Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 99–60

Dam Safety: Critical Flood Design Criteria

Ohio's Dam Safety Rules require dams to pass floods through their spillways without endangering the safety of the dam. The magnitude of the design flood is directly related to the classification of the dam - which in turn is related to the dam's downstream hazard and/or the dam's height. The greater the downstream hazard, i.e., loss of human life, high-value property, etc., the larger the design flood.

Definitions

The Probable Maximum Precipitation (PMP) is the greatest depth (amount) of precipitation for a given storm duration, that is theoretically possible for a particular area and geographic location. The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a particular drainage area.

Classification of Ohio Dams

Dams in Ohio are divided into four classes based on the storage volume of the impoundment, dam height, and potential downstream hazard (how far downstream residences, businesses are, etc.). More details about the classification system can be found in the Dam Safety: Classification of Structures Fact Sheet No. 94-29.

Critical Flood Design Criteria

Specific guidelines are available for preparing a critical flood engineering analysis. This analysis must be performed by a professional engineer licensed in the State of Ohio. The guidelines can be downloaded from the Division of Soil and Water Resources's world wide web site, (http://www.dnr.state.oh.us/odnr/water/temp/dartrlsa.html), or you can request a copy by calling our office directly.

Could the Critical Flood Analysis Make a Difference for My Dam?

The critical flood criteria were developed to make Ohio's Dam Safety Rules more flexible in recognizing that some dams fall outside of the typical parameters used in designing spillway capacity. Specifically, for those circumstances where the size of the dam, its downstream hazard, drainage area, and downstream topography are such that traditional flood design standards do not accurately account for the downstream hazard, critical flood criteria allow for a reduction of up to 60% of the design flood.

For example, let's look at a Class I dam. This type of dam is required to safely pass the 100% PMF through its spillway system without endangering the safety of the dam. As rain falls onto a dam's watershed, some of the rainfall will infiltrate into the ground, some will evaporate, and most of it will runoff across the ground into the pond or lake. The water level in the impoundment will begin to rise while simultaneously flowing through the dam's spillway(s). As water exits the dam's spillway(s), the downstream channel will begin to fill and flow accordingly. For most dams, the downstream channel will likely fill with some water, but most of the water flows downstream without backing up significantly. For those few cases where the downstream channel fills rapidly to the point where water rises dramatically and failure of the dam would have no additional significant increase in elevations of floods downstream, the design flood can be reduced. In other words, there may be a point, say 50% of the PMF (the critical flood in this case), where designing for additional flood capacity for the dam is no longer reasonable. If the dam were to fail, the downstream hazard would not be further adversely effected. In this case, the spillway system may be designed for half of what it would have been originally designed, therefore saving dollars without increasing the hazard to the downstream area.

What is the Maximum Reduction in Design Flood?

The design flood can be reduced approximately up to 60% for each class of dam:

Class I	100% PMF down to no less than 40% PMF
Class II	50% PMF down to no less than 20% PMF

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Class III 25% PMF down to no less than 100 Year

What Factors Should I Consider Before Proceeding With an Analysis?

The cost of the analysis can be thousands of dollars. Let's assume that a dam inspection by our engineers reveals that a dam is deficient in its ability to pass the design flood. It would be beneficial to have an analysis performed if the design flood was reduced enough so that the spillway system did not need to be upgraded or replaced. Let's assume that upgrading the spillway system costs $50,000. If the cost of the critical flood analysis was $5,000, the cost of the critical flood analysis would be warranted.

Sometimes it can be straightforward to predict whether or not an analysis would be beneficial. However, in those cases where it may not be clear, other options should be considered. For example, if room exists in one of the dam's abutments to excavate an emergency spillway or perhaps enlarge an existing emergency spillway, it may be more cost effective to do so. There is always a risk in running an analysis and finding out that the reduction in design flood is insignificant and the spillway system enlargement is still required.

A critical flood analysis approved by our office means that a reduced design flood is acceptable for your dam. Please note that a reduction in the design flood for your dam may increase the risk of failure or damage to your dam. This could result in an economical burden on the dam owner. This risk should be closely considered!

How Can I Apply for the Critical Flood Reduction?

A request for consideration must be submitted to the Chief of the Division of Soil and Water Resources. The request must be accompanied by supporting calculations based upon an analysis performed by a professional engineer registered in the State of Ohio. The engineer's analysis must conform to the critical flood guidelines provided by the Division of Soil and Water Resources.

Before applying, it is best to call and speak with an engineer in the Division's Dam Safety Program.

What Restrictions Are There?

A critical flood reduction based upon planned evacuation, probability of inhabitation, or monetary recovery of property damage will not be considered. In other words, guaranteeing that a downstream residence or business will be evacuated during a dam failure will not be considered. In situations where the downstream hazard may or may not be inhabited, such as in the case of a campground, rental property, hotel, and so forth, the probability of inhabitation will not be considered. Also, understanding that failure of a dam will damage downstream property and guaranteeing that the damages will be paid for will also not be considered. Finally, if the downstream hazard were to change, the critical flood exemption could be nullified.

Any other questions, comments concerns, or fact sheet requests, should be directed to:

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