Chapter NR 333

DAM DESIGN AND CONSTRUCTION

Note: Chapter NR 333 as it existed on May 31, 1985 was repealed and a new chapter NR 333 was created effective June 1, 1985.

NR 333.01 Purpose. The purpose of this chapter is to ensure that dams are designed, constructed and reconstructed so as to minimize the danger to life, health and property. This chapter is adopted pursuant to ss. 31.02 (2), 31.19 and 31.33, Stats.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85.

NR 333.02 Applicability. (1) The provisions of this chapter are applicable to dams not owned by the United States government that:

(a) Have a structural height of more than 6 feet and a maximum storage capacity of 50 acre-feet or more of water.

(b) Have a structural height of 25 feet or more and a maximum storage capacity of more than 15 acre-feet of water.

(c) Have a structural height of 6 feet or less or a maximum storage capacity of less than 50 acre-feet of water if the department determines that the dam is likely to endanger life, health or property if it is not designed, constructed or reconstructed in accordance with this chapter.

(2) All new and existing dams inspected, approved and licensed by a federal agency under 18 CFR Part 12, are exempt from the provisions of this chapter provided that the dam meets requirements which are at least as restrictive as the requirements of this chapter.

Note: Dams exempted from this chapter are still subject to the requirements of ch. 31, Stats., including, but not limited to, the requirements for permits and plan approvals.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: am. Register July 2001, No. 547 eff. 8-1-01.

NR 333.03 Definitions. (1) "Auxiliary spillway" means a secondary spillway designed to pass water only during flows exceeding the capacity of the principal spillway.

(2) "Base flow" means that part of the stream flow that is derived from groundwater and calculated as the 7-day low flow that occurs on an average of once in 2 years or has a 50% chance of occurring in any given year. The notation is $Q_{7,2}$.

(3) "Dam" means any artificial barrier in or across a watercourse which has the primary purpose of impounding or diverting water. A dam includes all appurtenant works, such as a dike, canal or powerhouse.

(4) "Department" means the department of natural resources.

(5) "Development" means any artificial change to improved or unimproved real estate not related to allowable open space use including, but not limited to, the construction of buildings, structures or accessory structures; the construction of additions or substantial improvements to buildings, structures or accessory structures; the placement of buildings or structures; and campgrounds.

(6) "Floodplain with the dam nonexistent" means that area of land downstream from a dam that would be inundated by water during the regional flood if the dam did not exist.

(7) "Floodway" means the channel of a river or stream and those portions of the floodplain adjoining the channel which are required to carry the regional flood discharge.

(8) "Hydraulic shadow" means that area of land downstream from a dam that would be inundated by water upon failure of the dam during the regional flood.

(9) "Land use controls in place" means future development within the hydraulic shadow is required to conform to the criteria specified in a zoning ordinance adopted and approved pursuant to s. 87.30, Stats., and also consistent with land use plans developed under s. 66.1001, Stats., or through restrictive covenants, easements, or other appropriate legal arrangements between the owner of the dam and the owners of all property within the hydraulic shadow.

(10) "Maximum headwater" means the maximum water surface elevation before overtopping would occur.

(11) "Maximum storage capacity" means the volume of water in acre-feet capable of being stored behind a dam at the maximum water surface elevation before overtopping would occur.

(12) "Minimum tailwater" means the water level downstream from a dam at base flow.

(13) "Open space use" means a use which has a relatively low flood damage potential, such as uses associated with agriculture, recreation, parking, storage yards, or certain sand and gravel operations.

(14) "Overtopping" means the flow of water over parts of a dam which are not part of its spillway system.

(15) "Owner" means any individual, partnership, public utility, company, cooperative, trust, corporation, association, state or interstate agency, city, village, town, county or special purpose district such as a drainage district or a public inland lake protection and rehabilitation district which has title to or recorded easement for operation, maintenance and access to a dam or to the specific parcel of land on which a dam exists.

(16) "Principal spillway" means the primary structure for the discharge of normal flow through a dam.

(17) "Q_{10}" means the flood flow having a recurrence interval of 10 years or a 10% chance of occurring or being exceeded in any given year.

(18) "Q_{50}" means the flood flow having a recurrence interval of 50 years or a 2% chance of occurring or being exceeded in any given year.

(19) "Q_{100}" means the flood flow having a recurrence interval of 100 years or a 1% chance of occurring or being exceeded in any given year.

(20) "Q_{500}" means the flood flow having a recurrence interval of 500 years or a 0.2% chance of occurring or being exceeded in any given year.

(21) "Q_{1000}" means the flood flow having a recurrence interval of 1000 years or a 0.1% chance of occurring or being exceeded in any given year.

(22) "Reconstruction" means alteration of an existing dam in a manner which affects its hydraulic capacity or structural integrity.

(23) "Regional flood" means a flood determined to be representative of large floods known to have occurred in Wisconsin and which may be expected to occur on a particular stream once in every 100 years.

Note: The regional flood is based upon a statistical analysis of stream flow records available for the watershed or an analysis of rainfall or runoff characteristics in the watershed or both. The flood frequency of the regional flood is once in every 100 years. In any given year, there is a 1% chance that the regional flood may occur or be exceeded.

(24) "Structural height" means the difference in elevation in feet between the point of lowest elevation of the top of the dam before overtopping and the lowest elevation of the natural stream or lake bed at the downstream toe of the dam.

(25) "Submerged" means that the difference between the water surface elevations upstream and downstream from a dam is one foot or less.

(26) "Total spillway capacity" means the sum of the auxiliary spillway and principal spillway capacities of a dam.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; am. (25), Register, April, 1987, No. 376, eff. 5-1-87; CR 00-136: renum. (1) to (4), (9), (13) to (16), (21) to (25), (27) and (28) to be (2) to (4), (1), (8), (14) to (17), (20) to (26), am. (1), (3), (15), (24) and (26), r. (5), (8), (17), (20) and (26), cr. (5), (9) and (13) Register July 2001, No. 547 eff. 8-1-01; correction in (9) made under s. 13.93 (2m) (b) 7., Stats., Register January 2002 No. 553.

NR 333.04 Compliance schedules. (1) DAM HAZARD RATING. The department shall assign a dam hazard rating according to the criteria in s. NR 333.06 for all dams subject to the provisions of this chapter. The assignment of a hazard rating shall be based on the findings of a dam failure analysis provided by the owner, pursuant to the standards of s. NR 333.05, according to the following schedule:

(a) For new dams, prior to granting permission or approval to construct.

(b) For existing dams which are to be reconstructed, prior to granting permission or approval to reconstruct.

(c) After a dam failure analysis has been approved by the department or is adopted in a floodplain zoning ordinance pursuant to s. 87.30, Stats., and approved by the department.

(d) Upon issuance of a department directive in a dam safety inspection report pursuant to s. 31.19, Stats.

(2) COMPLIANCE. (a) *New dams.* The design and construction of all new dams shall be in compliance with the requirements of this chapter.

(b) *Existing dams.* The owners of all existing dams shall bring their dams into compliance with the requirements of this chapter within 10 years after being notified of the dam's hazard rating pursuant to sub. (1), unless ordered to do so earlier under s. 31.19 (5), Stats.

(3) ENFORCEMENT. Administrative orders issued by the department under s. 31.19 (5), Stats., may be enforced under ss. 23.50, 23.79 (3), 30.03, 31.23 (2) and 31.25, Stats.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: r. and recr., Register July 2001, No. 547 eff. 8-1-01.

NR 333.05 Submission of plans, specifications and analyses. (1) PLANS AND SPECIFICATIONS. Plans and specifications prepared by a professional engineer registered in the state of Wisconsin shall be submitted to and approved by the department prior to the construction of a new dam or reconstruction of an existing dam.

(2) HYDRAULIC, HYDROLOGIC AND STABILITY ANALYSES. Hydraulic, hydrologic and stability analyses prepared by a professional engineer registered in the state of Wisconsin shall be submitted to and approved by the department prior to the construction of a new dam or the reconstruction of an existing dam. These analyses shall be conducted according to accepted engineering practice and unless the department determines otherwise shall be submitted in the form of a report which includes, at a minimum:

(a) Purpose of the report. Development of an emergency action plan, floodplain zoning or development of the hazard rating for the dam.

(b) Roles and participation of other agencies -- DNR, DEG, community officials, other agencies.

(c) Data collection methods and sources of information -- Development of cross sectional data, description of past flooding events, reference to previous studies, current floodplain zoning map.

(d) Methodologies and procedures -- Operation of dam during high water, breach parameters, description of all spillway components, scenario for failure, failure conditions.

(e) Regional flood flows calculated in conformance with the standards in s. NR 116.07 (3).

(f) Hydraulic modeling -- Determination and delineation of the following hydraulic conditions during the regional flood, using the standards in s. NR 116.07 (4):

1. Hydraulic shadow -- assuming that the dam is in existence and fails. Failure shall be considered to occur at the maximum upstream water elevation or at the point of overtopping, based upon the physical conditions at the dam.

2. Dam in place, no failure -- assuming the dam operates in accordance with its department approved operation plan, if one is available, or not operated if there is no plan.

3. Dam nonexistent -- assuming the dam has been removed and the natural stream cross-section is restored.

Note: For suggested dam breach parameters, see the National Weather Service "DAMBRK or FLDWAV" Users Manuals.

(g) Comparison table -- Summary by cross section of the maximum flood elevation for the 3 hydraulic conditions.

(h) Determination of the dam hazard rating using the criteria in s. NR 333.06.

(i) Design flood flows, based on the hazard rating and the hydraulic design standards in s. NR 333.07.

(j) Calculations for routing of the design flood through the structure. Starting conditions for the routing shall be at the normal pool and normal flow tailwater elevations.

(k) Stability analysis of the dam, which considers sliding, overturning and foundation failure during base flow conditions and at maximum load conditions, including ice loading, during routing of the design flood through the dam.

(L) Appendices:

1. Plan view of the dam.

2. Elevation view of the dam from downstream including breach geometry.

3. Pertinent elevations of the dam.

4. Stage vs. storage curve or area vs. volume curve, or both.

5. Spillway capacity rating curves or calculations, where appropriate.

6. Downstream water surface profiles and floodway data ta-

bles, for the dam failure, and the with and without dam conditions, during the regional flood.

7. Maps for the 3 modeled conditions, with cross section locations and structure identification adequate to determine the hazard rating for the dam, for the dam failure condition map, showing the floodway, and to an appropriate scale consistent with the community floodplain zoning map.

8. Cross section plots of actual field cross sections and comparison with dam break input cross sectional data.

9. Hard copy and data disk with computer input and output for all modeled conditions, including hydrology and hydraulic runs.

10. Other supporting calculations as the department deems necessary.

Note: Mapping, profiles and floodway data tables must be suitable for zoning purposes, as required in s. NR 116.07 (4).

(3) ESTIMATED COSTS. The estimated cost of construction of the new dam or reconstruction of the existing dam, and the estimated cost of removing the dam and restoring the channel to its natural condition, shall be submitted to the department prior to the construction of a new dam or reconstruction of an existing dam.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: am. (1) and (3), r. and recr. (2), Register July 2001, No. 547 eff. 8-1-01.

NR 333.06 Dam hazard ratings. (1) A hazard rating of low, significant or high for all existing and proposed dams shall be determined in accordance with the following criteria:

(a) *Low hazard.* A low hazard rating shall be assigned to those dams that have no development unrelated to allowable open space use in the hydraulic shadow where the failure or mis-operation of the dam would result in no probable loss of human life, low economic losses (losses are principally limited to the owners property), low environmental damage, no significant disruption of lifeline facilities, and have land use controls in place to restrict future development in the hydraulic shadow.

(b) *Significant hazard.* A significant hazard rating shall be assigned to those dams that have no existing development in the hydraulic shadow that would be inundated to a depth greater than 2 feet and have land use controls in place to restrict future development in the hydraulic shadow. Potential for loss of human life during failure must be unlikely. Failure or mis-operation of the dam would result in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities.

(c) *High hazard.* A high hazard rating shall be assigned to those dams that have existing development in the hydraulic shadow that will be inundated to a depth greater than 2 feet or do not have land use controls in place to restrict future development in the hydraulic shadow. This rating must be assigned if loss of human life during failure or mis-operation of the dam is probable.

(2) The owner of a dam may request that the department change the hazard rating of an existing or proposed dam by submitting adequate information which demonstrates that the land use and land use controls downstream from the dam meet the requirements for a different hazard rating. The department shall advise the owner of its action on the requested change within 90 business days after receiving the request.

History: Cr. Register, May, 1995, No. 353, eff. 6-1-85; CR 00-136: r. and recr., Register July 2001, No. 547 eff. 8-1-01.

NR 333.07 Hydraulic design and safety requirements. (1) MINIMUM HYDRAULIC CAPACITY. Except as provided in sub. (2), all proposed and existing dams shall have the minimum hydraulic capacity shown in Table I:

Table I
Required Spillway Design Capacities

Dam Hazard Rating	Minimum Principal Spillway Capacity	Minimum Total Spillway Capacity
Low (L)	Q_{10}	Q_{100}
Significant (S)	Q_{50}	Q_{500}
High (H)	Q_{100}	Q_{1000}

(2) REDUCED REQUIREMENTS. (a) Unless the department determines that public safety requires full compliance with the substantive requirements of this rule, all dams which will be submerged by flows less than the minimum hydraulic capacity specified in Table I shall be designed to pass the flow of the river at submergence.

(b) Any owner may provide documentation to justify a different spillway capacity from that specified in Table I. The department shall review such documentation and may approve the spillway capacity proposed by the owner if it determines that such capacity will not result in an additional hazard to life, health or property when compared to the capacity specified in Table I.

(3) SAFETY MEASURES. The owners of all new and existing dams shall comply with the following safety measures:

(a) The owner shall have an adequate operation, inspection and maintenance plan for the dam.

(b) The dam shall be structurally stable for any flow condition up to and including the design flood flow.

(c) An adequate emergency action plan shall be prepared for the area downstream from the dam in consultation with the local unit of government and concurred in by the division of emergency government. An adequate emergency action plan shall include, but is not limited to, the following information:

1. A notification flow chart identifying involved agencies, other dam owners both upstream and downstream and their phone numbers.

2. Emergency operation procedures.

3. An inundation map of the hydraulic shadow on a scale of l" = 2000' or less that extends downstream to an elevation within one foot of the dam nonexistent profile.

4. Procedures for notification of all property owners affected by a dam failure and a list of their names, addresses and phone numbers.

Note: For additional information on emergency action plans refer to Chapter 6 of the Federal Energy Regulatory Commission's "Engineering Guidelines for the Evaluation of Hydropower Projects".

(d) Documentation showing that the requirements of pars. (a) to (c) have been met shall be submitted to the department for approval. The department shall review and approve or disapprove of the documented safety measures in writing within 90 business days after the department receives the documentation.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: r. (1), renum. (2) to (4) to be (1) to (3) and am. (1), (2), (3) (c) and (d) and Table I, Register July 2001, No. 547 eff. 8-1-01.

NR 333.08 Construction. (1) Construction of a new dam or reconstruction of an existing dam may not begin until the department approves the plans and specifications submitted under s. NR 333.05.

(2) Alterations to any plans or specifications that were approved by the department under s. NR 333.05 which will affect the flood flow capacity or structural integrity of a dam shall be approved by the department before construction or reconstruction of the dam.

(3) All dams shall be constructed or reconstructed under the supervision of a professional engineer registered in the state of Wisconsin. The supervising engineer shall, within 10 days after completing the construction or reconstruction of a dam, submit a statement indicating that the dam was constructed or reconstructed in accordance with the plans and specifications approved by the department under s. NR 333.05.

(4) As-built plans shall be submitted to the department within 30 business days after the completion of construction or reconstruction of a dam.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: am. (3), Register July 2001, No. 547 eff. 8-1-01.

NR 333.09 Financial assurance. (1) GENERAL REQUIREMENT. (a) Except as provided in par. (b), the owner of a dam shall file a bond, escrow account, lien or other financial assurance satisfactory to the department prior to the commencement of construction or reconstruction of the dam. The amount of such financial assurance shall equal the estimated cost of removing the dam and restoring the stream channel to its natural condition or the cost of constructing or reconstructing the dam, whichever is less, based on the cost estimate submitted by the owner under s. NR 333.05 (3).

(b) Where the owner is a state or interstate agency or a city, county, village, special purpose district or other unit of government, financial assurance is not required if the owner demonstrates to the department's satisfaction that it has made or will make sufficient funds available to construct or reconstruct the dam or to remove the dam and restore the stream channel it its natural condition, whichever is less expensive.

(2) NOTIFICATION. As part of its approval of the plans and specifications submitted pursuant to s. NR 333.05, the department shall notify the applicant of the required level of financial assurance.

(3) FORFEITURE REQUIREMENTS. (a) The financial assurance filed with the department shall be conditioned upon faithful performance of all of the requirements of ch. 31, Stats., the provisions of this chapter, and the conditions of any permit or order issued to the applicant for the dam pursuant to ch. 31, Stats.

(4) RELEASE. The department shall release or authorize the release of the applicant's financial assurance within 60 business days after the receipt of a request for release if the department finds that the construction or reconstruction has been completed in accordance with the plans and specifications approved by the department, the provisions of this chapter and the conditions of any permit or order issued to the owner of the dam pursuant to ch. 3l, Stats.

History: Cr. Register, May, 1985, No. 353, eff. 6-1-85; CR 00-136: am. Register July 2001, No. 547 eff. 8-1-01.