within 30 days of the ownership transfer date.
[20.6.6.34 NMAC - N, 01/31/2011]

20.6.6.35 CONTINUING EFFECT OF PRIOR ACTIONS DURING TRANSITION:

A. A discharge permit issued pursuant to 20.6.2.3109 NMAC that has not expired on or before the effective date of the dairy rule shall remain in effect and enforceable pursuant to the conditions of the discharge permit and for its term as designated by Section 74-6-5 NMSA 1978. If an effective discharge permit contains a permit condition with a time period for submittal of a renewal application that is different from the time period contained in Subsection A of 20.6.6.10 NMAC that condition will remain in effect for two years following the effective date of the dairy rule.

B. An application for a new discharge permit or an application for a renewed or modified discharge permit submitted to the department before the effective date of the dairy rule shall be processed by the department if the application has been deemed administratively complete and the requirements of Subsection D of 20.6.2.3108 NMAC have been satisfied. The applicant shall submit a permit fee payment equal to one-half of the applicable permit fee from table 1 of 20.6.2.3114 NMAC within 90 days of the effective date of the dairy rule.

C. If a discharge permit for a dairy facility is expired on the effective date of the dairy rule and an application for renewal has not been received by the department, the permittee, owner of record of the dairy facility or the holder of the expired discharge permit:

(1) shall within 90 days of the effective date of the dairy rule submit to the department an application for a discharge permit renewal, renewal and modification or closure pursuant to 20.6.6.10 NMAC and a filing fee and permit fee payment pursuant to 20.6.6.9 NMAC; or

(2) if the dairy facility has not been constructed or operated, the permittee, the owner of record of the dairy facility or the holder of the expired discharge permit may submit a statement to the department instead of an application for renewal certifying that the facility has not been constructed or operated and that no discharges have occurred. Upon the department's verification of the certification, the department shall retire the discharge permit number from use.

D. The department shall process submissions meeting the requirements of Subsections B and C of this section according to the following schedule and subject to the public notice requirements of 20.6.2.3108 NMAC. If the department issues a discharge permit, the permittee shall have ninety days from the effective date of the discharge permit to submit all the necessary information to comply with 20.6.6.10 through 20.6.6.13 NMAC.

(1) For a new discharge permit application or for a renewal application for a discharge permit whose term ended on or before December 31, 2005, the department shall propose approval of a discharge permit or disapproval of an application within 90 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

(2) For a renewal application for a discharge permit whose term ended in calendar year 2006, the department shall propose approval of a discharge permit or disapproval of an application within 180 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

(3) For a renewal application for a discharge permit whose terms ended in calendar year 2007, the department shall propose approval of a discharge permit or disapproval of an application within 270 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

(4) For a renewal application for a discharge permit whose terms ended in calendar year 2008, the department shall propose approval of a discharge permit or disapproval of an application within 360 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

(5) For a renewal application for a discharge permits whose term ended in calendar year 2009, the department shall propose approval of a discharge permit or disapproval of an application within 450 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

(6) For a renewal application for a discharge permit whose term ended on or after January 1, 2010, but before the effective date of the dairy rule, the department shall propose approval of a discharge permit or disapproval of an application within 540 days of the effective date of the dairy rule. The department shall notify the applicant of the proposed action by certified mail.

E. Any dairy facility discharging, capable of recommencing discharging, or that has ceased discharging within the term of its most recent discharge permit shall continue all monitoring and submittal of monitoring reports as prescribed in the most recent discharge permit until the department issues a renewed or

renewed and modified discharge permit.

F. Any discharge permit proposed for approval (i.e., draft discharge permit) by the department pursuant to 20.6.2.3109 NMAC, but not made final before the effective date of the dairy rule, is withdrawn. Any permit fee submitted before the withdrawal of such a draft discharge permit shall be applied towards the permit fee for the permit issued pursuant to the dairy rule.

[20.6.6.35 NMAC - N, 01/31/2011]

HISTORY of 20.6.6 NMAC: [RESERVED]

EXHIBIT B
TO STIPULATION AMONG THE PARTIES REGARDING
PROPOSED AMENDMENTS TO THE DAIRY RULE
20.6.6 NMAC

Part IV
Protecting Ground Water

Chapter 7: Section B
Designing and Installing Liners

Technical Considerations for New Surface Impoundments, Landfills, and Waste Piles

Contents

Designing and Installing Liners—Technical Considerations for New Surface Impoundments, Landfills, and Waste Piles

This chapter will help you:

- *Employ liner systems where needed to protect ground water from contamination.*
- *Select from clay liners, synthetic liners, composite liners, leachate collection systems, and leak detection systems as appropriate.*
- *Consider technical issues carefully to ensure that the liner system will function as designed.*

Once risk has been characterized and the most appropriate design system is chosen, the next step is unit design. The Industrial Waste Management Evaluation Model (IWEM), discussed in Chapter 7, Section A—Assessing Risk can be used to determine appropriate design system recommendations. A critical part of this design for new landfills, waste piles, and surface impoundments is the liner system. The liner system recommendations in the Guide do not apply to land application units, since such operations generally do not include a liner system as part of their design. (For design of land application units, refer to Chapter 7, Section C—Designing a Land Application Program.) You should work with your state agency to ensure consideration of any applicable design system requirements, recommendations, or standard practices the state might have. In this chapter, sections I though IV discuss four design options—no liner/in-situ soils, single liner, composite liner, and double liner. Section V covers leachate collection and leak detection systems, and section VI discusses construction quality assurance and quality control.

I. In-Situ Soil Liners

For the purpose of the Guide, in-situ soil refers to simple, excavated areas or impoundments, without any additional engineering controls. The ability of natural soils to hinder transport and reduce the concentration of constituent levels through dilution and attenuation can provide sufficient protection when the initial constituent levels in the waste stream are very low, when the wastes are inert, or when the hydrogeologic setting affords sufficient protection.

What are the recommendations for in-situ soils?

The soil below and adjacent to a waste management unit should be suitable for construction. It should provide a firm foundation for the waste. Due to the low risk associated with wastes being managed in these units, a liner might not be necessary; however, it is still helpful to review the recommended location considerations and operating practices for the unit.

What technical issues should be considered with the use of in-situ soils?

In units using in-situ natural soils, construction and design of an engineered liner will not be necessary; however, there are still technical concerns to consider. These include the following:

- The stability of foundation soils.
- The compatibility of the waste with native soils.
- The location where the unit will be sited.
- The potential to recompact existing soils.

Potential instability can occur in the foundation soil, if its load-bearing capacity and resistance to movement or consolidation are insufficient to support the waste. The groundwater table or a weak soil layer also can influence the stability of the unit. You should take measures, such as designing maximum slopes, to avoid slope failure during construction and operation of the waste management unit. Most soil slopes are stable at a 3:1 horizontal to vertical inclination. There are common sense operating practices to ensure that any wastes to be managed on in-situ soils will not inappropriately interact with the soils. When using in-situ soils, refer to Chapter 4—Considering the Site. Selecting an appropriate location will be of increased importance, since the added barrier of an engineered liner will not be present. Because in-situ soil can have non-homogeneous material, root holes, and cracks, its performance can be improved by scarifying and compacting the top portion of the in-situ natural soils.

II. Single Liners

If the risk evaluation recommended the use of a single liner, the next step is to determine the type of single liner system most appropriate for the site. The discussion below addresses three types of single liner systems: compacted clay liners, geomembrane liners, and geosynthetic clay liners. Determining which material, or combination of materials, is important for protecting human health and the environment.[1]

A. Compacted Clay Liners

A compacted clay liner can serve as a single liner or as part of a composite or double liner system. Compacted clay liners are composed of natural mineral materials (natural soils), bentonite-soil blends, and other materials placed and compacted in layers called lifts. If natural soils at the site contain a significant quantity of clay, then liner materials can be excavated from onsite locations known as borrow pits. Alternatively, if onsite soils do not contain sufficient clay, clay materials can be hauled from offsite sources, often referred to as commercial pits.

Compacted clay liners can be designed to work effectively as hydraulic barriers. To ensure that compacted clay liners are well constructed and perform as they are designed, it is important to implement effective quality control methods emphasizing soil investigations and construction practices. Three objectives of quality assurance and quality control for compacted soil liners are to ensure that 1) selected liner materials are suitable, 2) liner materials are properly placed and compacted, and 3) the completed liner is properly protected before, during, and after construction. Quality assurance and quality control are discussed in greater detail in section VI.

[1] Many industry and trade periodicals, such as Waste Age, MSW Management, Solid Waste Technologies, and World Wastes, have articles on liner types and their corresponding costs, as well as advertisements and lists of vendors.

What are the thickness and hydraulic conductivity recommendations for compacted clay liners?

Compacted clay liners should be at least 2 feet thick and have a maximum hydraulic conductivity of 1×10^{-7} cm/sec (4×10^{-8} in/sec). Hydraulic conductivity refers to the degree of ease with which a fluid can flow through a material. A low hydraulic conductivity will help minimize leachate migration out of a unit. Designing a compacted clay liner with a thickness ranging from 2 to 5 feet will help ensure that the liner meets desired hydraulic conductivity standards and will also minimize leachate migration as a result of any cracks or imperfections present in the liner. Thicker compacted clay liners provide additional time to minimize leachate migration prior to the clay becoming saturated.

What issues should be considered in the design of a compacted clay liner?

The first step in designing a compacted clay liner is selecting the clay material. The quality and properties of the material will influence the performance of the liner. The most common type of compacted soil is one that is constructed from naturally occurring soils that contain a significant quantity of clay. Such soils are usually classified as CL, CH, or SC in the Unified Soil Classification System (USCS). Some of the factors to consider in choosing a soil include soil properties, interaction with wastes, and test results for potentially available materials.

Soil Properties

Minimizing hydraulic conductivity is the primary goal in constructing a soil liner. Factors to consider are water content, plasticity characteristics, percent fines, and percent gravel, as these properties affect the soil's ability to achieve a specified hydraulic conductivity.

Hydraulic conductivity. It is important to select compacted clay liner materials so that remolding and compacting of the materials will produce a low hydraulic conductivity. Factors influencing the hydraulic conductivity at a particular site include: the degree of compaction, compaction method, type of clay material used, soil moisture content, and density of the soil during liner construction. The hydraulic conductivity of a soil also depends on the viscosity and density of the fluid flowing through it. Consider measuring hydraulic conductivity using methods such as American Society of Testing and Materials (ASTM) D-5084.[2]

Water content. Water content refers to the amount of liquid, or free water, contained in a given amount of material. Measuring water content can help determine whether a clay material needs preprocessing, such as moisture adjustment or soil amendments, to yield a specified density or hydraulic conductivity. Compaction curves can be used to depict moisture and density relationships, using either ASTM D-698 or ASTM D-1557, the standard or modified Proctor test methods, depending on the compaction equipment used and the degree of firmness in the foundation materials.[3] The critical relationship between clay soil moisture content and density is explained thoroughly in Chapter 2 of EPA's 1993 technical guidance document *Quality*

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[2] ASTM D-5084, Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

[3] ASTM D-698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
ASTM D-1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

Assurance and Quality Control for Waste Containment Facilities (U.S. EPA, 1993c).

Plasticity characteristics. Plasticity characteristics describe a material's ability to behave as a plastic or moldable material. Soils containing clay are generally categorized as plastic. Soils that do not contain clay are non-plastic and typically considered unsuitable materials for compacted clay liners, unless soil amendments such as bentonite clay are introduced.

Plasticity characteristics are quantified by three parameters: liquid limit, plastic limit, and plasticity index. The liquid limit is defined as the minimum moisture content (in percent of oven-dried weight) at which a soil-water mixture can flow. The plastic limit is the minimum moisture content at which a soil can be molded. The plasticity index is defined as the liquid limit minus the plastic limit and defines the range of moisture content over which a soil exhibits plastic behavior. When soils with high plastic limits are too dry during placement, they tend to form clods, or hardened clumps, that are difficult to break down during compaction. As a result, preferential pathways can form around these clumps allowing leachate to flow through the material at a higher rate. Soil plasticity indices typically range from 10 percent to 30 percent. Soils with a plasticity index greater than 30 percent are cohesive, sticky, and difficult to work with in the field. Common testing methods for plasticity characteristics include the methods specified in ASTM D-4318, also known as Atterberg limits tests.[4]

Percent fines and percent gravel. Typical soil liner materials contain at least 30 percent fines and can contain up to 50 percent gravel, by weight. Common testing methods for percent fines and percent gravel are specified in ASTM D-422, also referred to as grain size distribution tests.[5] Fines refer to silt and clay-sized particles. Soils with less than 30 percent fines can be worked to obtain hydraulic conductivities below 1 x 10^{-7} cm/sec (4 x 10^{-8} in./sec), but use of these soils requires more careful construction practices.

Gravel is defined as particles unable to pass through the openings of a Number 4 sieve, which has an opening size equal to 4.76 mm (0.2 in.). Although gravel itself has a high hydraulic conductivity, relatively large amounts of gravel, up to 50 percent by weight, can be uniformly mixed with clay materials without significantly increasing the hydraulic conductivity of the material. Clay materials fill voids created between gravel particles, thereby creating a gravel-clay mixture with a low hydraulic conductivity. As long as the percent gravel in a compacted clay mixture remains below 50 percent, creating a uniform mixture of clay and gravel, where clay can fill in gaps, is more critical than the actual gravel content of the mixture.

You should pay close attention to the percent gravel in cases where a compacted clay liner functions as a bottom layer to a geosynthetic, as gravel can cause puncturing in geosynthetic materials. Controlling the maximum particle size and angularity of the gravel should help prevent puncturing, as well as prevent gravel from creating preferential flow paths. Similar to gravel, soil particles or rock fragments also can create preferential flow paths. To help prevent the development of preferential pathways and an increased hydraulic conductivity, it is best to use soil liner materials where the soil particles and rock fragments are typically small (e.g., 3/4 inch in diameter).

Interactions With Waste

Waste placed in a unit can interact with compacted clay liner materials, thereby influencing soil properties such as hydraulic con-

[4] ASTM D-4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

[5] ASTM D-422, Standard Test Method for Particle-Size Analysis of Soils.

ductivity and permeability. Two ways that waste materials can influence the hydraulic conductivity of the liner materials are through dissolution of soil minerals and changes in clay structure. Soil minerals can be dissolved, or reduced to liquid form, as a result of interaction with acids and bases. For example, aluminum and iron in the soil can be dissolved by acids, and silica can be dissolved by bases. While some plugging of soil pores by dissolved minerals can lower hydraulic conductivity in the short term, the creation of piping and channels over time can lead to an increased hydraulic conductivity in the long term. The interaction of waste and clay materials can also cause the creation of positive ions, or cations. The presence of cations such as sodium, potassium, calcium, and magnesium can change the clay structure, thereby influencing the hydraulic conductivity of the liner. Depending on the cation type and the clay mineral, an increased presence of such cations can cause the clay minerals to form clusters and increase the permeability of the clay. Therefore, before selecting a compacted clay liner material, it is important to develop a good understanding of the composition of the waste that will be placed in the waste management unit. EPA's Method 9100, in publication SW-846, measures the hydraulic conductivity of soil samples before and after exposure to permeants.[6]

Locating and Testing Material

Although the selection process for compacted clay liner construction materials can vary from project to project, some common material selection steps include locating and testing materials at a potential borrow or commercial pit before construction, and observing and testing material performance throughout construction. First, investigate a potential borrow or commercial pit to determine the volume of materials available. The next step is to test a representative sample of soil to determine material properties such as plasticity characteristics, percent gravel, and percent fines. To confirm the suitability of the materials once construction begins, you should consider requesting that representative samples from the materials in the borrow or commercial pit be tested periodically after work has started.

Material selection steps will vary, depending on the origin of the materials for the project. For example, if a commercial pit provides the materials, locating an appropriate onsite borrow pit is not necessary. In addition to the tests performed on the material, it is recommended that a qualified inspector make visual observations throughout the construction process to ensure that harmful materials, such as stones or other large matter, are not present in the liner material.

What issues should be considered in the construction of a liner and the operation of a unit?

You should develop test pads to demonstrate construction techniques and material performance on a small scale. During unit construction and operation, some additional factors influencing the performance of the liner include: preprocessing, subgrade preparation, method of compaction, and protection against desiccation and cracking. Each of these steps, from preprocessing through protection against desiccation and cracking, should be repeated for each lift or layer of soil.

Test Pads

Preparing a test pad for the compacted clay liner helps verify that the materials and methods proposed will yield a liner that meets the desired hydraulic conductivity. A test pad also provides an opportunity to

[6] SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.*

demonstrate the performance of alternative materials or methods of construction. A test pad should be constructed with the soil liner materials proposed for a particular project, using the same preprocessing procedures, compaction equipment, and construction practices proposed for the actual liner. A complete discussion of test pads (covering dimensions, materials, and construction) can be found in Chapter 2 of EPA's 1993 technical guidance document *Quality Assurance and Quality Control for Waste Containment Facilities* (U.S. EPA, 1993c). A discussion of commonly used methods to measure in-situ hydraulic conductivity is also contained in that chapter.

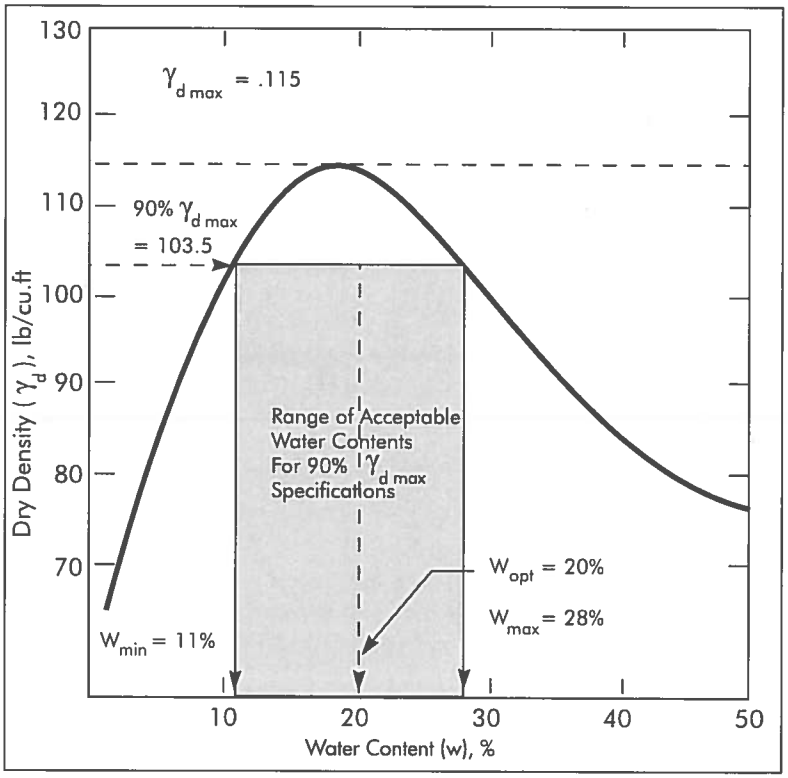
Preprocessing

Although some liner materials can be ready for use in construction immediately after they are excavated, many materials will require some degree of preprocessing. Preprocessing methods include: water content adjustment, removal of oversized particles, pulverization of any clumps, homogenization of the soils, and introduction of additives, such as bentonite.

Water content adjustment. For natural soils, the degree of saturation of the soil liner at the time of compaction, known as molding water content, influences the engineering properties of the compacted material. Soils compacted at water contents less than optimum tend to have a relatively high hydraulic conductivity. Soils compacted at water contents greater than optimum tend to have low hydraulic conductivity and low strength.

Proper soil water content revolves around achieving a minimum dry density, which is expressed as a percentage of the soil's maximum dry density. The minimum dry density typically falls in the range of 90 to 95 percent of the soil's maximum dry density value. From the minimum dry density range, the required water content range can be calculated, as shown in Figure 1. In this example the soil has a maximum dry density of 115 lb/cu ft. Based upon a required minimum dry density value of 90 percent of maximum dry density,

Figure 1.
Water Content for Achieving a Specific Density



Source: U.S. EPA, 1988.

which is equal to 103.5 lb/cu ft, the required water content ranges from 10 to 28 percent.

It is less problematic to compact clay soil at the lower end of the required water content range because it is easier to add water to the clay soil than to remove it. Thus, if precipitation occurs during construction of a site which is being placed at the lower end of the required water content range, the additional water might not result in a soil water content greater than the required range. Conversely, if the site is being placed at the upper end of the range, for example at 25 percent, any additional moisture will be excessive, resulting in water content over 28 percent and making the 90 percent maximum dry density unattainable. Under such conditions construction should halt while the soil is aerated and excess moisture is allowed to evaporate.

Removal of oversized particles. Preprocessing clay materials, to remove cobbles or large stones that exceed the maximum allowable particle size, can improve the soil's compactibility and protect any adjacent geomembrane from puncture. Particle size should be small (e.g., 3/4 inch in diameter) for compaction purposes. If a geomembrane will be placed over the compacted clay, only the upper lift of clay needs to address concerns regarding puncture resistance. Observation by quality assurance and quality control personnel is the most effective method to identify areas where oversized particles need to be removed. Cobbles and stones are not the only materials that can interfere with compactive efforts. Chunks of dry, hard clay, also known as clods, often need to be broken into smaller pieces to be properly hydrated, remolded, and compacted. In wet clay, clods are less of a concern since wet clods can often be remolded with a reasonable compactive effort.

Soil amendments. If the soils at a unit do not have a sufficient percentage of clay, a common practice is to blend bentonite with them to reduce the hydraulic conductivity. Bentonite is a clay mineral that expands when it comes into contact with water. Relatively small amounts of bentonite, on the order of 5 to 10 percent, can be added to sand or other noncohesive soils to increase the cohesion of the material and reduce hydraulic conductivity.

Sodium bentonite is a common additive used to amend soils. However, this additive is vulnerable to degradation as a result of contact with certain chemicals and waste leachates. Calcium bentonite, a more permeable material than sodium bentonite, is another common additive used to amend soils. Approximately twice as much calcium bentonite is needed to achieve a hydraulic conductivity comparable to that of sodium bentonite. Amended soil mixtures generally require mixing in a pug mill, cement mixer, or other mixing equipment that allows water to be added during the mixing process. Throughout the mixing and placement processes, water content, bentonite content, and particle distribution should be controlled. Other materials that can be used as soil additives include lime cement and other clay minerals, such as atapulgite. It can be difficult to mix additives thoroughly with cohesive soils, or clays; the resultant mixture might not achieve the desired level of hydraulic conductivity throughout the entire liner.

Subgrade Preparation

It is important to ensure that the subgrade on which a compacted clay liner will be constructed is properly prepared. When a compacted clay liner is the lowest component of a liner system, the subgrade consists of native soil or rock. Subgrade preparation for these systems involves compacting the native soil to remove any soft spots and adding water to or removing water from the native soil to obtain a specified firmness. Alternatively, in

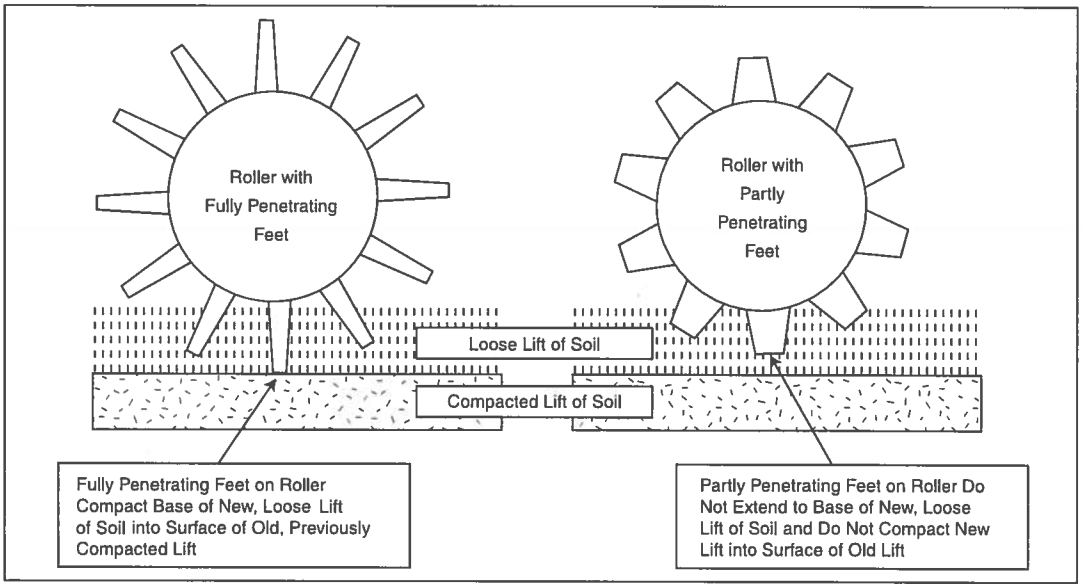
some cases, the compacted clay liner can be placed on top of a geosynthetic material, such as a geotextile. In such cases, subgrade preparation involves ensuring the smoothness of the geosynthetic on which the clay liner will be placed and the conformity of the geosynthetic material to the underlying material.

Compaction

The main purpose of compaction is to densify the clay materials by breaking and remolding clods of material into a uniform mass. Since amended soils usually do not develop clumps, the primary objective of compaction for such materials is to increase the material's density. Proper compaction of liner materials is essential to ensure that a compacted clay liner meets specified hydraulic conductivity standards. Factors influencing the effectiveness of compaction efforts include: the type of equipment selected, the number of passes made over the materials by such equipment, the lift thickness, and the bonding between the lifts. Molding water content, described earlier under preprocessing, is another factor influencing the effectiveness of compaction.

Type of equipment. Factors to consider when selecting compaction equipment include: the type and weight of the compactor, the characteristics of any feet on the drum, and the weight of the roller per unit length of drummed surface. Heavy compactors, weighing more than 50,000 pounds, with feet long enough to penetrate a loose lift of soil, are often the best types of compactor for clay liners. For bentonite-soil mixtures, a footed roller might not be appropriate. For these mixtures, where densification of the material is more important than kneading or remolding it to meet low hydraulic conductivity specifications, a smooth-drum roller or a rubber- tired roller might produce better results. Figure 2 depicts two types of footed rollers, a fully penetrating footed roller and a partially-penetrating footed roller.

Figure 2 Two Types of Footed Rollers



Source: U.S. EPA, 1993c.

For placement of liners on side slopes, consider the angle and length of the slope. Placing continuous lifts on a gradually inclined slope will provide better continuity between the bottom and sidewalls of the liner. Since continuous lifts might be impossible to construct on steeper slopes due to the difficulties of operating heavy compaction equipment on these slopes, materials might need to be placed and compacted in horizontal lifts. When sidewalls are compacted horizontally, it is important to avoid creating seepage planes, by securely connecting the edges of the horizontal lift with the bottom of the liner. Because the lift needs to be wide enough to accommodate compaction equipment, the thickness of the horizontal lift is often greater than the thickness specified in the design. In such cases, you should consider trimming soil material from the constructed side slopes and sealing the trimmed surface using a sealed drum roller.

It is common for contractors to use several different types of compaction equipment during liner construction. Initial lifts might need the use of a footed roller to fully penetrate a loose lift. Final lifts also might need the use of a footed roller for compaction, however, they might be formed better by using a smooth roller after the lift has been compacted to smooth the surface of the lift in preparation for placement of an overlying geomembrane.

Number of passes. The number of passes made by a compactor over clay materials can influence the overall hydraulic conductivity of the liner. The minimum number of passes that is reasonable depends on a variety of site-specific factors and cannot be generalized. In some cases, where a minimum coverage is specified, it might be possible to calculate the minimum number of passes to meet such a specification. At least 5 to 15 passes with a compactor over a given point are usually necessary to remold and compact clay liner materials thoroughly.

An equipment pass can be defined as one pass of the compaction equipment or as one pass of a drum over a given area of soil. It is important to clearly define what is meant by a pass in any quality assurance or quality control plans. It does not matter which definition is agreed upon, as long as the definition is used consistently throughout the project.

Lift thickness. You should determine the appropriate thickness (as measured before compaction) of each of the several lifts that will make up the clay liner. The initial thickness of a loose lift will affect the compactive effort needed to reach the lower portions of the lift. Thinner lifts allow compactive efforts to reach the bottom of a lift and provide greater assurance that compaction will be sufficient to allow homogenous bonding between subsequent lifts. Loose lift thicknesses typically range between 13 and 25 cm (5 and 10 in.). Factors influencing lift thickness are: soil characteristics, compaction equipment, firmness of the foundation materials, and the anticipated compaction necessary to meet hydraulic conductivity requirements.

Bonding between lifts. Since it is inevitable that some zones of higher and lower hydraulic conductivity, also known as preferential pathways, will be present within each lift, lifts should be joined or bonded in a way that minimizes extending these zones or pathways between lifts. If good bonding is achieved, the preferential pathways will be truncated by the bonded zone between the lifts. At least two recommended methods exist for preparing proper bonds. The first method involves kneading, or blending the new lift with the previously compacted lift using a footed roller. Using a roller with feet long enough to fully penetrate through the top lift and knead the previous lift improves the quality of the bond. A second method

involves using a disc harrow or similar equipment to scarify, or roughen, and wet the top inch of the recently placed lift, prior to placing the next lift.

Protection Against Desiccation and Cracking

You should consider how to protect compacted clay liners against desiccation and freezing during and after construction. Protection against desiccation is important, because clay soil shrinks as it dries. Depending on the extent of shrinkage, it can crack. Deep cracks, extending through more than one lift, can cause problems. You should measure water content to determine whether desiccation is occurring.

There are several ways to protect compacted clay liners from desiccation. One preventive measure is to smooth roll the surface with a steel drummed roller to produce a thin, dense skin of soil; this layer can help minimize the movement of water into or out of the compacted material. Another option is to wet the clay periodically in a uniform manner; however, it is important to make sure to avoid creating areas of excessive wetness. A third measure involves covering compacted clay liner materials with a sheet of white or clear plastic or tarp to help prevent against desiccation and cracking. The cover should be weighted down with sandbags or other material to minimize exposure of the underlying materials to air. Using a light-colored plastic will help prevent overheating, which can dry out the clay materials. If the clay liner is not being covered with a geosynthetic, another method to prevent desiccation involves covering the clay with a layer of protective cover soil or intentionally overbuilding the clay liner and shaving it down to liner grade.

Protection against freezing is another important consideration, because freezing can increase the hydraulic conductivity of a liner. It is important to avoid construction during freezing weather. If freezing does occur and the damage affects only a shallow depth, the liner can be repaired by rerolling the surface. If deeper freezing occurs, the repairs might be more complicated. For a general guide to frost depths, see Figure 1 of Chapter 11—Performing Closure and Post-Closure Care.

B. Geomembranes or Flexible Membrane Liners

Geomembranes or flexible membrane liners are used to contain or prevent waste constituents and leachate from escaping a waste management unit. Geomembranes are made by combining one or more plastic polymers with ingredients such as carbon black, pigments, fillers, plasticizers, processing aids, crosslinking chemicals, anti-degradants, and biocides. A wide range of plastic resins are used for geomembranes, including high density polyethylene (HDPE), linear low density polyethylene (LLDPE), low density linear polyethlene (LDLPE), very low density polyethlene (VLDPE), polyvinyl chloride (PVC), flexible polypropylene (fPP), chlorosulfonated polyethylene (CSPE or Hypalon), and ethylene propylene diene termonomer (EPDM). Most manufacturers produce geomembranes through extrusion or calendering. In the extrusion process, a molten polymer is stretched into a nonreinforced sheet; extruded geomembranes are usually made of HDPE and LLDPE. During the calendering process, a heated polymeric compound is passed through a series of rollers. In this process, a geomembrane can be reinforced with a woven fabric or fibers. Calendered geomembranes are usually made of PVC and CSPE.

What are the thickness recommendations for geomembrane liners?

Geomembranes range in thicknesses from 20 to 120 mil (1 mil = 0.001 in.). A good design should include a minimum thickness of 30 mil, except for HDPE liners, which should have a minimum thickness of 60 mil. These recommended minimum thicknesses ensure that the liner material will withstand the stress of construction and the weight load of the waste, and allow adequate seaming to bind separate geomembrane panels. Reducing the potential for tearing or puncture, through proper construction and quality control, is essential for a geomembrane to perform effectively.

What issues should be considered in the design of a geomembrane liner?

Several factors to address in the design include: determining appropriate material properties and testing to ensure these properties are met, understanding how the liner will interact with the intended waste stream, accounting for all stresses imposed by the design, and ensuring adequate friction.

Material Properties and Selection

When designing a geomembrane liner, you should examine several properties of the geomembrane material in addition to thickness, including: tensile behavior, tear resistance, puncture resistance, susceptibility to environmental stress cracks, ultraviolet resistance, and carbon black content.

Tensile behavior. Tensile behavior refers to the tensile strength of a material and its ability to elongate under strain. Tensile strength is the ability of a material to resist pulling stresses without tearing. The tensile properties of a geomembrane must be sufficient to satisfy the stresses anticipated during its service life. These stresses include the self-weight of the geomembrane and any down drag caused by waste settlement on side slope liners.

Puncture and tear resistance. Geomembrane liners can be subject to tearing during installation due to high winds or handling. Puncture resistance is also important to consider since geomembranes are often placed above or below materials that might have jagged or angular edges. For example, geomembranes might be installed above a granular drainage system that includes gravel.

Susceptibility to environmental stress cracks. Environmental factors can cause cracks or failures before a liner is stressed to its manufactured strength. These imperfections, referred to as environmental stress cracks, often occur in areas where a liner has been scratched or stressed by fatigue. These cracks can also result in areas where excess surface wetting agents have been applied. In surface impoundments, where the geomembrane liner has greater exposure to the atmosphere and temperature changes, such exposure can increase the potential for environmental stress cracking.

Ultraviolet resistance. Ultraviolet resistance is another factor to consider in the design of geomembrane liners, especially in cases where the liner might be exposed to ultraviolet radiation for prolonged periods of time. In such cases, which often occur in surface impoundments, ultraviolet radiation can cause degradation and cracking in the geomembrane. Adding carbon black or other additives during the manufacturing process can increase a geomembrane's ultraviolet resistance. Backfilling over the exposed geomembrane also works to prevent degradation due to ultraviolet radiation.

Interactions With Waste

Since the main purpose of a geomembrane is to provide a barrier and prevent contami-

nants from penetrating through the geomembrane, chemical resistance is a critical consideration. Testing for chemical resistance might be warranted depending on the type, volumes, and characteristics of waste managed at a particular unit and the type of geomembrane to be used. An established method for testing the chemical resistance of geomembranes, EPA Method 9090, can be found in SW-846. ASTM has also adopted standards for testing the chemical compatibility of various geosynthetics, including geomembranes, with leachates from waste management units. ASTM D-5747 provides a standard for testing the chemical compatibility of geomembranes.[7]

Stresses Imposed by Liner Design

A liner design should take into account the stresses imposed on the liner by the design configuration. These stresses include: the differential settlement in foundation soil, strain requirements at the anchor trench, strain requirements over long, steep side slopes, stresses resulting from compaction, and seismic stresses. Often an anchor trench designed to secure the geomembrane during construction is prepared along the perimeter of a unit cell. This action can help prevent the geomembrane from slipping down the interior side slopes. Trench designs should include a depth of burial sufficient to hold the specified length of liner. If forces larger than the tensile strength of the liner are inadvertently developed, then the liner could tear. For this reason, the geomembrane liner should be allowed to slip or give in the trench after construction to prevent such tearing. To help reduce unnecessary stresses in the liner design, it is advisable to avoid using horizontal seams. For more information on design stresses, consult *Geosynthetic Guidance for Hazardous Waste Landfill Cells and Surface Impoundments* (U.S. EPA, 1987).

Designing for Adequate Friction

Adequate friction between the geomembrane liner and the soil subgrade, as well as between any geosynthetic components, is necessary to prevent extensive slippage or sloughing on the slopes of a unit. Design equations for such components should evaluate: 1) the ability of a liner to support its own weight on side slopes, 2) the ability of a liner to withstand down-dragging during and after waste placement, 3) the best anchorage configuration for the liner, 4) the stability of soil cover on top of a liner, and 5) the stability of other geosynthetic components, such as geotextiles or geonets, on top of a liner. An evaluation of these issues can affect the choice of geomembrane material, polymer type, fabric reinforcement, thickness, and texture necessary to achieve the design requirements. Interface strengths can be significantly improved by using textured geomembranes.

What issues should be considered in the construction of a geomembrane liner?

When preparing to construct a geomembrane liner, you should plan appropriate shipment and handling procedures, perform testing prior to construction, prepare the subgrade, consider temperature effects, and account for wind effects. In addition, you should select a seaming process, determine a material for and method of backfilling, and plan for testing during construction.

Shipment, Handling, and Site Storage

You should follow quality assurance and quality control procedures to ensure proper handling of geomembranes. Different types of geomembrane liners require different types of packaging for shipment and storage. Typically a geomembrane manufacturer will provide specific instructions outlining the

[7] ASTM D-5747, Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids.

handling, storage, and construction specifications for a product. In general, HDPE and LLDPE geomembrane liners are packaged in a roll form, while PVC and CSPE-R liners (CSPE-R refers to a CSPE geomembrane liner reinforced with a fabric layer) are packaged in panels, accordion-folded in two directions, and placed onto pallets. Whether the liner is shipped in rolls or panels, you should provide for proper storage. The rolls and panels should be packaged so that fork lifts or other equipment can safely transport them. For rolls, this involves preparing the roll to have a sufficient inside diameter so that a fork lift with a long rod, known as a stinger, can be used for lifting and moving. For accordion panels, proper packaging involves using a structurally-sound pallet, wrapping panels in treated cardboard or plastic wrapping to protect against ultraviolet exposure, and using banding straps with appropriate cushioning. Once the liners have been transported to the site, the rolls or panels can be stored until the subgrade or subbase (either natural soils or another geosynthetic) is prepared.

Subgrade Preparation

Before a geomembrane liner is installed, you should prepare the subgrade or subbase. The subgrade material should meet specified grading, moisture content, and density requirements. In the case of a soil subgrade, it is important to prevent construction equipment used to place the liner from deforming the underlying materials. If the underlying materials are geosynthetics, such as geonets or geotextiles, you should remove all folds and wrinkles before the liner is placed. For further information on geomembrane placement, see Chapter 3 of EPA's *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities* (U.S. EPA, 1993c).

Testing Prior to Construction

Before any construction begins, is it recommended that you test both the geomembrane materials from the manufacturer and the installation procedures. Acceptance and conformance testing is used to evaluate the performance of the manufactured geomembranes. Constructing test strips can help evaluate how well the intended construction process and quality control procedures will work.

Acceptance and conformance testing. You should perform acceptance and conformance testing on the geomembrane liner received from the manufacturer to determine whether the materials meet the specifications requested. While the specific ASTM test methods vary depending on geomembrane type, recommended acceptance and conformance testing for geomembranes includes evaluations of thickness, tensile strength and elongation, and puncture and tear resistance testing, as appropriate. For most geomembrane liner types, the recommended ASTM method for testing thickness is ASTM D-5199.[8] For measuring the thickness of textured geomembranes, you should use ASTM D-5994.[9] For tensile strength and elongation, ASTM D-638 is recommended for the HDPE and LLDPE sheets, while ASTM D-882 and ASTM D-751 are recommended for PVC and CSPE geomembranes, respectively.[10] Puncture resistance testing is typically recommended for HDPE and LLDPE geomembranes using ASTM D-4833.[11] To evaluate tear resistance for HDPE, LLDPE, and PVC geomembrane

[8] ASTM D-5199, Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

[9] ASTM D-5994, Measuring Core Thickness of Textured Geomembranes.

[10] ASTM D-638, Standard Test Method for Tensile Properties of Plastics.
ASTM D-882, Standard Test Methods for Tensile Properties of Thin Plastic Sheeting.
ASTM D-751, Standard Test Methods for Coated Fabrics.

[11] ASTM D-4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

liners, the recommended testing method is ASTM D-1004, Die C.[12] For CSPE-R geomembranes, ply adhesion is more of a concern than tear or puncture resistance and can be evaluated using ASTM D-413, Machine Method, Type A.[13]

Test strips. In preparation for liner placement and field seaming, you should develop test strips and trial seams as part of the construction process. Construction of such samples should be performed in a manner that reproduces all aspects of field production. Providing an opportunity to test seaming methods and workmanship helps ensure that the quality of the seams remains constant and meets specifications throughout the entire seaming process.

Temperature Effects

Liner material properties can be altered by extreme temperatures. High temperatures can cause geomembrane liner surfaces to stick together, a process commonly referred to as blocking. On the other hand, low temperature can cause the liner to crack when unrolled or unfolded. Recommended maximum and minimum allowable sheet temperatures for unrolling or unfolding geomembrane liners are 50°C (122°F) and 0°C (32°F), respectively. In addition to sticking and cracking, extreme temperatures can cause geomembranes to contract or expand. Polyethylene geomembranes expand when heated and contract when cooled. Other geomembranes can contract slightly when heated. Those responsible for placing the liner should take temperature effects into account as they place, seam, and backfill in the field.

Wind Effects

It is recommended that you take measures to protect geomembrane liners from wind damage. Windy conditions can increase the potential for tearing as a result of uplift. If wind uplift is a potential problem, panels can be weighted down with sand bags.

Seaming Processes

Once panels or rolls have been placed, another critical step involves field-seaming the separate panels or rolls together. The selected seaming process, such as thermal or chemical seaming, will depend on the chemical composition of the liner. To ensure the integrity of the seam, you should use the seaming method recommended by the manufacturer. Thermal seaming uses heat to bond together the geomembrane panels. Examples of thermal seaming processes include extrusion welding and thermal fusion (or melt bonding). Chemical seaming involves the use of solvents, cement, or an adhesive. Chemical seaming processes include chemical fusion and adhesive seaming. For more information on seaming methods, *Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams* (U.S. EPA, 1991c), contains a full chapter on each of the traditional seaming methods and additional discussion of emerging techniques, such as ultrasonic, electrical conduction, and magnetic energy source methods.

Consistent quality in fabricating field seams is paramount to liner performance. Conditions that could affect seaming should be monitored and controlled during installation. Factors influencing seam construction and performance include: ambient temperature, relative humidity, wind uplift, changes in geomembrane temperature, subsurface water content, type of supporting surface used, skill of the seaming crew, quality and consistency of chemical or welding materials, preparation of liner surfaces to be joined, moisture at the seam interface, and cleanliness of the seam interface.

[12] ASTM D-1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.

[13] ASTM D-413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.

To help control some of these factors, no more than the amount of sheeting that can be used during a shift or a work day should be deployed at one time. To prevent erosion of the underlying soil surface or washout of the geomembrane, proper storm water control measures should be employed. Ambient temperature can become a concern, if the geomembrane liner has a high percentage of carbon black. Although the carbon black will help to prevent damage resulting from ultraviolet radiation, because its dark color absorbs heat, it can increase the ambient temperature of the geomembrane, making installation more complicated. To avoid surface moisture or high subsurface water content, geomembranes should not be deployed when the subgrade is wet.

Regardless of how well a geomembrane liner is designed, its ability to meet performance standards depends on proper quality assurance and quality control during installation. Geomembrane sheets and seams are subject to tearing and puncture during installation; punctures or tears can result from contact with jagged edges or underlying materials or by applying stresses greater than the geomembrane sheet can handle. Proper quality assurance and quality control can help minimize the occurrence of pinhole or seam leaks. For example, properly preparing the underlying layer and ensuring that the gravel is of an acceptable size reduces the potential for punctures.

Protection and Backfilling

Geomembrane liners that can be damaged by exposure to weather or work activities should be covered with a layer of soil or a geosynthetic as soon as possible after quality assurance activities associated with geomembrane testing are completed. If the backfill layer is a soil material, it will typically be a drainage material like sand or gravel. If the cover layer is a geosynthetic, it will typically be a geonet or geocomposite drain placed directly over the geomembrane. Careful placement of backfill materials is critical to avoid puncturing or tearing the geomembrane material.

For soil covers, three considerations determine the amount of slack to be placed in the underlying geomembrane. These considerations include selecting the appropriate type of soil, using the proper type of equipment, and establishing a placement procedure for the soil. When selecting a soil for backfilling, characteristics to consider include particle size, hardness, and angularity, as each of these can affect the potential for tearing or puncturing the liner. To prevent wrinkling, soil covers should be placed over the geomembrane in such a way that construction vehicles do not drive directly on the liner. Care should be taken not to push heavy loads of soil over the geomembrane in a continuous manner. Forward pushing can cause localized wrinkles to develop and overturn in the direction of movement. Overturned wrinkles create sharp creases and localized stress in the liner and can lead to premature failure. A recommended method for placing soil involves continually placing small amounts of soil or drainage material and working outward over the toe of the previously placed material.

Another recommended method involves placing soil over the liner with a large backhoe and spreading it with a bulldozer or similar equipment. If a predetermined amount of slack is to be placed in the geomembrane, the temperature of the liner becomes an important factor, as it will effect the ability of the liner to contract and expand. Although the recommended methods for covering geomembrane liners with soil can take more time than backfilling with larger amounts of soil, these methods are designed to prevent damage caused by covering the liner with too

much soil too quickly. In the long run, preventing premature liner failure can be faster and more cost-effective than having to repair a damaged liner.

The types of geosynthetics that are often used as protective covering include geotextiles and geonets. Geogrids and drainage geocomposites can be used for cover soil reinforcement on slopes. The appendix at the end of this chapter provides additional information on geosynthetic materials. For geosynthetic protective covers, as with soil backfilling, to prevent tearing or puncturing, most construction vehicles should not be permitted to move directly on the geomembrane. Some possible exceptions include small, 4-wheel, all terrain vehicles or other types of low ground pressure equipment. Even with these types of vehicles, drivers should take extreme care to avoid movements, such as sudden starts, stops, and turns, which can damage the geomembrane. Seaming-related equipment should be allowed on the geomembrane liner, as long as it does not damage the liner. Geosynthetic materials are placed directly on the liner and are not bonded to it.

Testing During Construction

Testing during construction enables assessment of the integrity of the seams connecting the geomembrane panels. Tests performed on the geomembrane seams are categorized as either destructive or nondestructive.

Destructive testing. Destructive testing refers to removing a sample from the liner seam or sheet and performing tests on the sample. For liner seams, destructive testing includes shear testing and peel testing; for liner sheets, it involves tensile testing. While quality control procedures often require destructive testing prior to construction, in order to ensure that the installed seams and sheets meet performance standards, destructive testing should be performed during construction also. For increased quality assurance, it is recommended that peel and shear tests on samples from the installed geomembrane be performed by an independent laboratory. Testing methods for shear testing, peel testing, and tensile testing vary for different geomembrane liner types.

Determining the number of samples to take is a difficult step. Taking too few samples results in a poor statistical representation of the geomembrane quality. On the other hand, taking too many samples requires additional costs and increases the potential for defects. Defects can result from the repair patches used to cover the areas from which samples were taken.

A common sampling strategy is "fixed increment sampling" where samples are taken at a fixed increment along the length of the geomembrane. Increments range from 80 to 300 m (250 to 1,000 ft). The type of welding, such as extrusion or fusion welding, used to connect the seams and the type of geomembrane liner can also help determine the appropriate sampling interval. For example, extrusion seams on HDPE require grinding prior to welding and if extensive grinding occurs, the strength of the HDPE might decrease. In such cases, sampling at closer intervals, such as 90 to 120 m (300 to 400 ft), might provide a more accurate description of material properties. If the seam is a dual hot edge seam, both the inner and outer seams might need to be sampled and tested.

If test results for the seam or sheet samples do not meet the acceptance criteria for the destructive tests, you should continue testing the area surrounding the rejected sample to determine the limits of the low quality seam. Once the area of low quality has been identified, then corrective measures, such as seaming a cap over the length of the seam or reseaming the affected area, might be necessary.

Nondestructive testing. Unlike destructive tests, which examine samples taken from the geomembrane liner in the containment area, nondestructive tests are designed to evaluate the integrity of larger portions of geomembrane seams without removing pieces of the geomembrane for testing. Common nondestructive testing methods include: the probe test, air lance, vacuum box, ultrasonic methods (pulse echo, shadow, and impedance planes), electrical spark test, pressurized dual seam, and electrical resistivity. You should select the test method most appropriate for the material and seaming method. If sections of a seam fail to meet the acceptable criteria of the appropriate nondestructive test, then those sections need to be delineated and patched, reseamed, or retested. If repairing such sections results in large patches or areas of reseaming, then destructive test methods are recommended to verify the integrity of such pieces.

C. Geosynthetic Clay Liners

If a risk evaluation recommended the use of a single liner, another option to consider is a geosynthetic clay liner (GCL). GCLs are factory-manufactured, hydraulic barriers typically consisting of bentonite clay (or other very low permeability materials), supported by geotextiles or geomembranes held together by needling, stitching, or chemical adhesives. GCLs can be used to augment or replace compacted clay liners or geomembranes, or they can be used in a composite manner to augment the more traditional compacted clay or geomembrane materials. GCLs are typically used in areas where clay is not readily available or where conserving air space is an important factor. As GCLs do not have the level of long-term field performance data that geomembranes or compacted clay liners do, states might request a demonstration that performance of the GCL design will be comparable to that of compacted clay or geomembrane liners.

What are the mass per unit area and hydraulic conductivity recommendations for geosynthetic clay liners?

Geosynthetic clay liners are often designed to perform the same function as compacted clay and geomembrane liner components. For geosynthetic clay liners, you should design for a minimum of 3.7 kg/m^2 (0.75 lb/ft^2) dry weight (oven dried at 105°C) of bentonite clay with a hydrated hydraulic conductivity of no more than 5 x 10^{-9} cm/sec (2 x 10^{-9} in/sec). It is important to follow manufacturer specifications for proper GCL installation.

What issues should be considered in the design of a geosynthetic clay liner?

Factors to consider in GCL design are the specific material properties needed for the liner and the chemical interaction or compatibility of the waste with the GCL. When considering material properties, it is important to keep in mind that bentonite has a low shear strength when it is hydrated. Manufacturers have developed products designed to increase shear strength.

Materials Selection and Properties

For an effective GCL design, material properties should be clearly defined in the specifications used during both manufacture and construction. The properties that should be specified include: type of bonds, thickness, moisture content, mass per unit area, shear strength, and tensile strength. Each of these properties is described below.

Type of bonds. Geosynthetic clay liners are available with a variety of bonding designs, which include a combination of clay, adhesives, and geomembranes or geotextiles. The type of adhesives, geotextiles, and geomembranes used as components of GCLs varies widely. One type of available GCL design uses a bentonite clay mixed with an adhesive bound on each side by geotextiles. A variation on this design involves stitching the upper and lower geotextiles together through the clay layer. Alternatively, another option is to use a GCL where geotextiles on each side of adhesive or nonadhesive bentonite clay are connected by needle punching. A fourth variation uses a clay mixed with an adhesive bound to a geomembrane on one side; the geomembrane can be either the lower or the upper surface. Figure 3 displays cross section sketches of the four variations of GCL bonds. While these options describe GCLs available at the time of this Guide, emerging technologies in GCL designs should also be reviewed and considered.

Thickness. The thickness of the various available GCL products ranges from 4 to 6 mm (160 to 320 mil). Thickness measurements are product dependent. Some GCLs can be quality controlled for thickness while others cannot.

Moisture content. GCLs are delivered to the job site at moisture contents ranging from 5 to 23 percent, referred to as the "dry" state. GCLs are delivered dry to prevent premature hydration, which can cause unwanted variations in the thickness of the clay component as a result of uneven swelling.

Stability and shear strength. GCLs should be manufactured and selected to meet the shear strength requirements specified in design plans. In this context, shear strength is the ability of two layers to resist forces moving them in opposite directions. Since hydrated bentonite clay has low shear strength, bentonite clay can be placed between geotextiles and stitch bonded or needle- punched to provide additional stability. For example, a GCL with geotextiles supported by stitch bonding has greater internal resistance to shear in the clay layer than a GCL without any stitching. Needle-punched GCLs tend to provide greater resistance than stitch-bonded GCLs and can also provide increased friction resistance against an adjoining layer, because they require the use of nonwoven geotextiles. Increased friction is an important consideration on side slopes.

Mass per unit area. Mass per unit area refers to the bentonite content of a GCL. It is important to distribute bentonite evenly throughout the GCL in order to meet desired hydraulic conductivity specifications. All GCL products available in North America use a sodium bentonite clay with a mass per unit area ranging from 3.2 to 6.0 kg/m^2 (0.66 to 1.2 lb/ft^2), as manufactured.

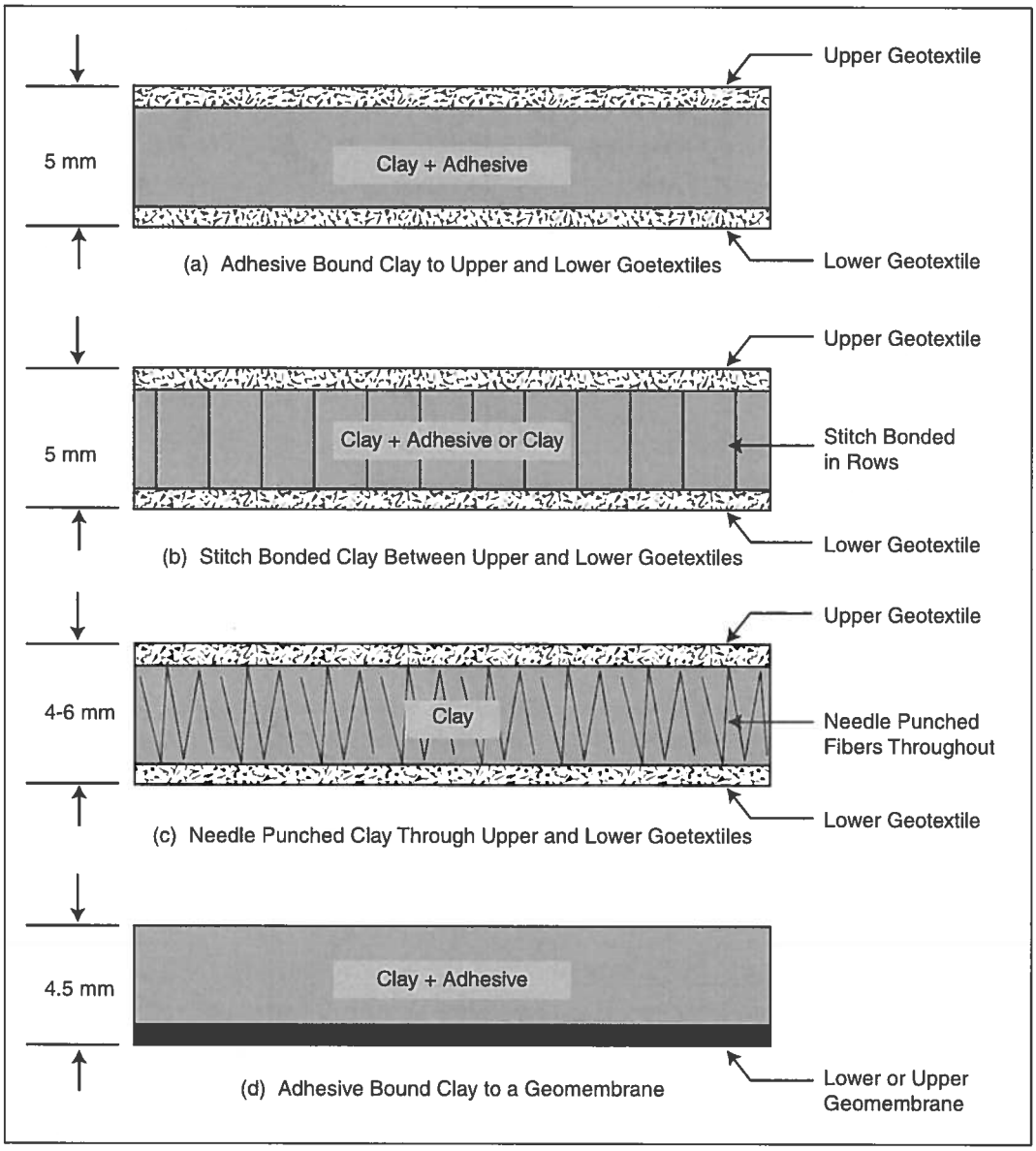
Interaction With Waste

During the selection process for a GCL liner, you should evaluate the chemical compatibility of the liner materials with the types of waste that are expected to be placed in the unit. Certain chemicals, such as calcium, can have an adverse effect on GCLs, resulting in a loss of liner integrity. Specific information on GCL compatibilities should be available from the manufacturer.

What issues should be considered in the construction of a geosynthetic clay liner?

Prior to and during construction, it is recommended that a qualified professional should prepare construction specifications for the GCL. In these specifications, procedures for shipping and storing materials, as well as performing acceptance testing on delivered

Figure 3
Four Variations of GCL Bonding Methods



Source: U.S. EPA, 1993c.

materials, should be identified. The specifications should also address methods for subgrade preparation, joining panels, repairing sections, and protective backfilling.

Shipment, Handling, and Site Storage

GCLs are manufactured in widths of approximately 2 to 5 m (7 to 17 ft) and lengths of 30 to 60 m (100 to 200 ft). Directly after manufacturing, GCLs are rolled around a core and covered with a thin plastic protective covering. This waterproof covering serves to protect the material from premature hydration. GCLs should be stored at the factory with these protective coverings. Typical storage lengths range from a few days to 6 months. To ensure protection of the plastic covering and the rolls themselves during loading and unloading, it is recommended that qualified professionals specify the equipment needed at the site to lift and deploy the rolls properly.

To reduce the potential for accidental damage or for GCLs to absorb moisture at the site, you should try to arrange for "just-in-time-delivery" for GCLs transported from the factory to the field. Even with "just-in-time-delivery," it might be necessary to store GCLs for short periods of time at the site. Often the rolls can be delivered in trailers, which can then serve as temporary storage. To help protect the GCLs prior to deployment, you should use wooden pallets to keep the rolls off the ground, placing heavy, waterproof tarps over the GCL rolls to protect them from precipitation, and using sandbags to help keep the tarps in place.

Manufacturer specifications should also indicate how high rolls of GCLs can be stacked horizontally during storage. Overstacking can cause compression of the core around which the GCL is wrapped. A damaged core makes deployment more difficult and can lead to other problems. For example, rolls are sometimes handled by a fork lift with a stinger attached. The stinger is a long tapered rod that fits inside the core. If the core is crushed, the stinger can damage the liner during deployment.

Acceptance and Conformance Testing

Acceptance and conformance testing is recommended either upon delivery of the GCL rolls or at the manufacturer's facility prior to delivery. Conformance test samples are used to ensure that the GCL meets the project plans and specifications. GCLs should be rewrapped and replaced in dry storage areas immediately after test samples are removed. Liner specifications should prescribe sampling frequencies based on either total area or on number of rolls. Since variability in GCLs can exist between individual rolls, it is important for acceptance and conformance testing to account for this. Conformance testing can include the following.

Mass per unit area test. The purpose of evaluating mass per unit area is to ensure an even distribution of bentonite throughout the GCL panel. Although mass per unit area varies from manufacturer to manufacturer, a typical minimum value for oven dry weight is 3.7 kg/m^2 (0.75 lb/ft^2). Mass per unit area should be tested using ASTM D-5993.[14] This test measures the mass of bentonite per unit area of GCL. Sampling frequencies should be determined using ASTM D- 4354.[15]

Free swell test. Free swell refers to the ability of the clay to absorb liquid. Either ASTM D-5890 or GRI-GCL1, a test method developed by the Geosynthetic Research Institute, can be used to evaluate the free swell of the material.[16]

[14] ASTM D-5993, Standard Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners.

[15] ASTM D-4354, Standard Practice for Sampling of Geosynthetics for Testing.

[16] ASTM D-5890, Test Method for Swell Index of Clay Mineral Components of Geosynthetic Clay Liners. GRI-GCL1, Swell Measurement of the Clay Component of Geosynthetic Clay Liners.

Direct shear test. Shear strength of the GCLs can be evaluated using ASTM D-5321.[17] The sampling frequency for this performance-oriented test is often based on area, such as one test per 10,000 m^2 (100,000 ft^2).

Hydraulic conductivity test. Either ASTM D-5084 (modified) or GRI-GCL2 will measure the ease with which liquids can move through the GCL.[18]

Other tests. Testing of any geotextiles or geomembranes should be made on the original rolls of the geotextiles or geomembranes and before they are fabricated into the GCL product. Once these materials have been made part of the GCL product, their properties can change as a result of any needling, stitching, or gluing. Additionally, any peel tests performed on needle punched or stitch bonded GCLs should use the modified ASTM D-413 with a recommended sampling frequency of one test per 2,000 m^2 (20,000 ft^2).[19]

Subgrade Preparation

Because the GCL layer is relatively thin, the first foot of soil underlying the GCL should have a hydraulic conductivity of 1 x 10^{-5} cm/sec or less. Proper subgrade preparation is essential to prevent damage to the GCL layer as it is installed. This includes clearing away any roots or large particles that could potentially puncture the GCL and its geotextile or geomembrane components. The soil subgrade should be of the specified grading, moisture content, and density required by the installer and approved by a construction quality assurance engineer for placement of the GCL. Construction equipment deploying the rolls should not deform or rut the soil subgrade excessively. To help ensure this, the soil subgrade should be smooth rolled with a smooth-wheel roller and maintained in a smooth condition prior to deployment.

Joining Panels

GCLs are typically joined by overlapping panels, without sewing or mechanically connecting pieces together. To ensure proper joints, you should specify minimum and maximum overlap distances. Typical overlap distances range from 150 to 300 mm (6 to 12 in.). For some GCLs, such as needle punched GCLs with nonwoven geotextiles, it might be necessary to place bentonite on the area of overlap. If this is necessary, you should take steps to prevent fugitive bentonite particles from coming into contact with the leachate collection system, as they can cause physical clogging.

Repair of Sections Damaged During Liner Placement

During installation, GCLs might incur some damage to either the clay component or to any geotextiles or geomembranes. For damage to geotextile or geomembrane components, repairs include patching using geotextile or geomembrane materials. If the clay component is disturbed, a patch made from the same GCL product should be used to perform any repairs.

Protective Backfilling

As soon as possible after completion of quality assurance and quality control activities, you should cover GCLs with either a soil layer or a geosynthetic layer to prevent hydration. The soil layer can be a compacted clay liner or a layer of coarse drainage material. The geosynthetic layer is typically a

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[17] ASTM D-5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

[18] ASTM D-5084, Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
GRI-GCL2, Permeability of Geosynthetic Clay Liners (GCLs).

[19] ASTM D-413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.

geomembrane; however, depending on site-specific designs, it can be a geotextile. As noted earlier, premature hydration before covering can lead to uneven swelling, resulting in a GCL with varied thickness. Therefore, a GCL should be covered with its subsequent soil or geosynthetic layer before a rainfall or snowfall occurs. Premature hydration is less of a concern for GCLs, where the geosynthetic components are needle punched or stitch bonded, because these types of connections can better limit clay expansion.

III. Composite Liners

A composite liner consists of both a geomembrane liner and natural soil. The geomembrane forms the upper component with the natural soil being the lower component. The ususal variations are:

- Geomembrane over compacted clay liner (GM/CCL).
- Geomembrane over geosynthetic clay liner (GM/GCL).
- Geomembrane over geosynthetic clay liner over compacted clay liner (GM/GCL/CCL).

A composite liner provides an effective hydraulic barrier by combining the complementary properties of the two different liners into one system. The geomembrane provides a highly impermeable layer to maximize leachate collection and removal. The natural soil liner serves as a backup in the event of any leakage from the geomembrane. With a composite liner design, you should construct a leachate collection and removal system above the geomembrane. Information on design and construction of leachate collection and removal systems is provided in Section V below.

What are the thickness and hydraulic conductivity recommendations for composite liners?

Each component of the composite liner should follow the recommendations for geomembranes, geosynthetic clay liners, and compacted clay liners described earlier. Geomembrane liners should have a minimum thickness of 30 mil, except for HDPE liners, which should have a minimum thickness of 60 mil. Similarly, compacted clay liners should be at least 2 feet thick and are typically 2 to 5 feet thick. For compacted clay liners and geosynthetic clay liners, you should use materials with maximum hydraulic conductivities of 1×10^{-7} cm/sec (4×10^{-8} in/sec) and 5×10^{-9} cm/sec (2×10^{-9} in/sec), respectively.

What issues should be considered in the design of a composite liner?

As a starting point, you should follow the design considerations discussed previously for single liners. In addition, to achieve the benefits of a combined liner system, you should install the geomembrane to ensure good contact with the compacted clay layer. The uniformity of contact between the geomembrane and the compacted clay layer helps control the flow of leachate. Porous material, such as drainage sand or a geonet, should not be placed between the geomembrane and the clay layer. Porous materials will create a layer of higher hydraulic conductivity, which will increase the amount of leakage below any geomembrane imperfection.

You should consider the friction or shear strength between a compacted clay layer and a geomembrane. The friction or shear stress at this surface is often low and can form a weak plane on which sliding can occur.

ASTM D-5321 provides a test method for determining the friction coefficient of soil and geomembranes.[20] When using bentonite-amended soils, it is important to account for how the percentage of bentonite added and the degree of saturation affect interface friction. To provide for stable slopes, it is important to control both the bentonite and moisture contents. A textured geomembrane can increase the friction with the clay layer and improve stability.

What issues should be considered in the construction of a composite liner?

To achieve good composite bonding, the geomembrane and the compacted clay layer should have good hydraulic contact. To improve good contact, you should smooth-roll the surface of the compacted clay layer using a smooth, steel-drummed roller and remove any stones. In addition, you should place and backfill the geomembrane so as to minimize wrinkles.

The placement of geomembranes onto a compacted clay layer poses a challenge, because workers cannot drive heavy machines over the clay surface without potentially damaging the compacted clay component. Even inappropriate footwear can leave imprints in the clay layer. It might be possible to drive some types of low ground pressure equipment or small, 4-wheel, all terrain vehicles over the clay surface, but drivers should take extreme care to avoid movements, such as sudden starts, stops, and turns, that could damage the surface. To avoid damaging the clay layer, it is recommended that you unroll geomembranes by lifting the rolls onto jacks at a cell side and pulling down on the geomembrane manually. Also, the entire roll with its core can be unrolled onto the cell (with auxiliary support using ropes on embankments).

To minimize desiccation of the compacted clay layer, you should place the geomembrane over the clay layer as soon as possible. Additional cover materials should also be placed over the geomembrane. Exposed geomembranes absorb heat, and high temperatures can dry out and crack an underlying compacted clay layer. Daily cyclic changes in temperature can draw water from the clay layer and cause this water to condense on the underside of the geomembrane. This withdrawal of water can lead to desiccation cracking and potential interface stability concerns.

IV. Double Liners (Primary and Secondary Lined Systems)

In a double-lined waste management unit, there are two distinct liners—one primary (top) liner and one secondary (bottom) liner. Each liner might consist of compacted clay, a geomembrane, or a composite (consisting of a geomembrane and a compacted clay layer or GCL). Above the primary liner, it is recommended that you construct a leachate collection and removal system to collect and convey liquids out of the waste management unit and to control the depth of liquids above the primary liner. In addition, you should place a leak detection, collection, and removal system between the primary and secondary liner. This leak detection system will provide leak warning, as well as collect and remove any liquid or leachate that has escaped the primary liner. See section V below for information on the design of leachate collection and removal systems and leak detection, collection, and removal systems.

[20] ASTM D-5321, Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

What are the thickness and hydraulic conductivity recommendations for double liners?

Each component of the double liner should follow the recommendations for geomembranes, compacted clay liners, or composite liners described earlier. Geomembrane liners should have a minimum thickness of 30 mil, except for HDPE liners, which should have a minimum thickness of 60 mil. Similarly, compacted clay liners should be at least 2 feet thick and are typically 2 to 5 feet thick. For compacted clay liners and geosynthetic clay liners, use materials with maximum hydraulic conductivities of 1×10^{-7} cm/sec (4×10^{-8} in/sec) and 5×10^{-9} cm/sec (2×10^{-9} in/sec), respectively.

What issues should be considered in the design and construction of a double liner?

Like composite liners, double liners are composed of a combination of single liners. When planning to design and construct a double liner, you should consult the sections on composite and single liners first. In addition, you should consult the sections on leachate collection and removal systems and leak detection systems.

V. Leachate Collection and Leak Detection Systems

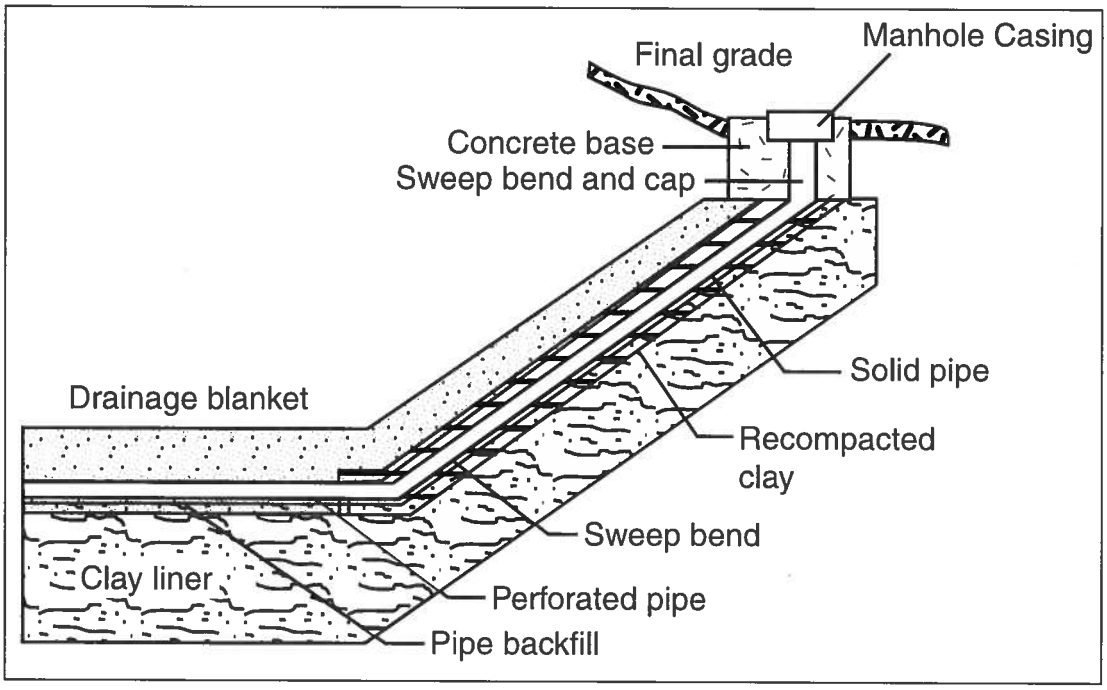
One of the most important functions of a waste management unit is controlling leachate and preventing contamination of the underlying ground water. Both leachate collection and removal systems and leak detection systems serve this purpose. You should consult with the state agency too determine if such systems are required. The primary function of a leachate collection and removal system is to collect and convey leachate out of a unit and to control the depth of leachate above a liner. The primary function of a leak detection system is to detect leachate that has escaped the primary liner. A leak detection system refers to drainage material located below the primary liner and above a secondary liner (if there is one); it acts as a secondary leachate collection and removal system. After the leachate has been removed and collected, a leachate treatment system might be incorporated to process the leachate and remove harmful constituents.

The information in this section on leachate collection and leak detection systems is applicable if the unit is a landfill or a waste pile. Surface impoundments, which manage liquid wastes, usually will not have leachate collection and removal systems unless they will be closed in-place as landfills; they might have leak detection systems to detect liquid wastes that have escaped the primary liner. Leachate collection or leak detection systems generally are not used with land application.

A. Leachate Collection System

A typical leachate collection system includes a drainage layer, collection pipes, a removal system, and a protective filter layer. Leachate collection systems are designed to collect leachate for treatment or alternate disposal and to reduce the buildup of leachate above the liner system. Figure 4 shows a cross section of a typical leachate collection system showing access to pipes for cleaning.

Figure 4
Typical Leachate Collection System



Source: U.S. EPA, 1995b

What are the recommendations for leachate collection and removal systems?

You should design a leachate collection and removal system to maintain less than 30 cm (12 in.) depth of leachate, or "head," above the liner if granular soil or a geosynthetic material is used. The reason for maintaining this level is to prevent excessive leachate from building up above the liner, which could jeopardize the liner's performance. This should be the underlying factor guiding the design, construction, and operation of the leachate collection and removal system.

You should design a leachate collection and removal system capable of controlling the estimated volume of leachate. To determine potential leachate generation, you should use water balance equations or models. The most commonly used method to estimate leachate generation is EPA's Hydrogeologic Evaluation of Landfill Performance (HELP) model.[21] This model uses weather, soil, and waste management unit design data to determine leachate generation rates.

What issues should be considered in the design of a leachate collection and removal system?

You should design a leachate collection and removal system to include the following elements: a low-permeability base, a high-permeability drainage layer, perforated leachate collection pipes, a protective filter layer, and a leachate removal system. During

[21] Available on the CD-ROM version of the Guide, as well as from the U.S. Army Corps of Engineers Web site **<www.wes.army.mil/el/elmodels/index.html#landfill>**

design, you should consider the stability of the base, the transmissivity of the drainage layers, and the strength of the collection pipes. It is also prudent to consider methods to minimize physical, biological, and chemical clogging within the system.

Low-Permeability Base

A leachate collection system is placed over the unit's liner system. The bottom liner should have a minimum slope of 2 percent to allow the leachate collection system to gravity flow to a collection sump. This grade is necessary to provide proper leachate drainage throughout the operation, closure, and post-closure of the unit. Estimates of foundation soil settlement should include this 2 percent grade as a post-settlement design.

High-Permeability Drainage Layer

A high-permeability drainage layer consists of drainage materials placed directly over the low-permeability base, at the same minimum 2 percent grade. The drainage materials can be either granular soil or geosynthetic materials. For soil drainage materials, a maximum of 12 inches of materials with a hydraulic conductivity of at least 1×10^{-2} cm/sec (4×10^{-3} in/sec) is recommended. For this reason, sand and gravel are the most common soil materials used. If the drainage layer is going to incorporate sand or gravel, it should be demonstrated that the layer will have sufficient bearing capacity to withstand the waste load of the full unit. Additionally, if the waste management unit is designed on grades of 15 percent or higher, it should be demonstrated that the soil drainage materials will be stable on the steepest slope in the design.

Geosynthetic drainage materials such as geonets can be used in addition to, or in place of, soil materials. Geonets promote rapid transmission of liquids and are most effective when used in conjunction with a filter layer or geotextile to prevent clogging. Geonets consist of integrally connected parallel sets of plastic ribs overlying similar sets at various angles. Geonets are often used on the side walls of waste management units because of their ease of installation. Figure 5 depicts a typical geonet material configuration.

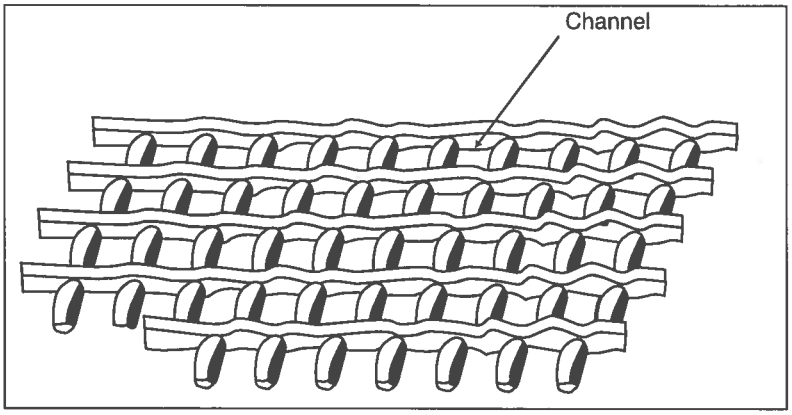
The most critical factor involved with using geonets in a high-permeability drainage layer is the material's ability to transmit fluids under load. The flow rate of a geonet can be evaluated by ASTM D-4716.[22] Several additional measures for determining the transmissivity of geonets are discussed in the *Solid Waste Disposal Facility Criteria: Technical Manual* (U.S. EPA, 1993b).

Perforated Leachate Collection Pipes

Whenever the leachate collection system is a natural soil, a perforated piping system should be located within it to rapidly transmit the leachate to a sump and removal system. Through the piping system, leachate flows gravitationally to a low point where the sump and removal system is located. The design of perforated leachate collection pipes, therefore, should consider necessary flow rates, pipe sizing, and pipe structural strength. After estimating the amount of leachate using the HELP model or a similar water balance model, it is possible to calculate the appropriate pipe diameter and spacing. For the leachate collection system design, you should select piping material that can withstand the anticipated weight of the waste, construction and operating equipment stresses, and foundation settling. Most leachate collection pipes used in modern waste management units are constructed of HDPE. HDPE pipes provide great structural strength, while allowing significant chemical resistance to the many constituents found in leachate. PVC pipes are also used in waste

[22] ASTM D-4716, Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.

Figure 5
Typical Geonet Configuration



management units, but they are not as chemically resistant as HDPE pipes.

Protective Filter Layer

To protect the drainage layer and perforated leachate collection piping from clogging, you should place a filter layer over the high-permeability drainage layer. To prevent waste material from moving into the drainage layer, the filter layer should consist of a material with smaller pore space than the drainage layer materials or the perforation openings in the collection pipes. Sand and geotextiles are the two most common materials used for filtration. You should select sand that allows adequate flow of liquids, prevents migration of overlying solids or soils into the drainage layer, and minimizes clogging during the service life. In designing the sand filter, you should consider particle size and hydraulic conductivity. The advantages of using sand materials include common usage, traditional design, and durability.

Any evaluation of geotextile materials should address the same concerns but with a few differences. To begin with, the average pore size of the geotextile should be large enough to allow the finer soil particles to pass but small enough to retain larger soil particles. The number of openings in the geotextile should be large enough that, even if some of the openings clog, the remaining openings will be sufficient to pass the design flow rate. In addition to pore size, geotextile filter specifications should include durability requirements. The advantages of geotextile materials include vertical space savings and easy placement. Chapter 5 of *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities* (U.S. EPA, 1993c) offers guidance on protection of drainage layers.

Leachate Removal System

Leachate removal often involves housing a sump within the leachate collection drainage layer. A sump is a low point in the liner constructed to collect leachate. Modern waste management unit sumps often consist of prefabricated polyethylene structures supported on a steel plate above the liner. Especially with geomembrane liners, the steel plate serves to support the weight of the sump and protect the liner from puncture. Gravel filled earthen depressions can serve as the sump. Reinforced concrete pipe and concrete flooring also can be used in place of the polyethylene structure but are considerably heavier.

To remove leachate that has collected in the sump, you should use a submersible pump. Ideally, the sump should be placed at a depth of 1 to 1.5 m (3 to 5 ft) to allow enough leachate collection to prevent the pump from running dry. You should consider

installing a level control, backup pump, and warning system to ensure proper sump operation. Also consider using a backup pump as an alternate to the primary pump and to assist it during high flow periods. A warning system should be used to indicate pump malfunction.

Standpipes, vertical pipes extending through the waste and cover system, offer one method of removing leachate from a sump without puncturing the liner. Alternatively, you can remove leachate from a sump using pipes that are designed to penetrate the liner. When installing pipe penetrations through the liner, you should proceed with extreme caution to prevent any liner damage that could result in uncontained leachate. Both of these options rely on gravity to direct leachate to a leachate collection pond or to an external pumping station.

Minimizing Clogging

Leachate collection and removal systems are susceptible to physical, biological, and chemical clogging. Physical clogging can occur through the migration of finer-grained materials into coarser-grained materials, thus reducing the hydraulic conductivity of the coarser-grained material. Biological clogging can occur through bacterial growth in the system due to the organic and nutrient materials in leachate. Chemical clogging can be caused by chemical precipitates, such as calcium carbonates, causing blockage or cementation of granular drainage material.

Proper selection of drainage and filter materials is essential to minimize clogging in the high-permeability drainage layer. Soil and geotextile filters can be used to minimize physical clogging of both granular drainage material and leachate collection pipes. When placed above granular drainage material, these filters can also double as an operations layer to prevent sharp waste from damaging the liner or leachate collection and removal systems. To minimize chemical and biological clogging for granular drainage material, the best procedure is to keep the interstices of the granular drainage material as open as possible.

The leachate collection pipes are also susceptible to similar clogging. To prevent this, you should incorporate measures into the design to allow for routine pipe cleaning, using either mechanical or hydraulic methods. The cleaning components can include pipes with a 15 cm (6 in) minimum diameter to facilitate cleaning; access located at major pipe intersections or bends to allow for inspections and cleaning; and valves, ports, or other appurtenances to introduce biocides and cleaning solutions. Also, you should check that the design does not include wrapping perforated leachate collection pipes directly with geotextile filters. If the geotextile becomes clogged, it can block flow into the pipe.

B. Leak Detection System

The leak detection system (LDS) is also known as the secondary leachate collection and removal system. It uses the same drainage and collection components as the primary leachate collection and removal system and identifies, collects, and removes any leakage from the primary system. The LDS should be located directly below the primary liner and above the secondary liner.

What are the recommendations for leak detection systems?

The LDS should be designed to assess the adequacy of the primary liner against leachate leakage; it should cover both the bottom and side walls of a waste management unit. The LDS should be designed to collect leakage through the primary layer and transport it to a sump within 24 hours.

The LDS should allow for monitoring and collection of leachate escaping the primary liner system. You should monitor the LDS on a regular basis. If the volume of leachate detected by the LDS appears to be increasing or is significant, you should consider a closer examination to determine possible remediation measures. A good rule of thumb is that if the LDS indicates a seepage level greater than 20 gallons per acre per day, the system might need closer monitoring or remediation.

C. Leachate Treatment System

Once the leachate has been removed from the unit and collected, you should consider taking measures to characterize the leachate in order to ensure proper management. There are several methods of disposal for leachate, and the treatment strategy will vary according to the disposal method chosen. Leachate disposal options include discharging to or pumping and hauling to a publicly owned treatment works or to an onsite treatment system; treating and discharging to the environment; land application; and natural or mechanical evaporation.

When discharging to or pumping and hauling leachate to a publicly owned treatment works, a typical treatment strategy includes pretreatment. Pretreatment could involve equalization, aeration, sedimentation, pH adjustment, or metals removal.[23] If the plan for leachate disposal does not involve a remote treatment facility, pretreatment alone usually is not sufficient.

There are two categories of leachate treatment, biological and physical/chemical. The most common method of biological treatment is activated sludge. Activated sludge is a "suspended-growth process that uses aerobic microorganisms to biodegrade organic contaminants in leachate."[24] Among physical/chemical treatment techniques, the carbon absorption process and reverse osmosis are the two most common methods. Carbon absorption uses carbon to remove dissolved organics from leachate and is very expensive. Reverse osmosis involves feeding leachate into a tubular chamber whose wall acts as a synthetic membrane, allowing water molecules to pass through but not pollutant molecules, thereby separating clean water from waste constituents.

What are the recommendations for leachate treatment systems?

You should review all applicable federal and state regulations and discharge standards to determine which treatment system will ensure long-term compliance and flexibility for the unit. Site-specific factors will also play a fundamental role in determining the proper leachate treatment system. For some facilities, onsite storage and treatment might not be an option due to space constraints. For other facilities, having a nearby, publicly owned treatment works might make pretreatment and discharge to the treatment works an attractive alternative.

VI. Construction Quality Assurance and Quality Control

Even the best unit design will not translate into a structure that is protective of human health and the environment, if the unit is not properly constructed. Manufacturing quality assurance and manufacturing quality control (MQA and MQC) are also important issues for the overall project; however, they are discussed only briefly here since they are primarily the responsibility of a manufacturer. Nonetheless, it is best to select a manufactur-

[23] Arts, Tom. "Alternative Approaches For Leachate Treatment." *World Wastes.*

[24] Ibid.

er who incorporates appropriate quality assurance and quality control (QA and QC) mechanisms as part of the manufacturing process. The remainder of this section provides a general description of the components of a construction quality assurance and construction quality control (CQA and CQC) program for a project. CQA and CQC are critical factors for waste management units. They are not interchangeable, and the distinction between them should be kept in mind when preparing plans. CQA is third party verification of quality, while CQC consists of in-process measures taken by the contractor or installer to maintain quality. You should establish clear protocols for identifying and addressing issues of concern throughout every stage of construction.

What is manufacturing quality assurance?

The desired characteristics of liner materials should be specified in the unit's contract with the manufacturer. The manufacturer should be responsible for certifying that materials delivered conform to those specifications. MQC implemented to ensure such conformance might take the form of process quality control or computer-aided quality control. If requested, the manufacturer should provide information on the MQC measures used, allow unit personnel or engineers to visit the manufacturing facility, and provide liner samples for testing. It is good practice for the manufacturer to have a dedicated individual in charge of MQC who would work with unit personnel in these areas.

What is construction quality assurance?

CQA is a verification tool employed by the facility manager or regulatory agency, consisting of a planned series of observations and tests designed to ensure that the final product meets project specifications. CQA testing, often referred to as acceptance inspection, provides a measure of the final product quality and its conformance with project plans and specifications. Performing acceptance inspections routinely, as portions of the project become complete, allows early detection and correction of deficiencies, before they become large and costly.

On routine construction projects, CQA is normally the concern of the facility manager and is usually performed by an independent, third-party testing firm. The independence of the testing firm is important, particularly when a facility manager has the capacity to perform the CQA activities. Although the

MQC, MQA, CQC, and CQA

Manufacturing quality control (MQC) is measures taken by the manufacturer to ensure compliance with the material and workmanship specifications of the facility manager.

Manufacturer quality assurance (MQA) is measures taken by facility personnel, or by an impartial party brought in expressly for the purpose, to determine if the manufacturer is in compliance with the specifications of the facility manager.

Construction quality control (CQC) is measures taken by the installer or contractor to ensure compliance with the installation specifications of the facility manager.

Construction quality assurance (CQA) is measures taken by facility personnel, or by an impartial party brought in expressly for the purpose, to determine if the installer or contractor is in compliance with the installation specifications of the facility manager.

facility's in-house CQA personnel might be registered professional engineers, a perception of misrepresentation might arise if CQA is not performed by an independent third party.

The independent party should designate a CQA officer and fully disclose any activities or relationships that the officer has with the facility manager that might impact his or her impartiality or objectivity. If such activities or relationships exist, the CQA officer should describe actions that have been or can be taken to avoid, mitigate, or neutralize the possibility they might affect the CQA officer's objectivity. State regulatory representatives can help evaluate whether these mechanisms are sufficient to ensure acceptable CQA.

What is construction quality control?

CQC is an ongoing process of measuring and controlling the characteristics of the product in order to meet manufacturer's or project specifications. CQC inspections are typically performed by the contractor to provide an in-process measure of construction quality and conformance with the project plans and specifications, thereby allowing the contractor to correct the construction process if the quality of the product is not meeting the specifications and plans. Since CQC is a production tool employed by the manufacturer of materials and by the contractor installing the materials at the site, the Guide does not cover CQC in detail. CQC is performed independently of CQA. For example, while a geomembrane liner installer will perform CQC testing of field seams, the CQA program should require independent testing of those same seams by a third-party inspector.

How can implementation of CQA and CQC plans be ensured?

When preparing to design and construct a waste management unit, regardless of design, you should develop CQA and CQC plans customized to the project. To help the project run smoothly, the CQA plan should be easy to follow. You should organize the CQA plan to reflect the sequence of construction and write it in language that will be familiar to an average field technician. For a more detailed discussion of specific CQA and CQC activities recommended for each type of waste management unit, you should consult *Technical Guidance Document: Quality Assurance and Quality Control for Waste Management Containment Facilities* (U.S. EPA, 1993c). This document provides information to develop comprehensive QA plans and to carry out QC procedures at waste management units.

CQA and CQC plans can be implemented through a series of meetings and inspections, which should be documented thoroughly. Communication among all parties involved in design and construction of a waste management unit is essential to ensuring a quality product. You should define responsibility and authority in written QA and QC plans and ensure that each party involved understands its role. Pre-construction meetings are one way to help clarify roles and responsibilities. During construction, meetings can continue to be useful to help resolve misunderstandings and to identify solutions to unanticipated problems that might develop. Some examples of typical meetings during the course of any construction project include pre-bid meetings, resolution meetings, pre-construction meetings, and progress meetings.

A. Compacted Clay Liner Quality Assurance and Quality Control

Although manufacturing quality control and quality assurance are often the responsibility of the materials manufacturer, in the case of soil components, manufacturing and construction quality control testing can be the responsibility of the facility manager. The CQA and CQC plans should specify procedures for quality assurance and quality control during construction of the compacted clay liners.

How can implementation of QA and QC be ensured for a compacted clay liner?

QC testing is typically performed by the contractor on materials used in construction of the liner. This testing examines material properties such as moisture content, soil density, Atterberg limits, grain size, and laboratory hydraulic conductivity. Additional testing of soil moisture content, density, lift thickness, and hydraulic conductivity helps ensure that the waste management unit has been constructed in accordance with the plans and technical specifications.

CQA testing for soil liners includes the same tests described for QC testing in the paragraph above. Generally, the tests are performed less frequently. CQA testing is performed by an individual or an entity independent of the contractor. Activities of the CQA officer are essential to document quality of construction. The responsibilities of the CQA officer and his or her staff might include communicating with the contractor; interpreting and clarifying project drawings and specifications with the designer, facility manager, and contractor; recommending acceptance or rejection by the facility manager of work completed by the construction contractor; and submitting blind samples, such as duplicates and blanks, for analysis by the contractor's testing staff or independent laboratories.

You should also consider constructing a test pad prior to full-scale construction as a CQA tool. As described earlier in the section on compacted clay liners, pilot construction or test fill of a small-scale test pad can be used to verify that the soil, equipment, and construction procedures can produce a liner that performs according to the construction drawings and specifications.

Specific factors to examine or test during construction of a test fill include: preparation and compaction of foundation material to the required bearing strength; methods of controlling uniformity of the soil material; compactive effort, such as type of equipment and number of passes needed to achieve required soil density and hydraulic conductivity; and lift thickness and placement procedures needed to achieve uniformity of density throughout a lift and prevent boundary effects between lifts or between placements in the same lift. Test pads can also provide a means to evaluate the ability of different types of soil to meet hydraulic conductivity requirements in the field. In addition to allowing an opportunity to evaluate material performance, test pads also allow evaluation of the skill and competence of the construction team, including equipment operators and QC specialists.

B. Geomembrane Liner Quality Assurance and Quality Control

As with the construction of soil liners, installation of geomembrane liners should be in conformance with a CQA and CQC plan. The responsibilities of the CQA personnel for the installation of the geomembrane are gen-

erally the same as the responsibilities for the construction of a compacted clay liner, with the addition of certain activities including observations of the liner storage area and liners in storage, and handling of the liner as the panels are positioned in the cell. Geomembrane CQA staff should also observe seam preparation, seam overlap, and materials underlying the liner.

How can implementation of QA and QC be ensured for a geomembrane liner?

Prior to installation, you should work with the geomembrane manufacturer to ensure the labeling system for the geomembrane rolls is clear and logical, allowing easy tracking of the placement of the rolls within the unit. It is important to examine the subgrade surface with both the subgrade contractor and the liner installer to ensure it conforms to specifications.

Once liner installation is underway, CQA staff might be responsible for observations of destructive testing conducted on scrap test welds prior to seaming. Geomembrane CQA staff might also be responsible for sending destructive seam sampling to an independent testing laboratory and reviewing the results for conformance to specifications. Other observations for which the CQA staff are typically responsible include observations of all seams and panels for defects due to manufacturing and handling, and placement and observations of all pipe penetrations through a liner.

Test methods, test parameters, and testing frequencies should be specified in the CQA plan to provide context for any data collected. It is prudent to allow for testing frequency to change, based on the performance of the geomembrane installer. If test results indicate poor workmanship, you should increase testing. If test results indicate high quality installation work, you can consider reducing testing frequencies. When varying testing frequency, you should establish well-defined procedures for modifying testing frequency. It is also important to evaluate testing methods, understand the differences among testing methods, and request those methods appropriate for the material and seaming method be used. Nondestructive testing methods are preferrable when possible to help reduce the number of holes cut into the geomembrane.

Geomembrane CQA staff also should document the results of their observations and prepare reports indicating the types of sampling conducted and sampling results, locations of destructive samples, locations of patches, locations of seams constructed, and any problems encountered. In some cases, they might need to prepare drawings of the liner installation. Record drawing preparation is frequently assigned to the contractor, to a representative of the facility manager, or to the engineer. You should request complete reports from any CQA staff and the installers. To ensure complete CQA documentation, it is important to maintain daily CQA reports and prepare weekly summaries.

C. Geosynthetic Clay Liner Quality Assurance and Quality Control

Construction quality assurance for geosynthetic clay liners is still a developing area; the GCL industry is continuing to establish standardized quality assurance and quality control procedures. The CQA recommendation for GCLs can serve as a starting point. You should check with the GCL manufacturer and installer for more specific information.

How can implementation of QA and QC be ensured for a geosynthetic clay liner?

It is recommended that you develop a detailed CQA plan, including product specifications; shipping, handling, and storage procedures; seaming methods; and placement of overlying material. It is important to work with the manufacturer to verify that the product meets specifications. Upon receipt of the GCL product, you should also verify that it has arrived in good condition.

During construction, CQA staff should ensure that seams are overlapped properly and conform to specifications. CQA staff should also check that panels, not deployed within a short period of time, are stored properly. In addition, as overlying material is placed on the GCL, it is important to restrict vehicle traffic directly on the GCL. You should prohibit direct vehicle traffic, with the exception of small, 4-wheel, all terrain vehicles. Even with the small all-terrain vehicles, drivers should take extreme care to avoid movements, such as sudden starts, stops, and turns, which can damage the GCL.

As part of the CQA documentation, it is important to maintain records of weather conditions, subgrade conditions, and GCL panel locations. Also, you should document any repairs that were necessary or other problems identified and addressed.

D. Leachate Collection System Quality Assurance and Quality Control

Leachate collection system CQC should be performed by the contractor. Similar activities should be performed for CQA by an independent party acting on behalf of the facility manager. The purpose of leachate collection system CQA is to document that the system is constructed in accordance with design specifications.

How can implementation of QA and QC be ensured for a leachate collection system?

Prior to construction, CQA staff should inspect all materials to confirm that they meet the construction plans and specifications. These materials include: geonets; geotextiles; pipes; granular material; mechanical, electrical, and monitoring equipment; concrete forms and reinforcements; and prefabricated structures such as sumps and manholes. The leachate collection system foundation, either a geomembrane or compacted clay liner, should also be inspected, upon its completion, to ensure that it has proper grading and is free of debris and liquids.

During construction, CQA staff should observe and document, as appropriate, the placement and installation of pipes, filter layers, drainage layers, geonets and geotextiles, sumps, and mechanical and electrical equipment. For pipes, observations might include descriptions of pipe bedding material, quality and thickness, as well as the total area covered by the bedding material. Observations of pipe installations should focus on the location, configuration, and grading of the pipes, as well as the quality of connections at joints.

For granular filter layers, CQA activities might include observing and documenting material thickness and quality during placement. For granular drainage layers, CQA might focus on the protection of underlying liners, material thickness, proper overlap with filter fabrics and geonets (if applicable), and documentation of any weather conditions that might affect the overall performance of the drainage layer. For geonets and

other geosynthetics, CQA observations should focus on the area of coverage and layout pattern, as well as the overlap between panels. For geonets, CQA staff might want to make sure that the materials do not become clogged by granular material that can be carried over, as a result of either wind or runoff during construction.

Upon completion of construction, each component should be inspected to identify any damage that might have occurred during its installation or during construction of another component. For example, a leachate collection pipe can be crushed during placement of a granular drainage layer. Any damage that does occur should be repaired, and the repairs should be documented in the CQA records.

Designing and Installing Liners Activity List

- ☐ Review the recommended location considerations and operating practices for the unit.
- ☐ Select appropriate liner type—single, composite, or double liner—or in-situ soils, based on risk characterization.
- ☐ Evaluate liner material properties and select appropriate clay, geosynthetic, or combination of materials; consider interactions of liner and soil material with waste.
- ☐ Develop a construction quality assurance (CQA) plan defining staff roles and responsibilities and specifying test methods, storage procedures, and construction protocols.
- ☐ Ensure a stable in-situ soil foundation, for nonengineered liners.
- ☐ Prepare and inspect subgrade for engineered liners.
- ☐ Work with manufacturer to ensure protective shipping, handling, and storage of all materials.
- ☐ Construct a test pad for compacted clay liners.
- ☐ Test compacted clay liner material before and during construction.
- ☐ Preprocess clay material to ensure proper water content, remove oversized particles, and add soil amendments, as applicable.
- ☐ Use proper lift thickness and number of equipment passes to achieve adequate compaction.
- ☐ Protect clay material from drying and cracking.
- ☐ Develop test strips and trial seams to evaluate geomembrane seaming method.
- ☐ Verify integrity of factory and field seams for geomembrane materials before and during construction.
- ☐ Backfill with soil or geosynthetics to protect geomembranes and geosynthetic clay liners during construction.
- ☐ Place backfill materials carefully to avoid damaging the underlying materials.
- ☐ Install geosynthetic clay liner with proper overlap.
- ☐ Patch any damage that occurs during geomembrane or geosynthetic clay liner installation.
- ☐ Design leachate collection and removal system to allow adequate flow and to minimize clogging; include leachate treatment and leak detection systems, as appropriate.
- ☐ Document all CQA activities, including meetings, inspections, and repairs.

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Appendix

Geosynthetic Materials[25]

Geotextiles

Geotextiles form one of the two largest group of geosynthetics. Their rise in growth during the past fifteen years has been nothing short of awesome. They are indeed textiles in the traditional sense, but consist of synthetic fibers rather than natural ones such as cotton, wool, or silk. Thus biodegradation is not a problem. These synthetic fibers are made into a flexible, porous fabric by standard weaving machinery or are matted together in a random, or nonwoven, manner. Some are also knit. The major point is that they are porous to water flow across their manufactured plane and also within their plane, but to a widely varying degree. There are at least 80 specific application areas for geotextiles that have been developed; however, the fabric always performs at least one of five discrete functions:

1. Separation
2. Reinforcement
3. Filtration
4. Drainage
5. Moisture barrier (when impregnated)

Geogrids

Geogrids represent a rapidly growing segment within the geosynthetics area. Rather than being a woven, nonwoven or knit textile (or even a textile-like) fabric, geogrids are plastics formed into a very open, gridlike configuration (i.e., they have large apertures). Geogrids are either stretched in one or two directions for improved physical properties or made on weaving machinery by unique methods. By themselves, there are at least 25 application areas, however, they function almost exclusively as reinforcement materials.

Geonets

Geonets, called geospacers by some, constitute another specialized segment within the geosynthetic area. They are usually formed by a continuous extrusion of parallel sets of polymeric ribs at acute angles to one another. When the ribs are opened, relatively large apertures are formed into a netlike configuration. Their design function is completely within the drainage area where they have been used to convey fluids of all types.

Geomembranes

Geomembranes represent the other largest group of geosynthetics and in dollar volume their sales are probably larger than that of geotextiles. Their growth has been stimulated by governmental regulations originally enacted in 1982. The materials themselves are "impervious" thin sheets of rubber or plastic material used primarily for linings and covers of liquid- or solid-storage facilities. Thus the primary function is always as a liquid or vapor barrier. The range of applications, however, is very great, and at least 30 individual applications in civil engineering have been developed.

Geosynthetic Clay Liners

Geosynthetic clay liners (or GCLs) are the newest subset within geosynthetic materials. They are rolls of factory fabricated thin layers of bentonite clay sandwiched between two geotextiles or bonded to a geomembrane. Structural integrity is maintained by needle punching, stitching or physical bonding. They are seeing use as a composite compo-

[25] Created by Geosynthetic Research Institute. Accessed from the Internet on October 16, 2001 at **<www.drexel.edu/gri/gmat.html>**.

nent beneath a geomembrane or by themselves as primary or secondary liners.

Geopipe (aka Buried Plastic Pipe)

Perhaps the original geosynthetic material still available today is buried plastic pipe. This "orphan" of the Civil Engineering curriculum was included due to an awareness that plastic pipe is being used in all aspects of geotechnical, transportation, and environmental engineering with little design and testing awareness. This is felt to be due to a general lack of formalized training. The critical nature of leachate collection pipes coupled with high compressive loads makes geopipe a bona-fide member of the geosynthetics family. The function is clearly drainage.

Geocomposites

A geocomposite consists of a combination of geotextile and geogrid; or geogrid and geomembrane; or geotextile, geogrid, and geomembrane; or any one of these three materials with another material (e.g., deformed plastic sheets, steel cables, or steel anchors). This exciting area brings out the best creative efforts of the engineer, manufacturer, and contractor. The application areas are numerous and growing steadily. The major functions encompass the entire range of functions listed for geosynthetics discussed previously: separation, reinforcement, filtration, drainage, and liquid barrier.

"Geo-Others"

The general area of geosynthetics has exhibited such innovation that many systems defy categorization. For want of a better phrase, geo-others, describes items such as threaded soil masses, polymeric anchors, and encapsulated soil cells. As with geocomposites their primary function is product-dependent and can be any of the five major functions of geosynthetics.