HAZUS-MH: Flood Event Report

Region Name: BedfordcheckMR2

Flood Study Case: ABS1

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Table of Contents

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Pennsylvania

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,015 square miles and contains 2,884 census blocks. There are over 20 thousand households in the region and has a total population of 49,984 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 18,191 buildings in the region with a total building replacement value (excluding contents of 2,645 million dollars (2002 dollars). Approximately 98.94% of the buildings (and 84.05% of the building value) are associated with residential housing.

General Building Stock

HAZUS estimates that there are 18,191 buildings in the region which have an aggregate total replacement value of 2,645 million (2002 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Study Case respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,223,338	84.1%
Commercial	244,198	9.2%
Industrial	82,742	3.1%
Agricultural	23,835	0.9%
Religion	55,928	2.1%
Government	3,849	0.1%
Education	11,224	0.4%
Total	2,645,114	100.00%

Table 2
Building Exposure by Occupancy Type for the Study Case

Occupancy	Exposure ($1000)	Percent of Total
Residential	488,670	77.3%
Commercial	85,018	13.5%
Industrial	34,438	5.5%
Agricultural	2,631	0.4%
Religion	18,150	2.9%
Government	1,035	0.2%
Education	1,830	0.3%
Total	631,772	100.00%

Essential Facility Inventory

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 27 beds. There are 22 schools, 4 fire stations, 3 police stations and 1 emergency operation center.

Flood Scenario Parameters

HAZUS used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	BedfordcheckMR2
Scenario Name:	ABS1
Return Period Analyzed:	50
Analysis Options Analyzed:	0

General Building Stock Damage

HAZUS estimates that about 129 buildings will be at least moderately damaged. This is over 28% of the total number of buildings in the study case. There are an estimated 34 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS Flood technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10 Count	(%)	11-20 Count	(%)	21-30 Count	(%)	31-40 Count	(%)	41-50 Count	(%)	Substantially Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00
Industrial	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	200	60.98	55	16.77	28	8.54	1	0.30	10	3.05	34	10.37
Total	**205**		**55**		**29**		**1**		**10**		**34**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10 Count	(%)	11-20 Count	(%)	21-30 Count	(%)	31-40 Count	(%)	41-50 Count	(%)	Substantially Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	58	63.04	12	13.04	8	8.70	0	0.00	3	3.26	11	11.96
Steel	3	75.00	0	0.00	1	25.00	0	0.00	0	0.00	0	0.00
Wood	143	60.08	43	18.07	21	8.82	1	0.42	7	2.94	23	9.66

Essential Facility Damage

Before the flood analyzed in this study case, the region had 0 hospital beds available for use. On the day of the study case flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	4	0	0	0
Hospitals	1	0	0	0
Police Stations	3	0	0	0
Schools	22	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

HAZUS estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 35,349 tons of debris will be generated. Of the total amount, Finishes comprises 23% of the total, Structure comprises 43% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1,414 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 476 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 640 people (out of a total population of 49,984) will seek temporary shelter in public shelters.

The total economic loss estimated for the flood is 147.76 million dollars, which represents 13.50 % of the total replacement value of the study case buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 99.22 million dollars. 33% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 37.79% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	34.74	6.38	4.44	1.19	46.75
	Content	17.90	15.95	10.14	5.27	49.25
	Inventory	0.00	0.73	2.49	0.00	3.22
	Subtotal	**52.65**	**23.05**	**17.06**	**6.46**	**99.22**
Business Interruption						
	Income	0.48	7.75	0.25	0.98	9.46
	Relocation	0.75	1.50	0.02	0.78	3.04
	Rental Income	0.82	1.11	0.00	0.26	2.19
	Wage	1.13	10.53	0.33	21.86	33.85
	Subtotal	**3.19**	**20.88**	**0.60**	**23.88**	**48.54**
ALL	**Total**	**55.84**	**43.94**	**17.66**	**30.33**	**147.76**

Appendix A: County Listing for the Region

Pennsylvania
- Bedford

Appendix B: Regional Population and Building Value Data

| | Population | Building Value (thousands of dollars) | | |
		Residential	Non-Residential	Total
Pennsylvania				
Bedford	49,984	2,223,338	421,776	2,645,114
Total State	**49,984**	**2,223,338**	**421,776**	**2,645,114**
Total Study Region	**49,984**	**2,223,338**	**421,776**	**2,645,114**