



FEMA Guidance for Modeling and Mapping the Impact of Dams and Dam-Like Structures on FEMA RiskMAP Products

E.G. Beadenkopf PE,CFM



Presentation Agenda

- Project Objectives
- Challenges Developing this Nationwide Guidance
- Addressing the Challenges
- Overview of the Guidance
- Input and Questions



Guidance for Flood Hazard
Analysis and Mapping of the
Impacts of Dams and Dam-
Like Structures on FEMA
Regulatory Flood Hazard
and Non-Regulatory Flood
Risk Products

Dams and Dam Like Structures

2018

Project Objectives

- Develop guidance to assist FEMA and Mapping Partners consistently address the influence of dams and structures that function like dams in the preparation flood hazard products
- Lay the groundwork for further alignment of the National Dam Safety Program and RiskMAP

- Wet and dry flood control
- Water supply
- Recreation
- Irrigation
- Flood fighting
- Power generation
- Multi-purpose

Dam



Dam- Like



- High level embankments
- Incidental flood storage



Project Challenges

- The existence of limited and unclear flood hazard program guidance
- The desire for new guidance but not new nationwide requirements
- The need for the new guidance to be RiskMAP specific
- The desire for the guidance to also align with the National Dam Safety Program



Project Challenges

- Recent H&H guidance does not address flood structure storage in detail
- 1992 G&S Appendix C sections covering structure storage is not considered by many Mapping Partners to be current policy



Project Challenges

- Very limited detail exists in current/past guidance
 - Lakes/reservoirs can be modeled for flow attenuation
 - Culverts/bridges/ high road embankments **can** be included
 - No specific details exist by storage structure type and routing preferences for use in the H&H modeling
- Legacy study methods need to be considered as the new guidance methodology is formulated
 - Most 1D models treat dams/roadways as weirs
 - Most 1D models use a steady state discharge. Typically not routed through the structure
 - 2D models typically include structure storage behind roads as channel storage with no controversy

Project Challenges

- FEMA Regions want maximum flexibility
 - They support guidance but not mandated requirements and want to make decisions what is hydrologically modeled to account for flood storage on a case-by case basis
- Hydrologically including structure flood storage in the floodplain mapping of downstream areas understates potential flood hazard
 - FPM decisions will be made assuming the structures stay do not fail, are not modified, and flood storage remains
- New guidance must be compatible with the guidance for RiskMAP non-regulatory products for dams and any TMAC guidance developed per BW12 requirements

Addressing the Challenges

- The guidance will focus on existing conditions flood hazard products (FIRM's, FIS's and FIRM database)
 - Existing physical conditions will be modeled
 - Target the 1% flood and then route other events
- Potential dam breach mapping will be addressed by RiskMAP non-regulatory products for dams and work resulting from TMAC recommendations
- New products will be needed to effectively communicate the real risk downstream of dams
 - Disclosure of assumptions in the FIS and flood risk reports
 - New non-regulatory product maps for dams
 - Potential use of shaded Zone X to map loss of flood storage at road crossings and some dams similar to the guidance that exists for future conditions hydrology

Addressing the Challenges

- FEMA Regions will make modeling decisions
 - Dams, culverts, bridges, high road embankments may be modeled for flood storage
 - Structures will be hydraulically modeled assuming they stay in place
 - A decision matrix will be part of the guidance
- Three categories of structures will have modeling guidance
 - Dams with a primary function to provide flood control
 - Multi purpose dams that include flood control storage
 - Dams, roadways, and high embankments that provide incidental flood storage

General Guidance Flood Control Dams

- Dams with a primary function to provide flood control
 - Typically designed by federal and state agencies and local governments
 - Examples include some dams designed by the NRCS, USACE, USBR and many by local governments
 - Identified as such in the National Inventory of Dams
- Guidance for hydrological routing
 - FEMA will create a rainfall-runoff hydrologic model or leverage an existing model
 - If the 1% flood overtops the dam (without overtopping erosion protection) assume that the dam hydraulically remains in place and do not model downstream flood reduction
 - Include flood reduction that produces a downstream BFE change of 1' or more
 - Map the upstream 1% flood storage pool as floodway

General Guidance Flood Control Dams

South River #25- Tom's Branch Augusta County VA



General Guidance Multi-purpose Dams

- Multi purpose dams with flood control storage
 - Typically designed by governments and utilities
 - Examples include some dams designed by the NRCS, USACE, USBR, TVA, and water/ power generation utility companies
 - Flood control could be a designed component or incidental
- Guidance for hydrological routing
 - FEMA will create a rainfall-runoff hydrologic model or leverage an existing model
 - If the 1% flood overtops the dam (without overtopping erosion protection) assume that the dam hydraulically remains in place and do not model downstream flood reduction
 - Include flood reduction that produces a downstream BFE change of 1' or more
 - Map the upstream 1% flood storage pool as floodway
 - For gated or human controlled outlet works, the operational plan rules will be used or worst case assumptions if no plan exists

General Guidance Multi-purpose Dams

T. Nelson Elliot Dam- Lake Manassas Prince William VA



Water supply reservoir providing incidental flood storage includes manual controls in the principal spillway to increase lake level for water supply

General Guidance Dam-like Structures

- Dams, roadways, and high embankments that provide incidental flood storage
 - Typically operated by states and private owners and generically include state/local roadways and privately owned and operated recreational dams
 - Most significant flood reduction occurs in small watersheds where available flood storage volume is a large percentage of runoff volume
- Guidance for hydrological routing
 - FEMA will create a rainfall-runoff hydrologic model or leverage an existing model
 - If the 1% flood overtops the dam (without overtopping erosion protection) assume that the dam hydraulically remains in place and do not model downstream flood reduction
 - Include flood reduction that produces a downstream BFE change of 1' or more
 - Map the upstream 1% flood storage pool as floodway
 - Guidance will be provided on the size of the contribution watershed and storage volume whether to model flood storage

General Guidance Dam-like Structures

- Dams, roadways, and high embankments guidance for hydrological routing (continued)
 - The embankment stability must be reasonably assured
 - Massive embankments e.g. Interstate Highways
 - Documented historical performance
 - Stable outlet pipes e.g. concrete pipes with headwall and outlet protection and seepage control
 - Storage depth and duration not high or long enough to produce seepage
 - The 1% flood storage pool is contained in the floodway
 - Agreement by community to not increase capacity of the outlet works

General Guidance Aides Dam-like Structures



MARYLAND DEPARTMENT OF THE ENVIRONMENT

1800 Washington Boulevard, Baltimore, Maryland 21230
410-537-3000 □ 1-800-633-6101 □ <http://www.mde.maryland.gov>

Roadway Embankment Design Criteria

Determine if both of the following apply :
1. $HW - TW > 10 \text{ Ft.}^*$ and
2. $HW / D > 2$
(Based on 100-Year Storm Event)

no

No Special Design
Required

yes

Determine if 8:1 Phreatic line
intersects D/S Embankment

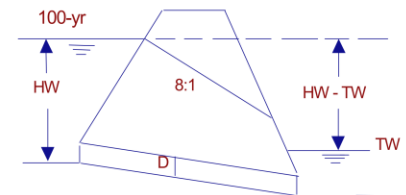
no

Use Watertight Pipe
and Filter Diaphragm

yes

Design as
a Dam

* Use HW when TW is below
the inlet invert elevation.



General Guidance Aides

PERCENTAGE OF STORAGE ABOVE SPILLWAY	REDUCTION IN MAXIMUM RATE DUE TO STORAGE
5	1
10	3
20	7
30	14
40	23
50	35
60	47
70	60

Aligning RiskMAP and the NDSP

- NDSP considerations for the guidance
 - Dams are not hazards but instead are infrastructure subject to internal and external stress or loads
 - Understanding the dam function and performance to the loads is critical to the decision whether and how to model and map flood reduction
 - Does the dam have a unconditional state NDSP operations & maintenance permit?
 - Do dam safety inspection reports identify maintenance issues or structural deficiencies?
 - Is it appropriate to assume the dam will not fail and will provide flood reduction?

Aligning RiskMAP and the NDSP

- Flood hazard mapping is a fundamental component of the NDSP
 - Preparedness planning
 - Risk assessments
 - Mitigation actions
 - Residual risk management
 - Emergency response during events
 - Post flood resiliency planning and recovery
- The guidance document will include additional sections to align RiskMAP with the NDSP

Aligning RiskMAP and the NDSP

Table of Contents

1.0	Overview	1
2.0	FEMA Risk MAP Regulatory Flood Hazard Products.....	2
2.1	Existing Guidance	2
2.2	Historical Practices	1
2.3	FEMA Options for Developing New Guidance.....	3
2.4	Recommendations	6
2.5	Draft Guidance.....	6
3.0	FEMA Risk MAP Non-Regulatory Products for Dams.....	7
3.1	Existing Guidance	7
3.2	Recommendations for Additional Guidance	7
4.0	Pre- disaster preparedness mapping of dam failure incidents.....	7
4.1	Existing Guidance	7
4.2	Recommendations for Additional Guidance	7
5.0	Disaster support dam breach modeling mapping and risk prioritization	7
6.0	Post Disaster dam breach advisory maps.....	7
7.0	Additional Resources.....	7
7.1	Other Resources.....	7
7.2	Guidance Aids	7
8.0	Glossary of Terms	8
9.0	Other Resources	10

- Regulatory flood hazard product guidance
- Recommendations for additional non-regulatory products for dams
- Pre-disaster preparedness modeling guidance for EM
- Disaster support dam breach modeling, mapping and risk prioritization
- Guidance for post disaster advisory dam breach recovery maps

Providing Input

The guidance is in progress and an initial draft for review by FEMA HQ staff is planned in 2018. A more thorough review by FEMA Regions and Mapping Partners will then take place leading to release of the guidance in 2019.

We want your input!

- Send me an e-mail and I will provide a questionnaire
- Or send us any thoughts including your preferences for policy and technical methodology to:

james.demby@fema.dhs.gov

and

edward.beadenkopf@atkinsglobal.com

Questions



*Pine Run Floodwater Retarding Structure,
Montgomery County, PA.*

04/15/2014