

HAZARD-POTENTIAL CLASSIFICATION GUIDELINES FOR DAMS IN OKLAHOMA



OKLAHOMA WATER RESOURCES BOARD
DAM SAFETY PROGRAM

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HAZARD-POTENTIAL CLASSIFICATION: GUIDELINES FOR DAMS IN OKLAHOMA

Background

State dam safety officials classify a dam according to the potential impact a dam failure (breach) or inappropriate operation (unscheduled release) would have on downstream areas or at locations remote from the dam. Three hazard-potential classes make up hazard-potential classification levels as follows: **Low**, **Significant**, and **High** hazard-potential. OWRB rule 785:25-3-3(a)(2) describes the hazard-potential classification as follows:

The hazard-potential classification of a dam is determined by the downstream risk in the event of a failure, without regard to the physical condition of the dam, as follows:

Low: Dams assigned the low hazard-potential classification are those where failure would result in no probable loss of human life and low economic losses.

Significant: Dams assigned the significant hazard-potential classification are those dams where failure would result in no probable loss of human life but can cause economic loss or disruption of lifeline facilities.

High: Dams assigned the high hazard-potential classification are those where failure will probably cause loss of human life.

OWRB Rule 785:25-1-2 defines “Loss of human life” as the human fatalities that would result from a failure of the dam, excluding the occasional passer-by or recreationist and without considering evacuation or other emergency actions. As with any classification system all possibilities cannot be defined. High usage areas of any type should be considered appropriately. Judgment and common sense

must ultimately be a part of any decision on classification. Further, no allowances for evacuation or other emergency actions by the population should be considered because emergency procedures should not be a substitute for appropriate design, construction, and maintenance of dam structures.

Minimum spillway performance standards are based on both the hazard-potential classification of the dam, as well as the size classification of the dam. The size classification of a dam in Oklahoma (785:25-3-3(a)(1)) is based on the following:

Small: maximum height of dam is less than 50 feet and maximum storage of the dam is less than 10,000 acre-feet.

Intermediate: maximum height of dam is between 50 and 100 feet or maximum storage of the dam is between 10,000 and 50,000 acre-feet.

Large: maximum height of dam is over 100 feet or maximum storage of the lake is over 50,000 acre-feet.

Hazard-Potential Classification for New Dams

The hazard-potential classification assigned to a dam is based on consideration of the effects of a failure of the dam or through operational failures during both normal and flood flow conditions. The classification assigned should be based on the worst-case probable scenario of failure or improper operation of the dam. Each element of a project must be evaluated to determine the proper hazard-potential classification for the project. However, there is only one hazard-potential classification assigned

Table 1. Minimum Performance Standards for Dam Spillways. (OWRB rule 785:25-3-6)

MINIMUM SPILLWAY STANDARDS			
Size of Dam	Hazard-Potential	Design Flood	Minimum Freeboard
Small	Low	25% PMF	0 Feet
Small	Significant	40% PMF	0 Feet
Small	High	50% PMF	1 Foot
Intermediate	Low	25% PMF	1 Foot
Intermediate	Significant	50% PMF	1 Foot
Intermediate	High	75% PMF	3 Feet
Large	Low	50% PMF	1 Foot
Large	Significant	75% PMF	1 Foot
Large	High	100% PMF	3 Feet

to the entire project. Individual elements are not assigned separate classifications.

The hazard-potential of a dam does not relate to the condition of the dam or appurtenant works, nor the anticipated operation or performance of the dam. The hazard-potential classification is merely descriptive of the development of the area downstream of the dam and represents the possible consequences to human life and property should a particular dam fail.

The probable scenarios considered should be reasonable and justifiable. For example, assuming reasonable breach parameters and a failure during normal operating conditions (“sunny day” failure) may result in the released water being confined to the river channel and no probable loss of human life, indicating a low hazard-potential classification. However, if the dam were assumed to fail in a similar manner during a flood condition, and the result would be probable loss of human life (excluding the occasional passer-by or recreationist) but minor economic losses, a high hazard-potential classification would be appropriate. The Oklahoma Dam Safety Program bases a dam’s hazard-potential classification on the dam breach with maximum storage under probable maximum flood conditions for that size of dam as described in OWRB rule 785:25-3-6.

Minimum Spillway Standards for New Dams

When a dam is constructed it is designed to meet the criteria of its designated hazard-potential. Depending the size and hazard-potential of the dam the principle and emergency spillways of the dam must have the capability to safely pass a certain amount of water. These spillway performance standards are shown in Table 1.

The Probable Maximum Flood (PMF) refers to the flood that may be expected from the most severe meteorological and hydrologic conditions that are reasonably possible in the region where the dam is located as listed in the National Weather Service’s Hydrometeorological Report No. 51. Any dam constructed prior to June 1973 and which is classified as intermediate and high hazard-potential shall be required to pass a minimum design flood of 50% PMF or if classified as large size and high hazard-potential shall be required to pass a minimum design flood of 75% PMF. A dam 6 feet in height or less, but subject to regulation because of its high hazard-potential shall be required to safely pass 25% PMF with no minimum freeboard.

Considerations for the Classification of Hazard-Potential

In addition to direct impacts on the potential loss of human life, the hazard-potential classification also takes into consideration of impacts on habitable structures, such as residences, businesses, and other occupied structures and roadways in the dam breach inundation area. For classification purposes if the difference between a breach and non-breach inundation is one foot or more at a dwelling, worksite, or temporary use area can be used to indicate a hazard to life. With regard to estimating the population at risk below a dam, it is assumed that 3 people inhabit each dwelling. Site specific information about the likely occupancy for buildings, including commercial buildings, businesses, hospitals, clinics, manufacturing or production facilities, water or

wastewater treatment facilities, etc. will need to be estimated.

Any roadway that crosses a dam or is located below a dam that would be overtopped, at any depth, by a dam failure may be considered to be impacted. In many instances the presence of these roadways with significant volumes of traffic can cause a dam to be classified as a high hazard-potential structure. Finally the potential overtopping and failure of any downstream dam that could be caused by the failure of the upstream dam being evaluated will be considered in the classification of the dam.

For purposes of classification the Population at Risk (PAR) is the primary factor differentiating between a significant and high hazard-potential dam. This is correlated to the number of individuals who may be present within the dam breach inundation area below a dam and are therefore at risk in the event of a dam failure. This includes residents in permanent dwellings, people at worksites or businesses, temporary use areas, and those who are passing through the area on roadways.

Significant hazard-potential dam: Dams assigned the significant hazard-potential classification are those dams where failure would result in no probable loss of human life but can cause economic loss or disruption of lifeline facilities. The intent in considering economic loss is to identify the relative magnitude of losses against a broad scale of values. No attempt is made to assess actual fair market value of the losses. Included in the determination of economic loss or disruption of lifeline facilities includes some of the following:

- Roadways which are a part of the Interstate Highways, Turnpikes, U.S. Highways and State Highways;
- Major electric transmission lines or electrical substations;
- Municipal and rural water districts water and wastewater treatment facilities, water towers, water and sewer pipelines;

- Bridges, culverts, roadways, and rail lines;
- Other downstream dams; and
- Other major infrastructure as determined by the Board.

When another dam is located downstream of a proposed or existing dam the potential impact of the failure of the upstream dam on the downstream dam must be determined by a dam breach analysis. If the breach analysis shows the downstream dam could be overtopped or fail, but without loss of life, then the upstream dam would be classified as a significant hazard-potential structure. The dam breach analysis will be done using the percent PMF design flood conditions for both dams.

High hazard-potential dam: Dams assigned the high hazard-potential classification are those where failure will probably cause loss of human life. When estimating the PAR below a dam, an estimate of three people per dwelling is assumed. Site specific data about the likely occupancy should be used for worksites, such as treatment plants, manufacturing and production facilities, commercial businesses, health care facilities, etc. The OWRB refers to the ACER Technical Memorandum No. 11 by the U.S. Bureau of Reclamation regarding depth and velocity determinations for hazard classification.

Roadways, including Interstate Highways, Turnpikes, U.S. Highways, State Highways, county roads, and public or private streets which could be overtopped, at any depth, and with an average total annual daily traffic (AADT) count of 1500 vehicles or more for all roadways within the inundation area. For purposes of determining traffic volumes, the most recent AADT counts available from the Oklahoma Department of Transportation. AADT counts by ODOT may be found on their website at: (<http://www.okladot.state.ok.us/aadtcnt/Default.aspx?list=allYearly>)

Where it can be demonstrated that the roadway, regardless of the average annual daily traffic count, will not be overtopped at any depth by the failure of a dam or is unlikely to have the roadbed washed out, under the percent PMF design flood conditions for that size of dam, the Board will take such information into consideration in the hazard-potential classification of a dam.

When another dam is located downstream of a proposed or existing dam the potential impact of the failure of the upstream dam on the downstream dam must be determined by a dam breach analysis. If the breach analysis shows the downstream dam could also fail, with loss of life, then the upstream dam would be classified as a high hazard-potential structure. The dam breach analysis will be done using the percent PMF design flood conditions for both dams.

Reclassification of the Hazard-Potential for an Existing Dam

Development below dams can change rapidly over time. Houses or other structures can be built downstream of a dam and the dam owner frequently does not have any control of the land in the breach inundation area for their dam. Therefore, the areas below a dam should be periodically checked, by the owner of the dam, for changes within these areas.



Purcell City Lake, McClain County - OK12149

OWRB rule 785:25-3-3(b)(3) states “The hazard-potential classification of a dam may change as the area downstream from the dam develops and the dam may be reclassified from time to time under the provisions of 785:25-9-10 and 785:25-9-11.” Therefore, if a residence, business, or other structures and improvements are built within the potential dam breach inundation area below the dam then the hazard-potential classification of the dam may have to be changed.

Once the determination has been made to reclassify the hazard-potential of the dam to either a significant or high hazard-potential, the dam owner will be notified of the reclassification (785:25-9-10). The owner of the dam will be required to upgrade the dam if necessary to meet the spillway flood design requirement for that size and hazard-potential classification. Upgrades to the dam may involve modification to the spillway to meet the requirements in Table 1 above for a higher hazard-potential dam. In addition to possible structural upgrades to the dam, the owner will also be required to begin having the dam inspected by a registered Professional Engineer experienced in the inspection of dams.

Inspections for high hazard-potential dams must be done annually by a professional engineer, and inspected once every three years by a professional engineer for significant hazard-potential dams. Additionally, for those dams reclassified as a high hazard-potential an emergency action plan and dam breach inundation map must be completed, as well as a detailed report of the dam breach analysis for review and approval. A schedule of compliance may be developed which sets the time frames for the various stages of work to be performed.

References

- ACER Technical Memorandum No. 11, Bureau of Reclamation, U.S. Department of the Interior, 1988.
- Federal Guidelines for Dam Safety: Emergency Action Planning For Dam Owners, U.S. Department of Homeland Security, Federal Emergency Management Agency, April 2004.
- Federal Guidelines for Dam Safety: Hazard Potential Classification System For Dams, U.S. Department of Homeland Security, Federal Emergency Management Agency, October 1998.