

SUBCHAPTER 2K - DAM SAFETY

SECTION .0100 - GENERAL PROVISIONS

15A NCAC 02K .0101 DEFINITIONS

15A NCAC 02K .0102 DAM SAFETY ORDERS

History Note: Authority G.S. 143-215.25; 143-215.32; 143-215.34;
Eff. January 22, 1977;
Amended Eff. November 1, 1978;
Repealed Eff. June 15, 1980.

15A NCAC 02K .0103 PURPOSE

The rules and regulations contained in this Subchapter are intended to carry out the purposes of the Dam Safety Law of 1967, as expressed in G.S. 143-215.24 which authorizes the implementation of a dam inspection and certification program in the interest of public health, safety and welfare.

History Note: Authority G.S. 143-215.31; 143-215.34;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0104 DEFINITIONS

As used in this Subchapter, the following terms have their stated meaning:

- (1) "Applicant" means any person who has notified the department that he or she desires to construct, repair, alter, or remove a dam and requests approval by the department.
- (2) "Appurtenance" means an accessory or integral subordinate structure associated with a dam, such as a spillway, conduit, walkway, valve, control gate, etc.
- (3) "Articulation" means provisions for safe movement at the joint or juncture of sections of conduit.
- (4) "As-built plans" means drawings, photographs, test data, and descriptions that clearly and accurately define the dam and its appurtenances after all construction is completed.
- (5) "Conduit" means a natural or artificial channel or pipe through which water or other fluid is conveyed.
- (6) "Critical circle" means the circle with the lowest factor of safety against mass movement in a circular arc analysis of slope stability.
- (7) "Critical failure wedge" means the mass or block having the lowest factor of safety against mass movement in an analysis of slope stability along planar surfaces.
- (8) "Director" means the Director of the Division of Energy, Mineral, and Land Resources, North Carolina Department of Natural Resources and Community Development.
- (9) "Equipotential lines" means lines which represent points of equal energy level or head in a flow net.
- (10) "Factor of safety" means the ratio of the forces or moments resisting mass movement to the forces or moments tending to produce mass movement.
- (11) "Flow lines" means lines which represent the direction of flow in a flow net.
- (12) "Flow net" means a graphical representation of flow lines and equipotential lines.
- (13) "Hazard potential" means the probable damage that would occur if the structure failed, in terms of loss of human life and economic loss or environmental damage.
- (14) "Maintenance plan" means written instructions prepared by the engineer that prescribe the proper servicing and repair of mechanical equipment, appurtenances, spillways, vegetative cover, and other aspects related to the safety of the dam.
- (15) "Owner" means the individual or association of individuals owning the property on which the dam exists or is to be constructed, and the persons financially responsible for the construction.
- (16) "Phreatic surface" means the free-water surface of a zone of seepage; it is represented by the uppermost flow line, or seepage line, in a flow net.

- (17) "Qualified engineer" means a professional engineer legally qualified to practice in North Carolina pursuant to Chapter 89C of the General Statutes of North Carolina, and having appropriate specialty expertise for the particular dam engineering problem with which he is involved.
- (18) "Qualified geologist" means an earth scientist experienced in applied geology with respect to the interaction of lithologies, soils, and geologic structures with dams and impoundments, who can provide professional credentials such as certification by the American Institute of Professional Geologists or registration as a geologist in the United States.
- (19) "Quality control" means that combination of testing, observation, and monitoring provided during construction to confirm that requirements stated or depicted in the plans and specifications are being achieved.
- (20) "Rapid drawdown" means removal of liquid from a reservoir at a rate that is significantly faster than the rate of drainage of the materials composing the portions of the reservoir exposed by the fluid removal.
- (21) "Seepage" means the movement of water in a porous material and the water exiting at the visible surface of the material.
- (22) "Sliding base analysis" means an analysis of the safety of a structure against lateral movement along its foundation.
- (23) "Waste treatment and mine refuse dam" means a structure for impounding, restraining, storing, or disposing of liquids, slurries, or materials capable of liquification, produced from industrial, commercial, municipal, agricultural, or mining activities.
- (24) "Construction" means any action, other than by natural causes, that creates a structure capable of impounding water or other liquids, or which increases the impoundment capacity of an existing structure. For the purposes of 15A NCAC 2K .0222, it shall also mean the reduction of the height or impoundment capacity of a dam when the effect of such reduction will be to exempt the dam from the North Carolina Dam Safety Law of 1967.

History Note: Authority G.S. 143-215.25; 143-215.31;
 Eff. June 15, 1980;
 Amended Eff. July 1, 1988; November 1, 1984;
 Temporary Amendment Eff. November 1, 1990 For a Period of 180 Days to Expire on April 29, 1991;
 ARRC Objection Lodged November 14, 1990;
 ARRC Objection Removed December 20, 1990;
 Amended Eff. August 1, 2012 (see S.L. 2012-143, s.1.(f)); January 1, 1991;
 Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0105 CLASSIFICATION OF DAMS

- (a) For the purposes of this Subchapter, dams shall be divided into three classes, which shall be known as class A (low hazard), class B (intermediate hazard), and class C (high hazard):
 - (1) Class A includes dams located where failure may damage uninhabited low value non-residential buildings, agricultural land, or low volume roads.
 - (2) Class B includes dams located where failure may damage highways or secondary railroads, cause interruption of use or service of public utilities, cause minor damage to isolated homes, or cause minor damage to commercial and industrial buildings. Damage to these structures will be considered minor only when they are located in back water areas not subjected to the direct path of the breach flood wave; and they will experience no more than 1.5 feet of flood rise due to breaching above the lowest ground elevation adjacent to the outside foundation walls or no more than 1.5 feet of flood rise due to breaching above the lowest floor elevation of the structure, the lower of the two elevations governing. All other damage potential will be considered serious.
 - (3) Class C includes dams located where failure will likely cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, primary highways, or major railroads.
- (b) Classifications shall be proposed by the design engineer and are subject to approval by the Director.
- (c) Probable future development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification.

(d) Dams will be subject to reclassification if the Director determines that the hazard potential has changed. Non-structural provisions of adequately demonstrated effectiveness and reliability such as flood plain zoning, and early warning systems may be considered by the Director in making this determination.

(e) When dams are spaced so that the failure of an upper dam would likely fail a lower dam, the consequence of the lower dam's failure shall be a determining factor for the upper dam's hazard classification.

(f) In assigning a hazard classification where a bridge or roadway is the only damageable property below a dam, consideration shall be given to the possibility of loss of human life, indirect economic impact through loss of service, and direct cost of damage to the bridge or roadway.

*History Note: Authority G.S. 143-215.31; 143-215.34;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

SECTION .0200 - OBTAINING APPROVAL FOR DAM CONSTRUCTION: REPAIR:OR REMOVAL

15A NCAC 02K .0201 APPLICATIONS

(a) Any person(s) who proposes to construct, repair, alter or remove a dam must file with the Director a statement concerning the location of the dam, including the name of the stream and county, height, purpose, and impoundment capacity, 10 days before start of construction. If the Director determines that the proposed dam is exempt from the law, the applicant will be notified and he may then proceed with the construction.

(b) If the Director determines that the proposed dam is not exempt from the Dam Safety Law of 1967, the applicant will be so notified within 10 days of receipt of the statement described in (a) of this Rule and construction may not commence until a full and complete application has been filed and approved. This application must be filed at least 60 days before the proposed start of construction:

- (1) When an application to construct a dam has been completed pursuant to Subsection (a) of this Rule, the department shall refer copies of the completed application papers to the Department of Human Resources, the Wildlife Resources Commission, the Department of Transportation, and such other state and local agencies as it deems appropriate for review and comment.
- (2) Before commencing the repair, alteration, or removal of a dam, application shall be made for written approval by the department, except as otherwise provided by this Subchapter or in accordance with G.S. 143-215.27(b). The application shall state the name and address of the applicant; shall adequately detail the changes it proposes to effect; and shall be accompanied by maps, plans, and specifications setting forth such details and dimensions as the department requires. The department may waive such requirements in accordance with G.S. 143-215.27(a). The application shall give such other information concerning the dam and reservoir required by the department concerning the safety of any change as it may require, and shall state the proposed time of commencement and completion of the work. When an application has been completed, it may be referred by the department for agency review and report as provided by G.S. 143-215.26(b) in the case of original construction.

(c) The application for any dam shall include a preliminary report. (Filing of the preliminary report prior to filing the final design report, early in the site investigation and design schedule, is encouraged to assure the state's concurrence with the hazard classification, site investigation, and design concept. This is especially encouraged for class C dams.) The preliminary report shall be filed with the application and shall include the following information:

- (1) a general description of the dam and appurtenances and a proposed classification as set forth in Rule .0105 of this Subchapter; The description shall include a statement of the purpose for which the dam is to be used;
- (2) a description of properties located below the dam including number of homes, buildings, roads, utilities, and other property that, as determined by the engineer, would be endangered should failure of the dam occur;
- (3) maps showing the location of the proposed structure that include the county, location of state roads, access to site, and outline of the reservoir; aerial photographs or USGS maps may be used;
- (4) preliminary drawings or sketches that include cross-sections, plans and profiles of the dam, proposed pool levels, and types of all spillways;
- (5) preliminary design criteria and basis for selection including a description of the size, ground cover conditions, and extent of development of the watershed, drainage area, spillway design storm, geology and

geotechnical engineering, assumptions for the foundation and embankment materials, and type of materials to be used in the principal spillways(s).

(d) The Final Design Report. A "Certificate of Approval" to construct will not be issued until the final design report is received and approved. The preliminary report as described in (c) of this Rule and the final design report may be submitted as one document. The final design report shall include:

- (1) a report of the investigation of the foundation soils or bedrock and the borrow materials, including the location of borrow areas, that are to be used to construct the dam;
- (2) criteria to indicate that the dam will be stable during construction and filling and under all conditions of reservoir operations;
- (3) computations indicating that the dam is safe against overtopping during occurrence of the inflow design flood and wave action; Wave action need not be considered when the design flood is based on the probable maximum precipitation (pmp);
- (4) criteria, design data or references to indicate that seepage flow through the embankment, foundation, and abutments will be controlled so that no internal erosion will take place and so there will be no sloughing in the area where the seepage emerges;
- (5) calculations and assumptions relative to design of the spillway(s);
- (6) provision to protect the upstream slope, crest, and downstream slope of earth embankments and abutments from erosion due to wind and rain;
- (7) other design data, assumptions, and analysis data pertinent to individual dams and site conditions;
- (8) a proposed construction schedule;
- (9) a proposed filling schedule for the reservoir;
- (10) a maintenance and operation plan;
- (11) the estimated design life of the dam and the reservoir;
- (12) provision for maintaining minimum stream flow requirements.

(e) The Plans and Specifications. Five sets of plans and specifications must be submitted. The plans shall be a detailed engineering design that consists of drawings and specifications and that include the following as a minimum:

- (1) Sheet one shall show the name of the project; name of owner; hazard classification of the dam; designated access to the project; and location with respect to highways, roads, streams, and any dam(s) that would affect or be affected by the proposed structure;
- (2) Maps shall be included showing the drainage area and outline of the reservoir and the ownership of properties covered by the reservoir or flood pool;
- (3) Geologic investigation, cross-section, profiles, logs of borings, location of borrow areas, drawings of principal and emergency spillways, and other additional sheets shall be included and drawn in sufficient detail to clearly indicate the extent and complexity of the work to be performed; The degree of detail required shall be determined by the applicable provisions of Rules .0204 through .0212 of this Section;
- (4) The technical provisions, as may be required, to describe the method of construction and quality control for the project;
- (5) Special provisions, as may be required, to describe technical provision needed to ensure that the dam is installed according to the approved plans and specifications;
- (6) General provisions that specify the rights, duties, and responsibilities of the applicant, applicant's engineer and builder and the prescribed order of work.

(f) The Director, within 60 days following receipt of a completed application, shall notify the applicant, by mail, that the application is either approved or disapproved. An approved application shall conform to the requirements of Rule .0202 of this Section.

*History Note: Authority G.S. 143-215.26, 143-215-2; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0202 CERTIFICATE OF APPROVAL

(a) Approval of construction, repair, alteration, or removal of a dam will be contained in a certificate called a "Certificate of Approval" to be issued by the Director. A Certificate of Approval is a letter from the Director constituting approval subject to written general stipulations and specific written stipulations deemed necessary by the Director on a case by case basis.

(b) No construction shall be performed until the certificate is issued. The Certificate of Approval period shall be valid for the construction schedule specified in the approved final design report. Construction must commence within one year after the certificate is issued.

(c) Notice by registered or certified mail shall be given to the Director at least 10 days before construction is commenced. When repairs are necessary to safeguard life and property, they may be started immediately; but the department shall be notified forthwith of the proposed repairs and of the work under way, and they shall be made to conform to its orders.

(d) If construction does not commence within one year after the certificate of approval is issued, the certificate shall expire and a new application shall be submitted. Upon written application and for good cause shown, the Director may extend the time for commencing construction.

(e) Certificates of Approval are revocable in the event that the terms of the certificate, including the written stipulations and those terms stated in G.S. 143-215.23, are violated or in the event that conditions develop during construction that are hazardous to life and property. If the certificate is revoked due to development of hazardous conditions, the Director will issue an order requiring the owner or owners of the dam to make at his or their expense maintenance, alterations, or removal as deemed necessary within a time limited by the order; provided, any dam covered by a certificate issued under this Rule is considered to be within the definition of dams in G.S. 143-215.25 and .0104 of this Subchapter.

(f) Certificates of Approval are revocable in the event that the approved construction schedule is deviated from without prior written approval of a substitute construction schedule submitted in writing. Such approval of a substitute construction schedule shall be in the form of an Addendum to the Certificate of Approval to be issued by the Director.

History Note: Authority G.S. 143-215.26,-27,-31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0203 PROFESSIONAL ENGINEER REQUIREMENTS

The design, preparation of the plans and specifications, inspection of the construction of or on the dam, and certification that the dam was constructed, repaired, altered, or removed according to the plans approved by the Director and that the dam or its remains are safe shall be done by a legally qualified engineer and shall bear his professional seal unless exempted under the provisions of G.S. 89C-25.

History Note: Authority G.S. 143-215.29,-31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0204 INVESTIGATIONS

(a) General. The applicant shall be required to complete all investigations prior to submission of the final plans and application. The scope and the degree of precision that will be required for a specific project will depend on the conditions of the site and the hazard created by the proposed structure.

(b) Foundations and Abutments. The foundation and abutments investigation shall consist of borings, test pits, and other subsurface exploration necessary to assess the soil, rock, and groundwater conditions. Geologic profiles and a geologic report prepared by a qualified geologist may be required for class B dams and shall be required for class C dams.

(c) Construction Materials. Specifications for construction materials shall establish minimum acceptance criteria so that design properties are achieved. If the use of on site borrow materials is specified, exploration, testing, and calculations should be performed to indicate that there are sufficient quantities of material available that meet the design criteria.

(d) Surveys. Surveys shall be made with sufficient accuracy to locate the proposed construction and to define the volume of the storage in the reservoir. The downstream area shall be investigated in order to delineate the area of potential damage in case of failure. Locations of centerlines, and other horizontal and vertical control points, shall be shown on a map of the site.

(e) Hydrologic Investigation. The drainage area shall be determined. Both present and projected future land use shall be considered in determining the runoff characteristics of the drainage area. The most severe of these two conditions shall be used in the design. All hydrologic assumptions and design calculations shall be included in the report.

History Note: Authority G.S. 143-215.26,-27,-31;
Eff. June 15, 1980;

Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0205 SPILLWAY DESIGN

- (a) All dams shall have a spillway system with capacity to pass a flow resulting from a design storm indicated in (e) of this Rule for a hazard classification appropriate for the dam, unless the applicant provides calculations, designs, and plans to show that the design flow can be stored, passed through, or passed over the dam without failure occurring.
- (b) A vegetated earth or unlined emergency spillway will be approved when computations indicate that it will pass the design storm without jeopardizing the safety of the structure. The risk of recurring storms, excessive erosion, and inadequate vegetative cover will be considered acceptable in such a spillway when its average frequency of use is predicted to be no more frequent than once in 25 years for existing class B and for class A dams except for small class A dams designed in accordance with all design criteria established by the U.S.D.A., Soil Conservation Service, and as contained in Engineering Standard 378 of the U.S.D.A., Soil Conservation Service; once in 50 years for new class B, small and medium new class C, and existing class C dams; and once in 100 years for large and very large new class C dams. The dam sizes referred to in this Subsection are defined in (e) of this Rule.
- (c) Lined Spillways and Channels. The design report shall include design data criteria for open channel, drop, ogee, and chute spillways and other spillway types that include crest structures, walls, channel lining, and miscellaneous details. All masonry or concrete structures shall have joints that are relatively water-tight and shall be placed on foundations capable of sustaining applied loads without undue deformation. Provisions must be made for handling leakage from the channel or underseepage from the foundation which might cause saturation of underlying materials or uplift against the undersurfaces.
- (d) Within 15 days following passage of the design storm peak, the spillway system shall be capable of removing from the reservoir at least 80 percent of the water temporarily detained in the reservoir above the elevation of the primary spillway.
- (e) It is recognized that the relationships between valley slope and width, total reservoir storage, drainage area, other hydrologic factors, and specific cultural features have a critical bearing on determining the safe spillway design flood. Rational selection of a safe spillway design flood for specific site conditions based on quantitative analysis is acceptable. The spillway should be sized so that the increased downstream damage resulting from overtopping failure of the dam would not be significant as compared with the damage caused by the flood in the absence of dam overtopping failure. A design storm more frequent than once in 100 years will not be acceptable for any class C dam. In lieu of quantitative analysis, the following tables shall be used as criteria for spillway design storms and permissible velocities for vegetated earth spillways:

CRITERIA FOR SPILLWAY DESIGN STORM SIZE CLASSIFICATION		
Size	Total Storage (Ac-Ft) ¹	Height (ft) ¹
Small	less than 750	less than 35
Medium	equal to or greater than 750 and less than 7,500	equal to or greater than 35 and less than 50
Large	equal to or greater than 7,500 and less than 50,000	equal to or greater than 50 and less than 100
Very Large	equal to or greater than 50,000	equal to or greater than 100

¹ The factor determining the largest size shall govern

MINIMUM SPILLWAY DESIGN STORMS		
Hazard	Size	Spillway Design Flood (SDF)
Low (Class A)	Small	50 year
	Medium	100 year
	Large	1/3 PMP
	Very Large	1/2 PMP
Intermediate (Class B)	Small	100 year
	Medium	1/3 PMP
	Large	1/2 PMP
	Very Large	3/4 PMP
High (Class C)	Small	1/3 PMP
	Medium	1/2 PMP
	Large	3/4 PMP

MINIMUM SPILLWAY DESIGN STORMS		
Hazard	Size	Spillway Design Flood (SDF)
	Very Large	PMP

PERMISSIBLE VELOCITIES FOR VEGETATED EARTH SPILLWAYS				
	Permissible velocity ¹ feet per second			
	Erosion resistant soils		Easily erodible soils	
	Slope of exit channel Percent		Slope of exit channel Percent	
Vegetation	0 to 5	5 thru 10	0 to 5	5 thru 10
Bermuda Grass	8	7	6	5
Bahia grass				
Tall fescue	7	6	5	4
Kentucky bluegrass				
Reed canary				
Sod forming grass mixture	5	4	4	3
Lespedeza sericea	3.5	Do not use	2.5	Do not use
Weeping lovegrass				
Alfalfa				
Crabgrass				

² Increase values 10 percent when the anticipated average use of the spillway is not more frequent than once in 50 years or 25 percent when the anticipated average use is not more frequent than once in 100 years.

History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31; Eff. June 15, 1980; Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0206 CONDUITS

- (a) A conduit shall be provided to drain each reservoir. The conduit design shall include the computation of the minimum time required to drain the reservoir.
- (b) All pipe conduits shall convey water at the design velocity without damage to the interior surface.
- (c) Protection shall be provided to prohibit unsafe seepage along conduits through the dam, abutments, and foundation. The specific design for seepage protection along conduits shall be shown in the drawings and specifications.
- (d) Adequate allowances shall be incorporated in the design to compensate for differential settlement and possible elongation of the pipe conduit.
- (e) Trash racks shall be installed at the intake of conduits to prevent clogging the conduit.
- (f) Pipe Conduit Spillway Materials
 - (1) Pipe conduits shall be designed to support the total external loads in addition to the total internal hydraulic pressure without leakage.
 - (2) Reinforced or Prestressed Concrete Pipe Conduits
 - (A) All conduits are to be designed and constructed to remain watertight under maximum anticipated hydraulic pressure and maximum probable joint opening, including the effects of joint rotation and extensibility.
 - (B) Provisions for safe movement of the barrel are to be provided at each joint in the barrel and at the junction of the barrel and riser or inlet. Cradles are to be articulated if constructed on a yielding foundation.
 - (C) The engineer shall submit the final design details of the proposed pipe to be used for all class A dams where the height of the dam exceeds 35 feet and all class B and C dams.
 - (3) Corrugated Metal Pipe Conduits

- (A) Corrugated metal pipe shall not be used in class A dams over 35 feet high or in class B and C dams, except for special cases when the design engineer can adequately demonstrate satisfactory performance.
- (B) Corrugated metal pipe may be used in class A dams which are less than 35 feet high.
- (C) Corrugated metal conduits shall have watertight connecting bands designed and installed to remain watertight under maximum anticipated hydrostatic head and joint rotation.
- (D) Flange type couplings shall not be used for corrugated metal pipe or corrugated steel pipe where the diameter exceeds 12 inches unless the applicant produces computations to verify that the flanges and the pipe conduit are of such design to safely support the total external loads in addition to the total internal hydraulic pressure without leakage.

(g) Dissipating Devices. All gates, valves, conduits and concrete channel outlets shall be provided with a dissipator designed and constructed to control erosion and prevent damage to the embankment or the downstream outlet or channel.

(h) In the case of repair to an existing dam, the engineer may determine that the conduit should not be repaired or replaced and shall submit reasoning to support this determination in the application for the Certificate of Approval to repair. The Director shall approve, disapprove, or approve in part this determination.

History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31; Eff. June 15, 1980; Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0207 SEEPAGE CONTROL

(a) All dams shall be designed and constructed to prevent the development of instability due to excessive seepage forces, uplift forces, or loss of materials in the embankment, abutments, spillway areas, or foundation. Seepage analysis for design shall identify areas having high internal uplift or exit gradients.

(b) The design may include an embankment internal drainage system, a zoned embankment, a foundation cut-off, an upstream blanket, a sufficiently wide homogeneous section, or other methods to protect against instability from excessive seepage forces or high hydraulic gradients.

(c) For class C dams, a flow net analysis shall be made to determine the location of the phreatic surface, flow lines, and equipotential lines within the embankment and its foundation. This analysis may be based on graphical construction, electrical or liquid analogs, soil prototype methods, or other accepted methods. The flow net and stability analysis shall use the maximum operating pool level with not less than five feet of clear water at the surface. Possible fluctuations in tail water elevation shall be included in the analysis. The flow net and seepage analysis shall be documented in the final design report, as required by .0201(d)(4) of this Section.

(d) Piezometers for confirming the location of the phreatic surface assumed for seepage and slope stability analyses should be considered by the design engineer for class A and class B dams and shall be required for class C dams. Where piezometers are required, their design, depths, and locations shall be provided as required in .0201(d) and .0212(b) of this Section.

History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31; Eff. June 15, 1980; Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0208 STRUCTURAL STABILITY AND SLOPE PROTECTION

(a) Design and construction of dams to assure structural stability shall be consistent with modern engineering practice. The scope and degree of precision that will be required for a specific project will depend on the conditions of the site and the damage potential of the proposed structure. Consideration in design for structural stability shall include, but are not necessarily limited to, the following:

- (1) the hazard potential of the dam under present downstream conditions and under conditions which would likely develop during the life of the reservoir;
- (2) foundation bearing capacity, compressibility, and permeability; the extent and reliability of the site investigation; and the predictability of the site and foundation conditions;
- (3) the reliability of construction materials, such as borrow soils, in terms of sufficient volume to complete construction without unanticipated interruption and in terms of predictability of physical properties such as strength, permeability, and compressibility;

- (4) durability of construction materials;
- (5) construction conditions at the site;
- (6) the degree of quality control to be exercised during construction;
- (7) pore pressure build-up during construction;
- (8) the rate of filling the reservoir and the rate of possible reservoir drawdown;
- (9) tailwater conditions and the impact of tailwater drawdown;
- (10) possible effects of landslides and subsurface solution activity on the structural stability of the dam and spillway structures;
- (11) the extent of piezometers and other devices which will be used to monitor the completed dam and the degree of access for inspections.

(b) Slope stability analyses should be considered by the design engineer for all embankment dams and may be required for class B and class C dams. Where slope stability analyses are required, documentation in the final design report shall include the design cross section(s) showing the soil parameters assumed for analysis, the location of the phreatic surface assumed for analysis, stability computations, and the location and computed safety factor(s) for the most critical circle(s) or failure wedge(s). A minimum factor of safety of 1.5 for slope stability for normal loading conditions, and 1.25 for quick drawdown conditions and for construction conditions, shall be required unless the design engineer provides a thoroughly documented basis for using other safety factors.

(c) Foundation bearing capacity and sliding base analyses should be considered for all dams and may be required for class B and C dams. Where bearing capacity or sliding base analyses are required, documentation of assumptions, computations, and safety factors shall be included in the final design report. A minimum factor of safety against bearing capacity and sliding wedge failure of 2.0 shall be required unless the design engineer provides a thoroughly documented basis for using other safety factors.

(d) Resistance of appurtenant structures against flotation uplift shall be provided for all dams. If the structures are anchored by dead weight alone, the buoyant weight shall be used for analysis and the minimum factor of safety shall be 1.15. If the structures are anchored to soil or rock, the minimum factor of safety for that portion of the resistance provided by soil or rock anchorage shall be 2.0 unless the design engineer provides a thoroughly documented basis for using a lower safety factor.

(e) For concrete, masonry, or other similar dams of relatively narrow cross section, resistance against overturning under maximum design loading conditions shall be considered; overturning stability computations shall be required for class B and class C dams. Where overturning analyses are required, the computations shall be included in the final design report. The minimum safety factor against overturning under maximum design loading conditions shall be 1.5 unless the design engineer provides a thoroughly documented basis for using a lower safety factor.

(f) The anticipated reservoir and tailwater drawdown conditions shall be considered in all stability computations and shall be included in the design documents provided in the final design report.

(g) The slopes must be protected against erosion by wave action, and the crest and downstream slope must be protected against erosion due to wind and rain. Riprap and other erosion protection shall be provided over the full range in stage between the lowest drawdown elevation and at least two feet above full normal pool. Exceptions for slowly rising reservoirs, such as waste storage facilities, may be approved in writing by the Director.

*History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0209 DESIGN LIFE OF A DAM AND RESERVOIR

(a) The selection of materials and equipment to be used in a dam and all of its appurtenant features shall either be based on sufficient quality and durability to satisfactorily function throughout the design life or shall provide for safe and economical replacement within the design life span.

(b) The design life of a dam and reservoir is the period of time the dam and reservoir can be expected to perform effectively as planned. The design life of a dam shall be determined by the following:

- (1) the time required to fill the reservoir with sediment from the contributing watershed,
- (2) the durability of appurtenances and materials used to construct the dam,
- (3) the time required to permanently fill a waste treatment or storage facility with waste,
- (4) the time required to perform the specific function for which the dam was designed.

History Note: Authority G.S. 143-215.27; 143-215.31;

Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0210 SEDIMENT CONTROL

Sediment control related to earth moving activities involved in construction or repair of dams shall be provided in accordance with the North Carolina Sediment Pollution Control Act of 1973 (G.S. 113A-50 through 113A-66). Devices for sediment control during drainage of a reservoir shall be provided; exceptions for emergency drainage of a reservoir may be approved by the Director.

History Note: Authority G.S. 143-215.31, -113A-54;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0211 WASTE TREATMENT AND MINE REFUSE DAMS

(a) Waste treatment and mine refuse dams and reservoirs shall conform to all requirements of this Subchapter. In addition to the requirements of Rule .0105 of this Subchapter, a waste treatment or mine refuse dam may be classified A, B, or C on the basis of potential environmental damage.

(b) Mine refuse dams that are designed to be constructed in stages shall include an emergency spillway system that is capable of safely passing the required storm frequency below the top of the dam for each stage of construction. The refuse facility shall not be used until each stage of construction is completed and approved by the Director.

History Note: Authority G.S. 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0212 ADDITIONAL DESIGN REQUIREMENTS

(a) All elements of the dam and reservoir shall conform to generally accepted engineering standards. The safety factors, design standards, and design references that are used shall be included with the final design report and the plans and specifications as set forth in Rule .0201 of this Section.

(b) Monitoring or inspection devices may be required by the Director for use by inspectors or owners in the inspection during construction and filling and after completion of construction if the Director determines that these measures are needed to carry out the purposes of the Dam Safety Law of 1967. The Director shall also require that monitoring or inspection devices be observed and the information recorded and made available to the Department.

(c) The plans, construction schedule, and construction specification shall also contain the elements necessary to achieve the conditions specified in G.S. 143-215.31(b).

History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31;
Eff. June 15, 1980;
Readopted Eff. December 1, 2018.

15A NCAC 02K .0213 CONSTRUCTION SCHEDULE

The applicant shall submit a construction schedule that includes:

- (1) Techniques and work force to be used to insure that the dam is constructed according to the plans and specifications;
- (2) A construction schedule that includes the estimated time to complete the construction activities;
- (3) Techniques to be used to divert the stream flow to prevent interference with construction and hazard to life, health, or property;
- (4) The extent and method of quality control shall be subject to approval of the Director.

History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31;
Eff. June 15, 1980;

Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0214 PROPOSED CHANGES IN DESIGN

The owner shall notify the director of any proposed changes in design, plans, and specifications that will affect the stability of the dam. Approval must be obtained from the Director prior to installation. This approval shall be in the form of a written addendum to the Certificate of Approval.

*History Note: Authority G.S. 143-215.26; 143-215.27; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0215 AS-BUILT PLANS

Two complete sets of as-built plans shall be submitted to the Director within 30 days of completion of the project.

*History Note: Authority G.S. 143-215.30; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0216 ENGINEER'S CERTIFICATION

The engineer who has inspected the construction of or on the dam shall submit written certification bearing his professional seal, unless exempted under the provisions of G.S. 89C-25, that the dam and all appurtenances have been built, repaired, altered, or removed in conformance with the plans, specifications, and drawings approved by the Director and that the dam is safe.

*History Note: Authority G.S. 143-215.30; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0217 AUTHORITY FOR INSPECTION

Authorized personnel of the department may make inspection during construction as deemed necessary to ensure that the structure is being built in conformance with the Certificate of Approval issued. Said inspections do not relieve the engineer in charge from the responsibility of providing adequate inspection of the work.

*History Note: Authority G.S. 143-215.29; 143-215.30; 143-215.31;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0218 EXEMPTIONS

*History Note: Authority G.S. 143-215.21; 143-215.31;
Eff. June 15, 1980;
Amended Eff. November 1, 1985;
Repealed Eff. July 1, 1988.*

15A NCAC 02K .0219 ACCEPTABLE DESIGN: PROCEDURES AND TECHNICAL REFERENCES

The following represent acceptable design procedures and references:

- (1) the design procedures, manuals, and criteria used by the United States Corps of Engineers;
- (2) the procedures, manuals, and criteria used by the United States Soil Conservation Service;
- (3) the procedures, manuals, and criteria used by the United States Department of Interior, Bureau of Reclamation;

- (4) other procedures that are approved by the Director.

History Note: Authority G.S. 143-215.31; 143-215.34;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0220 GRANTING OF FINAL APPROVAL

(a) Unless the Director has reason to believe that the dam, as completed, is unsafe or not in compliance with any applicable requirement, regulation, or law, the Director, upon completion of construction and upon receipt of the engineer's certification pursuant to Rule .0215 of this Section, shall grant final approval of the work in accordance with the certificate, subject to such terms as he/she deems necessary for the protection of life and property.

(b) Pending issuance of final approval, a new dam or the addition to an existing dam shall not be used except on written consent of the Director and subject to conditions he/she may impose relating to safety of life and property and the satisfaction of minimum stream flow requirements.

History Note: Authority G.S. 143-215.3; 143-215.30;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0221 DELEGATION OF AUTHORITY

The Director has the authority to:

- (1) issue approval, disapproval, or approval subject to conditions for proposed construction, repair, alteration or removal of dams;
- (2) require progress reports, issue notices of non-compliance and orders to comply, order a halt in construction in the event of non-compliance;
- (3) receive notices of completion, specify details of description, grant final approval;
- (4) assess civil penalties; and
- (5) perform other related functions.

History Note: Authority G.S. 143-215.3; 143-215.3(a)(4); 143-215.28; 143-215.29; 143-215.30; 143-215.36(b);
Eff. June 15, 1980;
Amended Eff. November 1, 1982;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0222 APPLICATION PROCESSING FEES

(a) A nonrefundable minimum application processing fee, in the amount stated in Paragraph (d)(1) of this Rule, shall be paid when an application for construction or removal of a dam is filed in accordance with 15A NCAC 2K .0201. Each application for construction or removal of a dam shall be deemed incomplete and shall not be reviewed until the minimum application processing fee is paid.

(b) A nonrefundable additional application processing fee, in the amount stated in Paragraph (d)(2) of this Rule, shall be paid when the as-built plans are submitted to the Director in accordance with 15A NCAC 2K .0215. Final approval to impound, pursuant to 15A NCAC 2K .0220, shall not be granted until the owner's certification and the accompanying documentation are filed in accordance with Paragraph (e) of this Rule, and the additional processing fee is paid.

(c) The application processing fee for the construction or removal of a dam shall be based on the actual cost of construction or removal of the applicable dam.

- (1) The actual cost of construction or removal of a dam shall include all labor and materials costs associated with the construction or removal of the dam and appurtenances.
- (2) The actual cost of construction or removal of a dam shall not include the costs associated with acquisition of land or right of way, design, quality control, electrical generating machinery, or constructing a roadway across the dam.

(d) Schedule of Fees:

- (1) The minimum application processing fee shall be two hundred dollars (\$200.00).

- (2) The additional application processing fee shall be the following percentages of the cost of construction or removal:
 - (A) 2 percent of the actual costs between ten thousand and one dollars (\$10,001) and one hundred thousand dollars (\$100,000);
 - (B) 1.5 percent of the actual costs between one hundred thousand and one dollars (\$100,001) and five hundred thousand dollars (\$500,000);
 - (C) 1.0 percent of the actual costs between five hundred thousand and one dollars (\$500,001) and one million dollars (\$1,000,000);
 - (D) 0.5 percent of the actual costs over one million dollars (\$1,000,000).

In no case, however, shall the additional application fee be more than fifty thousand dollars (\$50,000).

(e) Immediately upon completion of construction or removal of a dam, the owner shall file with the Director a certification, on a form prescribed by the Department, and accompanying documentation, which shows the actual cost incurred by the owner for construction or removal of the applicable dam.

- (1) The owner's certification and accompanying documentation shall be filed with the as-built plans and the engineer's certification in accordance with 15A NCAC 2K .0215 and 15A NCAC 2K .0216, respectively.
- (2) If the Director finds that the owner's certification and accompanying documentation contain inaccurate cost information, the Director shall either withhold final impoundment approval, or revoke final impoundment approval, until the owner provides the accurate documentation and that documentation has been verified by the Department.

(f) Payment of the dam application processing fee shall be by check or money order made payable to the "N.C. Department of Environment, Health, and Natural Resources". The payment should refer to the applicable dam.

(g) In order to comply with the limit on fees set forth in G.S. 143-215.28A, the Director shall, in the first half of each state fiscal year, project revenues for the fiscal year from fees collected pursuant to this Rule. If this projection shows that the statutory limit will be exceeded, the Director shall order a pro rata reduction in the fee schedule for the remainder of the fiscal year to avoid revenue collection in excess of the statutory limits.

*History Note: Authority G.S. 143-215.28A;
 Temporary Rule Eff. November 1, 1990 For a Period of 180 Days to Expire on April 29, 1991;
 ARRC Objection Lodged November 14, 1990;
 ARRC Objection Removed December 20, 1990;
 Eff. January 1, 1991;
 Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0223 DAM HEIGHT AND STORAGE DETERMINATION

(a) For the purpose of determining size classification, the height of a dam shall be measured from the highest point on the crest of the dam to the lowest point on the downstream toe.

(b) The total storage capacity of a dam shall be that volume which would be impounded at the elevation of the highest point on the crest of the dam.

*History Note: Authority G.S. 143-215.31;
 Temporary Rule Eff. November 1, 1990 For a Period of 180 Days to Expire on April 29, 1990;
 ARRC Objection Lodged November 14, 1990;
 ARRC Objection Removed December 20, 1990;
 Eff. January 1, 1991;
 Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.*

15A NCAC 02K .0224 ADDITIONAL REQUIREMENTS FOR DAMS THAT IMPOUND COAL COMBUSTION RESIDUALS

(a) For the purposes of this Rule:

- (1) "CCR" means Coal Combustion Residuals.
- (2) "CCR unit" means any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit, or a combination of more than one of these units, based on the context of the paragraph(s) in which it is used. This term includes both new and existing units, unless otherwise specified in this Subchapter or the Dam

Safety Law of 1967. For the purpose of this Rule, the term only applies to CCR dams and surface impoundments.

- (3) "Dam" means a structure and appurtenant works erected to impound or divert water.
 - (4) "Design flood" means the flood hydrograph that is used during an engineering assessment of the CCR unit.
 - (5) "Liquefaction" means a phenomenon whereby a saturated or partially saturated soil loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid.
 - (6) "Probable Maximum Flood" or "PMF" means the theoretically largest flood resulting from the most severe combination of meteorological and hydrological conditions that could conceivably occur in the drainage basin. The PMF is the runoff resulting from the Probable Maximum Precipitation.
 - (7) "Probable Maximum Precipitation" or "PMP" means the theoretically greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular geographical location at a certain time of the year. Estimates of rainfall amounts and distributions associated with the PMP can be found at the following locations: http://www.nws.noaa.gov/oh/hdsc/PMP_documents/HMR51.pdf and http://www.nws.noaa.gov/oh/hdsc/PMP_documents/HMR52.pdf
 - (8) "Toe" means the point of intersection between the upstream or downstream face of a dam and the natural ground.
 - (9) "100-year flood" means a flood that has a 1-percent chance of recurring in any given year. Rainfall amounts for the 100-year flood can be found at: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html.
 - (10) "1000-year flood" means a flood that has a 0.1-percent chance of recurring in any given year. Rainfall amounts for the 1000-year flood can be found at: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html.
- (b) This Rule shall apply to a CCR unit that meets one or more of the following:
- (1) has a dam height of 25 feet or more above the downstream toe of the structure and has a storage volume of 50 acre-feet or more, unless the unit is exempt by G.S. 143-215.25A;
 - (2) contains residuals to an elevation of five feet or more above the downstream toe of the structure and that has a storage volume of 20 acre-feet or more;
 - (3) contains residuals to an elevation of greater than or equal to 20 feet above the downstream toe of the structure; or
 - (4) has been classified as high hazard (Class C) according to Rule .0105 of this Subchapter.
- (c) Inspections and Structural Stability Assessments of CCR units shall be completed as follows:
- (1) At intervals not exceeding seven days, a qualified engineer, or a person under his or her responsible charge, shall inspect the discharge of all outlets of hydraulic structures that pass underneath the base of the CCR unit for discoloration of discharge or changes in flow.
 - (2) A qualified engineer, or a person under his or her responsible charge, shall conduct monitoring of all instrumentation supporting the operation of the CCR unit no less than once per month according to the standards listed under 40 CFR 257.83(a), which is hereby incorporated by reference, including subsequent amendments and additions. A copy of this document may be obtained at no cost at https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr257_main_02.tpl.
 - (3) During the annual inspections of all CCR units, a qualified engineer, or a person under his or her responsible charge, shall conduct a visual inspection of hydraulic structures underlying the base of the CCR unit in order to maintain structural integrity by being kept free of deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris.
 - (4) A qualified engineer, or a person under his or her responsible charge, shall conduct structural stability assessments and shall document whether the design, construction, operation, and maintenance of the CCR unit is consistent with the provisions of 40 CFR 257.73(d) and 257.74(d), which is hereby incorporated by reference, including subsequent amendments and additions, the NC Dam Safety Law of 1967, and the rules of this Subchapter. The structural stability assessment shall be completed by a qualified engineer once every five years and submitted to the Department for review for consistency with this Subchapter and the Dam Safety Law of 1967.
- (d) All CCR dams described in Paragraph (b) of this Rule shall have a spillway system with capacity to pass a flow resulting from a design flood as specified in the Minimum Spillway Design Flood for CCR Units table provided in this Paragraph, unless the applicant provides calculations, designs, and plans, prepared in accordance with generally-accepted engineering standards, to show that the design flood can be stored, passed through, or passed over the CCR unit without failure occurring. The requirements in the table below shall apply in place of the Minimum Spillway Design Storm table under Rule .0205(e) of this Section.

Minimum Spillway Design Flood for CCR Units		
Hazard¹	Size²	Spillway Design Flood³
Low (Class A)	Small	100 year
	Medium	100 year
	Large	1/3 PMF
	Very Large	½ PMF
Intermediate (Class B)	Small	1000 year
	Medium	1/3 PMF or 1000 year, whichever is larger
	Large	½ PMF
	Very Large	¾ PMF
High (Class C)	Small	PMF
	Medium	PMF
	Large	PMF
	Very Large	PMF
<p>¹ The "Hazard" categories in this table for CCR units are based on 15A NCAC 02K .0105 Classification of Dams and are the same "Hazard" categories shown in the "Minimum Spillway Design Storms" table for non-CCR dams contained in Rule .0205(e) of this Section.</p> <p>² The "Size" categories are the same as described in the "Criteria for Spillway Design Storm Size Classification" table found in Rule .0205(e) of this Section.</p> <p>³ The "Spillway Design Flood" specifications were derived from the combination of the more-stringent criterion from the spillway design-flood elements of the federal CCR regulations and the existing spillway design elements of Rule .0205(e) of this Section.</p>		

(e) Structural stability assessments shall be evaluated as follows:

- (1) For purposes of this Rule, the "critical cross sections" utilized for the required structural stability assessments are the cross sections anticipated by the design engineer to be the most susceptible to structural failure.
- (2) CCR surface impoundments shall be assessed under seismic loading conditions for a seismic loading event with a 2 percent probability of exceedance in 50 years, equivalent to a return period of approximately 2,500 years, based on the USGS Seismic Hazard Maps for seismic events with this return period for the region where the CCR unit is located. This document is hereby incorporated by reference, including subsequent amendments and editions. A copy may be obtained at no cost at <https://earthquake.usgs.gov/hazards/hazmaps>.
- (3) CCR units constructed of or founded upon soils that are susceptible to liquefaction, as identified by a liquefaction potential analysis, shall meet liquefaction factors of safety as required in Part (5)(E) of this Subparagraph. The liquefaction potential analysis shall include:
 - (A) soil classifications of the embankment and foundation soils;
 - (B) fines content;
 - (C) plasticity index;
 - (D) water content;
 - (E) saturation;
 - (F) maximum current, past, and anticipated phreatic surface levels within the embankment, foundation, and abutments;
 - (G) location beneath or above the natural ground surface; and
 - (H) penetration resistance through cone penetration testing (CPT).
- (4) Stability assessments shall be required for CCR units with downstream slopes that may be inundated by the pool of an adjacent water body. These assessments shall include conditions for maximum pool loading, minimum pool loading, and rapid drawdown of the adjacent waterbody.
- (5) The safety factor assessments shall be supported by the following engineering calculations:
 - (A) The calculated static factor of safety for the end-of-construction loading condition shall equal or exceed 1.30. The assessment of this loading condition is only required for the initial safety factor assessment and is not required for subsequent assessments;

- (B) the calculated static factor of safety for the long-term, maximum storage pool loading condition shall equal or exceed 1.50;
- (C) the calculated static factor of safety under the maximum surcharge pool loading condition shall equal or exceed 1.40;
- (D) the calculated seismic factor of safety shall equal or exceed 1.00; and
- (E) for dams constructed of or founded upon soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety shall equal or exceed 1.20. Post-liquefaction stability analyses shall include characterization of the site conditions, identification of the minimum liquefaction-inducing forces based on soil characterization, determination of seismic effect on liquefied layers of the embankment, and calculation of factors of safety against liquefaction for each liquefied layer of the embankment.

(f) CCR units and surrounding areas that are constructed of earthen material shall be designed, constructed, operated, and maintained so that the vegetation meets the conditions outlined in the FEMA 534 guidance document entitled, "Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams" issued on September 2005. This document is hereby incorporated by reference, including subsequent amendments and editions. A copy may be obtained at no cost at <https://www.fema.gov/media-library/assets/documents/1027>. However, alternative forms of slope protection may be approved by the Director, upon request by a qualified engineer through a plan submittal showing that the proposed alternative slope protection will provide equal or better protection from erosion than would be achieved with vegetation as specified in FEMA 534.

History Note: Authority G.S. 143-215.25A; 143-215.26; 143-215.27; 143-215.31; 143-215.32; 143-215.34; Eff. January 1, 2019.

SECTION .0300 - INSPECTIONS: DAM SAFETY ORDERS

15A NCAC 02K .0301 INSPECTION BY THE DEPARTMENT

(a) Schedule of Inspections

- (1) All class A and B dams shall be inspected at least once every five years.
- (2) Class C dams shall be inspected at least once every two years.

(b) At any time an inspection indicates that a dam may not perform satisfactorily or that the hazard classification has changed, the Director may require a detailed investigation at the owners expense to determine the required remedial action, if any.

History Note: Authority G.S. 143-215.31; 143-215.32; Eff. June 15, 1980; Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0302 DAM SAFETY ORDERS

(a) The Director may issue an order directing the owner(s) of a dam to make, in not less than 90 days from issuance of the order and at the owner(s) expense, any maintenance, alteration, repairs, reconstruction, or change in construction upon a finding that the dam:

- (1) is not sufficiently strong,
- (2) is not maintained in good repair or operating condition,
- (3) is dangerous to life or property, or
- (4) does not satisfy minimum stream-flow requirements.

(b) The Director may issue an order directing the owner(s) of any dam to take such measures as may be essential, including lowering the level of the impounded water, drainage of the impoundment, and destruction of the dam or reservoir in whole or in part, immediately or within a time limited by the order if the condition of the dam is found to have become so dangerous to the safety of life or property, in the opinion of the Director, as not to safely permit sufficient time for issuance of an order in the manner provided by Subdivision (a) of this Rule.

(c) The Director may, if at any time the condition of any dam becomes so dangerous to the safety of life or property, in the opinion of the Director, as not to permit sufficient time for issuance of an order in the manner provided by Subdivision (a) or (b) of this Rule, immediately take such measures as may be essential to provide emergency protection to life and property including the lowering of the level of a reservoir by releasing water impounded or the destruction in whole or in part of the

dam or reservoir. Costs of such measures may be recovered from the owner(s) of the dam by appropriate legal action by the Commission.

(d) Orders issued by the Director may be conditioned so as to require the dam owner, if he is required or given the option to remove the dam, to undertake the removal in such a manner as to minimize the amount of sediment transported from the impoundment downstream.

(e) Dam safety orders issued by the Director in no way relieve the owner(s) of the dam from duties and obligations imposed by regulations in Section .0200 of this Subchapter, nor do they relieve the owner(s) of the dam from any liabilities or other legal obligations.

History Note: Authority G.S. 143-215.32; 143-215.34;
Eff. June 15, 1980;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

SECTION .0400 - ADMINISTRATIVE HEARINGS

15A NCAC 02K .0401 OPPORTUNITY FOR HEARING 15A NCAC 02K .0402 PROCEDURES

History Note: Authority G.S. 143-215.33; 150B-23;
Eff. June 15, 1980;
Amended Eff. August 1, 2012 (see S.L. 2012-143, s.1.(f)); August 1, 1988; July 1, 1988; November 1, 1984;
Expired Eff. January 1, 2018 pursuant to G.S. 150B-21.3A.

15A NCAC 02K .0403 DELEGATION OF AUTHORITY: APPOINTMENT OF HEARING OFFICERS 15A NCAC 02K .0404 NOTICE: WAIVER 15A NCAC 02K .0405 PLACE OF THE HEARING 15A NCAC 02K .0406 PROCEDURES 15A NCAC 02K .0407 HEARING OFFICERS: POWERS AND DUTIES 15A NCAC 02K .0408 FINAL DECISIONS: JUDICIAL REVIEW

History Note: Authority G.S. 143-215.3(a)(4); 143-215.33; 150B-23; 150B, Article 3;
150B, Article 4;
Eff. June 15, 1980;
Legislative Objection (c) Lodged Eff. October 10, 1980;
Amended Eff. November 1, 1982;
Repealed Eff. November 1, 1984.

SECTION .0500 - MINIMUM STREAM FLOWS TO MAINTAIN AQUATIC HABITAT

15A NCAC 02K .0501 DEFINITIONS

- (a) Aquatic habitat shall be divided into three classes - "poor," "moderate," and "good."
- (1) Streams with poor aquatic habitat are those which have a "poor" fish assemblage rating, and which are rated "poor" for at least two of the following three characteristics:
 - (A) Substrate;
 - (B) Cover; and
 - (C) Macro-invertebrate organisms.
 - (2) Streams with moderate aquatic habitat are those which exhibit physical conditions and biota which are intermediate between the poor and good categories.
 - (3) Streams with good aquatic habitat are those which receive at least two "good" ratings when the substrate, cover, and macro-invertebrate organism characteristics are evaluated. The fish assemblage also must receive a "good" rating.
- (b) Cover means objects within or overhanging the stream channel which provide shelter for aquatic organisms. "Good" cover occurs when cover is widespread and diverse. "Poor" cover occurs when the amount of cover is small or non-existent.

(c) Substrate means the predominant particle size of the material which makes up the stream bed. "Good" substrate is composed of at least 50 percent silt free substrate with gravel or cobble. "Poor" substrate is composed of at least 80 percent silt, sand, or smooth bedrock.

(d) The macro-invertebrate organisms of the affected reach are rated as "good" if the affected reach is rated good or excellent in the Division of Environmental Management's (DEM) biological monitoring database, or by a site-specific survey according to Standard Operating Procedures for Biological Monitoring, 1995, Division of Environmental Management as defined in 15A NCAC 2B .0103(b). Macro-invertebrates are rated "poor" if the reach is rated fair or poor in DEM's biological monitoring database, or by a site-specific survey according to Standard Operating Procedures for Biological Monitoring, 1995, Division of Environmental Management as defined in 15A NCAC 2B .0103(b).

(e) The fish assemblage rating shall be based on the North Carolina Index of Biotic Integrity (IBI). Existing ratings from the DEM biological monitoring database shall be used where available. If no rating exists, then a site-specific survey shall be conducted according to Standard Operating Procedures for Biological Monitoring, 1995, Division of Environmental Management as defined in 15A NCAC 2B .0103(b). The fish assemblage shall be rated as "good" if the IBI rating is good, good-excellent, or excellent. The fish assemblage shall be rated as "poor" if the IBI rating is poor or lower.

(f) The affected reach of stream means that section of a stream downstream of a dam which experiences significant changes in hydrology. The exact delineation of the affected reach shall be site-specific and depend on factors including, but not limited to:

- (1) volume of storage in the impoundment;
- (2) upstream and downstream hydrologic characteristics of the stream;
- (3) withdrawals from the impoundment; and
- (4) downstream point source discharges to the stream.

For the purpose of evaluating aquatic habitat, the affected reach of a stream does not include any portion which is in the backwater of a downstream dam when the level of that downstream impoundment is at normal pool.

(g) "Special case" streams are those which exhibit at least one of the following characteristics:

- (1) supplemental classification as an Outstanding Resource Water as defined in 15A NCAC 2B .0101(e)(4) and .0216;
- (2) populations of aquatic species listed as threatened or endangered by the U.S. Fish and Wildlife Service, or species which are listed as threatened or endangered by the N.C. Wildlife Resources Commission;
- (3) self-sustaining populations of wild trout; or
- (4) exceptional non-game or fishery resources as determined by the Wildlife Resources Commission.

(h) The use of the regression equations in Rule .0502 of this Section shall depend on the geographic region of the state in which the stream is located. The geographic region shall be determined from the North Carolina Atlas, edited by Clay, Orr, and Stuart, published by the University of North Carolina Press, 1975.

(i) A continuous stream gage record means a continuous record of daily flows from a stream gage which:

- (1) has at least 15 years of continuous daily records;
- (2) has no significant hydrological effects caused by upstream regulation, withdrawals, or discharges;
- (3) is no less than one-half and no more than one and one-half times the drainage area of the site in question; and
- (4) has low flow and average flow yields which are comparable to the site in question.

(j) A site-specific instream flow study conducted by the applicant or his consultants, which is subject to approval by the Department, means a study performed according to the following conditions:

- (1) A plan of study shall be developed in consultation with the Department and submitted to the Department for review and approval prior to commencement of the study.
- (2) The plan of study shall identify the aquatic habitat parameters to be evaluated by the study. The selection of these parameters shall depend on factors including, but not limited to:
 - (A) the aquatic species being evaluated;
 - (B) the habitat quality of the affected reach; and
 - (C) existing or potential water shortages or water use conflicts.
- (3) The Department shall have the option of participating in the collection of all field data, and shall be notified prior to collection of any set of data.
- (4) The results of the study shall accurately determine the parameters identified during study design.
- (5) The Department may review the field data and results of these studies to determine the stream flow needed to maintain aquatic habitat.

History Note: Authority G.S. 143-215.24; 143-215.25; 143-215.31; 143-215.32; 143-215.33; 143-215.36;

Eff. December 1, 1994;
Amended Eff. April 1, 1995;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0502 REQUIRED MINIMUM FLOW FOR DAMS (NOT SMALL HYDRO PROJECTS)

(a) A dam operated by a small power producer, as defined in G.S. 62-3(27a), that diverts water from 4,000 feet or less of the natural stream bed, shall be exempt from this Rule.

(b) A dam proposed for a small stream with a mean annual daily flow less than or equal to 3.0 cubic feet per second (cfs) shall be subject to the following review process in determining the required minimum flow:

- (1) If the mean annual daily flow is less than or equal to 3.0 cfs and the 7-day, 10-year low flow (7Q10) is less than or equal to 0.2 cfs; and if there are no existing point source discharges of wastewater to the affected stream reach; then no minimum release will be required.
- (2) If the mean annual daily flow is less than or equal to 3.0 cfs and the 7Q10 is less than or equal to 0.2 cfs; and one or more existing point source discharges of wastewater enter the affected stream reach; then the minimum release shall be equal to the 7Q10.
- (3) If the mean annual daily flow is less than or equal to 3.0 cfs and the 7Q10 is greater than 0.2 cfs, then the minimum release shall be equal to the 7Q10.

(c) If the mean annual daily flow is greater than 3.0 cfs, then the following procedures shall be used to determine the minimum flow requirement:

- (1) The minimum flow for a dam on a stream with poor aquatic habitat shall be the 7Q10 flow determined by using U.S. Geological Survey procedures.
- (2) The minimum flow for a dam on a stream with moderate aquatic habitat in the piedmont, as defined in Rule .0501(h) of this Section, shall be determined using regression equations provided in this Subparagraph.
 - (A) All flows used in regression equations shall be measured in cubic feet per second, all drainage areas shall be measured in square miles, and all logarithmic expressions shall refer to base 10 logarithms.
 - (B) The regression equation used to determine the minimum flow for a stream in the piedmont which exhibits moderate aquatic habitat, and for which no continuous stream gage record, as defined in Rule .0501(i) of this Section, exists, shall be as follows:

$$\text{LRF} = (3.204 \times M) - (2.618 \times D)$$

LRF = LOG of regression flow
M = LOG of mean annual daily flow
D = LOG of drainage area

The regression flow (RF) is calculated by raising 10 to the power of the LRF.

If the drainage area is greater than 95 square miles, the required minimum flow is 1.4 x RF. Otherwise the required minimum flow is equal to RF.

- (C) The regression equation used to determine the minimum flow for a stream in the piedmont which exhibits moderate aquatic habitat, and for which a continuous stream gage record, as defined in Rule .0501(i) of this Section, does exist, shall be as follows:

$$\text{LRF} = (0.812 \times M) + (8.111 \times E92) - (4.806 \times E85) - (3.275 \times E95)$$

LRF = LOG of regression flow
M = LOG of mean annual daily flow
E85 = LOG of 85% annual exceedance flow
E92 = LOG of 92.5% annual exceedance flow
E95 = LOG of 95% annual exceedance flow

The regression flow (RF) is calculated by raising 10 to the power of the LRF.

The required minimum flow is 1.1 x RF.

- (3) The minimum flow for a dam on a stream with moderate aquatic habitat, located in a geographical region for which regression formulas are not provided, shall be determined by a site-specific instream flow study,

as defined in Rule .0501(j) of this Section, conducted by the applicant or his consultants and subject to the approval of the Department.

- (4) The minimum flow for a dam on a special case stream, or on a stream with good aquatic habitat, shall be determined by a site-specific instream flow study, as defined in Rule .0501(j). This study shall be conducted by the applicant or his consultants, and shall be subject to approval by the Department.
- (5) If the applicant or owner disputes the minimum flow determined by the procedures described in Subparagraphs (c)(1) or (c)(2) of this Rule for streams with poor or moderate aquatic habitat, he may undertake a site-specific field study, as defined in Rule .0501(j) of this Section, subject to the review and approval of the Department. The final minimum release required will not exceed the amount determined by the procedures described in this Rule.
- (6) The minimum release schedule for a water supply reservoir shall include provisions for reductions in the minimum flow which coincide with reductions in the usable water supply storage remaining in the impoundment and with reductions in the amount of water withdrawn from the reservoir.
 - (A) This system of tiered releases shall apply to new water supply reservoirs and any existing water supply reservoirs for which the minimum release is revised.
 - (B) The exact percentage of storage which triggers reductions in minimum flow will depend on several site-specific factors, including, but not limited to:
 - (i) size of the reservoir;
 - (ii) rate of the water supply demand;
 - (iii) hydrologic characteristics of the impounded stream; and
 - (iv) the impoundment levels which result in local efforts to reduce water usage through conservation measures.
 - (C) At least three levels of minimum releases shall be included in the release schedule for a water supply reservoir.
 - (D) When usable water supply storage has been reduced to a level which triggers the first reduction in minimum flow, then the average daily water withdrawal shall be reduced by at least 10 percent from the average daily withdrawal for the 60 day period immediately prior to the first reduction in the minimum flow. The water supply operator shall accomplish this reduction in withdrawal within two weeks of the reduction in the minimum release.
 - (E) When usable water supply storage has been reduced to a level which triggers the second reduction in minimum flow, then the average daily water withdrawal shall be reduced by at least 20 percent from the average daily withdrawal for the 60 day period immediately prior to the first reduction in the minimum flow. The water supply operator shall accomplish this further reduction in withdrawal within two weeks of the second reduction in the minimum release.
 - (F) The water system operator shall document reduction in water withdrawals by submitting reports of daily water withdrawals to the Department. These shall be submitted every two weeks for as long as the minimum release is reduced below the amount normally required.
 - (G) An example is shown in the table below. (Note that the percentages of water supply storage which trigger the changes in minimum release are site-specific for this example and may vary according to the factors described in Part (B) of this Paragraph.)

LEVEL	REMAINING USABLE WATER SUPPLY STORAGE	MINIMUM RELEASE	WATER USE REDUCTION
1	between 70% and 100%	A	----
2	between 40% and 70%	B	10%
3	below 40%	C	20%

A = normal minimum release determined by a field study, regression equation, or use of the 7Q10
 B = intermediate reduction in minimum release
 C = low minimum release equal to no more than the 7Q10

- (7) An existing dam which was built subject to review under the National or the State Environmental Policy Acts, and for which a minimum release has been established, will not have its minimum release changed

under this Rule. However, the Department may review and adjust the minimum flow released by any other existing dam if there is evidence of any of the following conditions downstream of that dam:

- (A) water quality standards not being maintained;
 - (B) water quality classifications which are being only partially supported or not being supported; or
 - (C) aquatic habitat not being maintained.
- (8) If the minimum release required from an existing water supply reservoir is reviewed by the Department, any increase in minimum flow will be determined on a case-by-case basis in consideration of the following factors, including, but not limited to:
- (A) availability of water to meet existing demands;
 - (B) rate of growth in water demand;
 - (C) planned development of alternative sources of water supply;
 - (D) structural difficulties;
 - (E) capital costs; and
 - (F) anticipated improvements in water quality and aquatic habitat in the affected reach resulting from the proposed change in minimum flow.

The change in minimum release shall be set no higher than an amount which would reduce the water supply safe yield, as determined by standard accepted engineering practices, by more than 10 percent.

- (9) If a new minimum release requirement from an existing water supply reservoir is being delayed until a new source of water supply is developed, then this delay shall not exceed a period of five years from the written notification that a new minimum release will be required. This period may be extended by approval of the Environmental Management Commission in consideration of the following factors:
- (A) delays in developing a new water supply source;
 - (B) changes in water quality and aquatic habitat in the affected reach; or
 - (C) availability of water to meet existing demands.

History Note: Authority G.S. 143-215.24; 143-215.25; 143-215.31; 143-215.32; 143-215.33; 143-215.36; Eff. December 1, 1994; Amended Eff. April 1, 1995; Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

15A NCAC 02K .0503 REQUIRED MINIMUM FLOW FOR SMALL HYDROELECTRIC PROJECTS

(a) This Rule shall apply only to a dam operated by a small power producer, as defined in G.S. 62-3(27a), that diverts water from 4,000 feet or less of the natural stream bed. The length of the bypassed reach shall be measured from the toe of the dam to the point where the diverted water re-enters the natural channel, following the centerline of the natural channel.

(b) The minimum release for a hydroelectric project subject to this Rule shall be determined according to the procedures described in Subparagraphs (1)-(5) of this Paragraph. If at any time the inflow just upstream of the dam is less than the minimum flow required in the bypassed reach, then the minimum flow may be reduced to a level equal to this inflow.

- (1) If the aquatic habitat in the bypassed reach is rated poor, then the minimum release to the bypassed reach shall be determined as follows:
- (A) If the 7Q10 is less than or equal to 10 percent of the mean annual daily flow, then the minimum release to the bypassed reach shall be the 7Q10 flow.
 - (B) If the 7Q10 is greater than 10 percent of the mean annual daily flow, and there are no existing point source discharges of wastewater to the bypassed reach, then the minimum release to the bypassed reach shall be 0.8 times the 7Q10.
 - (C) If the 7Q10 is greater than 10 percent of the mean annual daily flow, and one or more existing point source discharges of wastewater enter the bypassed reach, then the minimum release to the bypassed reach shall be the 7Q10 flow.
- (2) If the bypassed reach does not have an aquatic habitat rating of "poor," is not on a special case stream, and is located in the piedmont region, as defined in Rule .0501(h) of this Section, then the minimum release to the bypassed reach shall be determined as follows:
- (A) If the 7Q10 is less than or equal to six percent of the mean annual daily flow, then the minimum release to the bypassed reach shall be 3.0 times the 7Q10 flow.

- (B) If the 7Q10 is greater than six percent of the mean annual daily flow, and less than or equal to 10 percent of the mean annual daily flow, then the minimum release to the bypassed reach shall be 2.2 times the 7Q10 flow.
 - (C) If the 7Q10 is greater than 10 percent of the mean annual daily flow, then the minimum release to the bypassed reach shall be 1.2 times the 7Q10 flow.
 - (3) The minimum flow determined by the procedures described in Subparagraphs (1) and (2) of this Paragraph may be adjusted downward by the Department if that adjustment would not result in significant loss of aquatic habitat. This adjustment may be based on factors including:
 - (A) the type of aquatic habitat present in the bypassed reach;
 - (B) the length of the bypassed reach.
 - (4) If the applicant or owner disputes the minimum flow determined by the procedures described in Subparagraphs (1) and (2) of this Paragraph, he may undertake a site-specific field study, as defined in Rule .0501(j) of this Section, subject to the review and approval of the Department. The final minimum release required will not exceed the amount determined by the procedures described in this Section.
 - (5) The minimum flow for a dam on a special case stream, or on a stream located in the mountain region, as defined in Rule .0501(h) of this Section, which does not exhibit poor aquatic habitat; shall be determined by a site-specific instream flow study, as defined in Rule .0501(j) of this Section. This study shall be conducted by the applicant or his consultants, and shall be subject to approval by the Department.
- (c) A dam operated by a small power producer, as defined in G.S. 62-3(27a), which was operating to produce power as of October 13, 1994, and which is not under the jurisdiction of the Federal Energy Regulatory Commission, shall not be required by this Rule to increase its minimum flow above the amount required on October 13, 1994.

History Note: Authority G.S. 143-215.24; 143-215.25; 143-215.31; 143-215.32; 143-215.33; 143-215.36; Eff. December 1, 1994;
Amended Eff. April 1, 1995;
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15A NCAC 02K .0504 MONITORING OF MINIMUM FLOW REQUIREMENTS

- (a) An owner of a dam with a minimum flow requirement greater than 1.0 cfs shall install, calibrate, and maintain one or more stream staff gages following procedures described in U.S. Geological Survey Water Supply Paper 2175, "Measurement and Computation of Streamflow." Plans for such gages shall be submitted to the Department for approval prior to installation. Staff gages shall be calibrated to indicate the water surface elevations which correspond to the required flows. Calibration shall be verified at least every two years. All initial calibration and re-calibration measurements, including field data, shall be provided to the Department within 30 days of completion.
- (b) If the minimum release from a dam is less than or equal to 1.0 cfs, then an accurately calibrated release mechanism such as a gate or pipe opening shall be acceptable in lieu of a staff gage. Plans for making the required release shall be submitted to the Department for review and approval prior to construction, repair, or modification of the dam.
- (c) An owner of a dam who does not comply with a minimum flow requirement may be required to install automated gaging which continuously monitors flow. Records from this type of gage shall be provided to the Department upon request, for the time period being investigated.
- (d) Minimum release requirements may be modified or suspended for a term determined by the Department for reasons including pre-scheduled maintenance or construction involving the dam. The Department must approve a written request for such a change in the minimum flow requirement prior to any change in the minimum release.
- (e) Reduction or cessation of the minimum flow as a result of emergency conditions or equipment failure shall not constitute a violation of the minimum flow requirement, so long as the event is reported to the Department within 48 hours. The Department may set forth a schedule for correcting the problem and restoring the required minimum flow. If the schedule is not met, and the problem continues to cause violation of the minimum flow requirement, then this violation may be subject to enforcement action.

History Note: Authority G.S. 143-215.24; 143-215.25; 143-215.31; 143-215.32; 143-215.33; 143-215.36; Eff. December 1, 1994;
Pursuant to G.S. 150B-21.3A, rule is necessary without substantive public interest Eff. December 23, 2017.

