

HAZUS-MH: Flood Event Report

Region Name: DelawareMR2

Flood Study Case: DelawareMR2

Print Date: Tuesday, January 23, 2007

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Flood. These results can be improved by using enhanced inventory data and flood hazard information.

Table of Contents

Section	Page #
General Description of the Region	3
Building Inventory	4
General Building Stock	
Essential Facility Inventory	
Flood Scenario Parameters	5
Building Damage	6
General Building Stock	
Essential Facilities Damage	
Induced Flood Damage	8
Debris Generation	
Social Impact	8
Shelter Requirements	
Economic Loss	9
Building-Related Losses	
Appendix A: County Listing for the Region	10
Appendix B: Regional Population and Building Value Data	11

General Description of the Region

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 184 square miles and contains 8,006 census blocks. There are over 206 thousand households in the region and has a total population of 550,864 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 160,161 buildings in the region with a total building replacement value (excluding contents) of 32,373 million dollars (2002 dollars). Approximately 98.67% of the buildings (and 86.08% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

HAZUS estimates that there are 160,161 buildings in the region which have an aggregate total replacement value of 32,373 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	27,866,433	86.1%
Commercial	3,382,629	10.4%
Industrial	600,382	1.9%
Agricultural	33,505	0.1%
Religion	191,040	0.6%
Government	61,017	0.2%
Education	237,910	0.7%
Total	32,372,916	100.00%

Table 2
Building Exposure by Occupancy Type for the Study Case

Occupancy	Exposure (\$1000)	Percent of Total
Residential	3,671,489	85.8%
Commercial	433,604	10.1%
Industrial	94,081	2.2%
Agricultural	4,062	0.1%
Religion	28,486	0.7%
Government	5,202	0.1%
Education	43,631	1.0%
Total	4,280,555	100.00%

Essential Facility Inventory

For essential facilities, there are 6 hospitals in the region with a total bed capacity of 1,327 beds. There are 216 schools, 29 fire stations, 35 police stations and 2 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:	DelawareMR2
Scenario Name:	DelawareMR2
Return Period Analyzed:	500
Analysis Options Analyzed:	0

General Building Stock Damage

HAZUS estimates that about 1,252 buildings will be at least moderately damaged. This is over 46% of the total number of buildings in the region. There are an estimated 3 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 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		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	3	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	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	2	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	1,079	83.51	132	10.22	36	2.79	8	0.62	34	2.63	3	0.23
Total	1,084		132		36		8		34		3	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	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	352	84.21	40	9.57	11	2.63	2	0.48	12	2.87	1	0.24
Steel	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	726	83.26	91	10.44	25	2.87	6	0.69	22	2.52	2	0.23

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	# Facilities			
	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	29	0	0	0
Hospitals	6	0	0	0
Police Stations	35	0	0	0
Schools	216	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 91,291 tons of debris will be generated. Of the total amount, Finishes comprises 33% of the total, Structure comprises 39% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 3,652 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 2,896 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 7,157 people (out of a total population of 550,864) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 354.83 million dollars, which represents 11.11 % 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 291.27 million dollars. 18% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 64.39% 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
<u>Building Loss</u>						
	Building	143.72	11.56	5.34	0.90	161.52
	Content	83.60	26.42	13.47	3.48	126.96
	Inventory	0.00	0.75	2.01	0.02	2.79
	Subtotal	227.32	38.73	20.83	4.40	291.27
<u>Business Interruption</u>						
	Income	0.08	20.91	0.29	0.96	22.24
	Relocation	0.53	0.54	0.04	0.07	1.18
	Rental Income	0.35	0.38	0.01	0.02	0.75
	Wage	0.19	19.12	0.51	19.57	39.39
	Subtotal	1.15	40.94	0.85	20.61	63.56
ALL	Total	228.46	79.68	21.68	25.01	354.83

Appendix A: County Listing for the Region

Pennsylvania
- Delaware

Appendix B: Regional Population and Building Value Data

	Building Value (thousands of dollars)			
	Population	Residential	Non-Residential	Total
Pennsylvania				
Delaware	550,864	27,866,433	4,506,483	32,372,916
Total State	550,864	27,866,433	4,506,483	32,372,916
Total Study Region	550,864	27,866,433	4,506,483	32,372,916