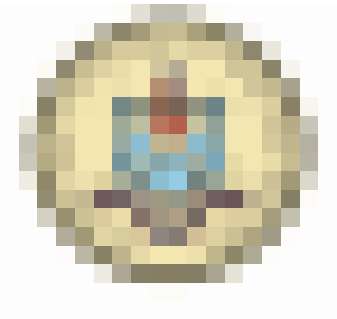
Gloucester County, New Jersey
Multi-Jurisdictional Hazard Mitigation Plan

prepared by:



Gloucester County
Office of Emergency Management

August 19, 2009

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Section 2
Executive Summary

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2.1 Overview

On October 30, 2000, the President signed into law the Disaster Mitigation Act of 2000, also known as DMA 2000. Among its other features, DMA 2000 established a requirement that in order to remain eligible for federal disaster assistance and grant funds, local and state governments must develop and adopt hazard mitigation plans. On February 26, 2002, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule (IFR) that set forth the guidance and regulations under which such plans are supposed to be developed. The IFR provides detailed descriptions of both the planning process that states and localities are required to observe and the contents of the plan that emerges. This Gloucester County Multi-Jurisdictional Hazard Mitigation Plan (the Plan) responds to those requirements.

Hazard mitigation is often defined as actions taken to reduce the effects of natural hazards on a place and its population. Gloucester County decided to develop this Plan because of increasing awareness that natural hazards, especially flood and wind, have the potential to affect people, physical assets and operations in Gloucester County.

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The purpose of a mitigation plan is to rationalize the process of determining appropriate hazard mitigation actions. The document includes a detailed characterization of natural hazards in Gloucester County; a risk assessment that describes potential losses to physical assets, people and operations; a set of goals, objectives, strategies and actions that will guide Gloucester County mitigation activities, and a detailed plan for implementing and monitoring the Plan.

This Plan focuses on six countywide hazards and one municipality specific hazard with the highest potential for damaging physical assets, people and operations in Gloucester County. These hazards are floods, high wind–straight-line winds, severe storm−winter weather, earthquake/geological, dam failure, levee failure, and (for selected municipalities) wildfire. Both the risk assessment and mitigation action plan sections reflect this emphasis, which was the result of careful consideration and a numerical ranking process carried out by the Gloucester County Hazard Mitigation Working Group (HMWG).

2.2 Organization of the Plan

The Plan is organized to parallel the structure provided in the IFR. The Plan has 10 sections.

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There are references to the IFR throughout the Plan. Where possible these provide specific section and subsection notations to aid the review process. The Plan also includes references to the FEMA crosswalk document, which is used in reviewing mitigation plans.

2.3 Hazards and Risks

2.3.1 Hazards

Sections 6 and 7 of this Plan include detailed descriptions of the process that was used to assess and prioritize Gloucester County risks from natural hazards, quantitative risk assessments for Gloucester County as a whole, and more detailed assessments for certain asset classes. Twenty-one hazards were initially identified and profiled by the HMWG. These are:

- Dam Failure
- Drought
- Earthquake/Geological
- Erosion–Hurricane/Nor'easter/Coastal Storm
- Extreme Temperature–Cold
- Extreme Temperature–Heat
- Flood
- Hail
- Hazardous Materials Release–Fixed Site

- Hazardous Materials Release–Transportation
- High Wind–Straight-Line Winds
- High Wind–Tornado
- Ice Storm
- Landslide (non-seismic)
- Levee Failure
- Losses, Crops
- Losses, Fishing
- Severe Storm–Lightning
- Severe Storm–Winter Weather
- Storm Surge–Hurricane/Nor'easter/Coastal Storm
- Wildfire

For each of these hazards, the profiles in Section 6 include:

- Description
- Geographical Extent
- Severity
- Impact on Life and Property
- Occurrence (probability)

After these initial 21 hazards were profiled, the HMWG used an evaluation system with five criteria to reduce the range of hazards to those with the most potential to impact the Gloucester County. The criteria are also discussed in detail in Section 6. The criteria included: (1) History, (2) Potential for mitigation, (3) Presence of susceptible areas, (4) Data availability, (5) Federal disaster declarations and local emergency declarations.

As a result of this evaluation, the HMWG determined that six countywide hazards present the greatest risk to Gloucester County and its residents: floods, high wind–straight-line winds, severe storm−winter weather, earthquake/geological, dam failure, and levee failure. Additionally, the HMWG recommended including the wildfire hazard for the Townships of Franklin and Monroe. These hazards were further examined to determine the extent of the risk and to start to identify potential projects.

2.3.2 Risks

A risk calculation is a FEMA requirement. Risk is a numerical indication of potential future damages. Although the range of events from winter weather to hurricanes all have some potential to affect the Gloucester County area, floods, high wind–straight-line winds, severe storm−winter weather, earthquake/geological, dam failure, and levee failure are clearly the most significant countywide hazards, based on qualitative assessments and experience. Additionally, wildfire hazard poses risks for certain municipalities. These six countywide hazards, and one municipality specific hazard, were selected for much more detailed assessments and estimations of future damages.

Section 7 includes details about calculation methodologies and results of the countywide risk assessment. A summary of these results is presented in Table 2.3.2-1.

Table 2.3.2-1:
Summary of Countywide Natural Hazard Risks in Gloucester County
By Asset and Hazard Type (100-Year Horizon)
(Sources: 2000 US Census, HAZUS)

Hazard	Asset	Risk (100-year horizon)	Risk Per SF (1)	Risk Per Capita (2)
Flood	Repetitive loss properties (residential)	$230,744	$7.69	$6,153
Flood	Severe repetitive loss properties	$85,447	$42.72	$34,179
Flood	Deaths and injuries	Not Determined	NA	NA
High Wind−Straight-Line Wind	All assets	$144,638,230	$1.20	$568
High Wind−Straight-Line Wind	Deaths and injuries	Not Determined	NA	NA
Severe Storm−Winter Weather	All assets, direct damages (3)	$30,406,076	NA	$119
Severe Storm−Winter Weather	Deaths (monetized) (4)	$3,253,560	NA	NA
Severe Storm−Winter Weather	Injuries (monetized)	$527,990	NA	NA
Earthquake/Geological	All assets	$19,155,941	$0.16	$75
Earthquake/Geological	Deaths (monetized)	$32,907,424	NA	NA
Earthquake/Geological	Injuries (monetized)	$888,034	NA	NA
Dam Failure	All assets, direct damages	See Section 7.3.5	NA	NA
Levee Failure	Injuries	See Section 7.3.6	NA	NA

Notes: (1) Risk per square foot (SF) estimate for the flood hazard based on average building size of 2,000 SF. Risk per SF for the high wind−straight-line wind and earthquake/geological hazards based on HAZUS estimate of total square footage for the County (See Table 7.3.2-6). (2) Risk Per Capita column based on Gloucester County 2000 population from the US Census Bureau. Flood risk per capita based on household occupancy of 2.5 people per dwelling. (3) Winter storm risks are assumed to be primarily related to damages to public assets and infrastructure, to interrupted services, or to response requirements. (4) Standard FEMA practice is to express deaths and injuries in terms of dollars (monetized) in order that the risks can be compared to other categories that are not related to life safety. For further information see FEMA Guidance titled *What is a Benefit*? (included on BCA Toolkit version 3.0).

2.4 Goals, Objectives, and Actions

Section 9 of this Plan describes Gloucester County priorities for mitigation actions. The section divides the actions by priority, and describes the funding required, sources of funding, the level of support and the timing of the action. The section also includes Gloucester County hazard mitigation goals and objectives.

2.4.1 Gloucester County Hazard Mitigation Goals

Goals are general guidelines that explain what Gloucester County wants to achieve. Goals are expressed as broad policy statements representing desired long-term results. Gloucester County mitigation planning goals include:

1. Improve education and outreach efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact
2. Improve data collection, use, and sharing to reduce the impacts of hazards
3. Improve capabilities, coordination, and opportunities at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities

4. Pursue opportunities to implement projects including mitigation of repetitive and severe repetitive loss properties and other appropriate programs and activities

Please refer to section 9.3.2 for more information on goals for the Gloucester County Hazard Mitigation Plan.

2.4.2 Objectives

Objectives are well-defined intermediate points in the process of achieving goals (*Objectives* are generally coterminous with *strategies*). Gloucester County mitigation planning objectives include:

- Increase awareness of risks and understanding of the advantages of mitigation by the general public and by local government officials
- Increase local government official awareness regarding funding opportunities for mitigation
- Improve availability to the county and participating communities of data related to all relevant hazards for use in future planning efforts
- Provide government officials and local practitioners with educational opportunities and information regarding best practices for hazard mitigation planning, project identification, and implementation
- Acquire and maintain detailed data regarding critical facilities such that these sites can be prioritized and risk-assessed for possible mitigation actions
- Explore possibility of further regionalizing certain functions of hazard mitigation planning, administration, and management at the county level
- Continue support of hazard mitigation planning, project identification, and implementation at the municipal and county level
- Support increased participation in the National Flood Insurance Program Community Rating System
- Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/county zoning regulation, subdivision regulation, and comprehensive planning
- Provide for user-friendly hazard data accessibility for mitigation and other planning efforts and for private citizens
- Provide direct support, where possible, to municipal mitigation programs
- Facilitate development and timely submittal of project applications meeting state and federal guidelines for funding for repetitive and severe repetitive loss properties and for hardening/retrofitting infrastructure and critical facilities with highest vulnerability rankings
- Maintain and enhance local regulatory standards including full and effective building code enforcement, floodplain management, and other vulnerability-reducing regulations

Please refer to section 9.3.2 for more information on objectives for the Gloucester County Hazard Mitigation Plan.

2.4.3 Actions

Action Items are the specific steps (projects, policies, and programs) that advance a given objective. They are highly focused, specific, and measurable. Gloucester County mitigation actions include, but are not limited to:

- Acquisition of flood prone properties in Harrison Township
- Community outreach to residents in South Harrison to education on hurricane/evacuation strategies
- Structural retrofit the Swedesboro police station by providing envelop hardening and improved load path
- Elevation and dry floodproofing of private homes in Monroe Township
- Improve stormwater conveyance at the Senior Center in Woodbury City

- Engineering study to assess risk of dam located in Mantua Township
- Install backup power at the Emergency Operations Center in Woodbury Heights

The above list is intended to be illustrative of the overall action items, rather than an exhaustive list. Please refer to section 9.3.3 for more information on municipality specific mitigation actions.

2.5 Planning Process

Section 5 provides details about the process that was used to develop this Plan. The process closely followed the guidance in the FEMA *386* series of planning guidance, which recommend a four-stage process for developing mitigation plans.

- Step 1 Organize resources
- Step 2 Assess risks
- Step 3 Develop a mitigation plan
- Step 4 Implement the plan and monitor progress

Step 1, organizing resources, is described in Section 5 (Planning Process). The section includes details about who was involved, the processes that were used to establish leadership and advisory groups, and public and other outreach and involvement efforts.

Step 2, the risk assessment, was completed by the HMWG. The Risk Assessment is included as Section 7 of the Plan, and is preceded by a separate Hazard Identification in Section 6.

Step 3, development of the Mitigation Plan is described in Section 5 (Planning Process) and Section 9 (Mitigation Action Plan). Section 5 includes details about who was involved, the processes that were used, and the products that were developed. Section 9 includes specific details about the identification and development of mitigation goals, objectives, and actions based upon Section 7 (Risk Assessment) and Section 8 (Capability Assessment).

Step 4, implementing the Plan, is described in the Mitigation Action Plan in Section 9, which includes details about who is responsible for implementation of specific strategies and actions; and in Section 10, the Plan Monitoring and Maintenance section, which describes long term implementation through periodic updates and reviews.

2.6 Adoption and Approval

The Gloucester County Office of Emergency Management (GCOEM), with the endorsement of the HMWG, was responsible for recommending plan approval to Gloucester County Board of Chosen Freeholders. Consistent with that recommendation, the Gloucester County Board of Chosen Freeholders approved this Hazard Mitigation Plan on August 19, 2009. Following adoption, the Plan was submitted to FEMA Region II. FEMA reviewed and approved the Plan on March 15, 2009. Subsequently, the participating municipalities also adopted the Plan, submitted their adoption resolutions to FEMA and received their own approval notifications (see Appendices H and I).

The following 23 municipalities and institutions participated in the Plan by taking an active part in the planning process, identifying mitigation actions, and will adopt the plan:

- Clayton Borough
- Deptford Township
- Elk Township
- Franklin Township
- Glassboro Borough
- Gloucester County
- Greenwich Township
- Harrison Township
- Logan Township
- Mantua Township
- Monroe Township
- National Park Borough
- Paulsboro Borough
- Pitman Borough
- Rowan University
- South Harrison Township
- Swedesboro Borough
- Washington Township
- Wenonah Borough
- West Deptford Township
- Woodbury City
- Woodbury Heights Borough
- Woolwich Westville Borough

The following municipalities did not participate in the Plan:

- East Greenwich Township
- Newfield Borough
- Westville Borough

2.7 Implementation

The implementation process is described as part of the specific actions in the Mitigation Action Plan in Section 9.

2.8 Monitoring and Updating the Plan

Section 10 (Plan Monitoring and Maintenance) describes the schedule and procedures for ensuring that the Plan stays current. The section identifies when the Plan must be updated, who is responsible for monitoring the Plan and ensuring that the update procedures are implemented. This section provides a combination of cyclical dates (oriented toward FEMA requirements) and triggering events that will initiate amendments and updates to the Plan. The GCOEM is responsible for monitoring the Plan and initiating the cyclical update process. The point of contact at Gloucester County is:

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Section 3
Context

Contents of this Section

3.1 Introduction

The recommendations in the Gloucester County Multi-Jurisdictional Hazard Mitigation Plan are based in large part on identification of past and potential problems due to natural and man-made hazards. As part of the process of identifying potential problems, it is useful to understand the physical characteristics of Gloucester County. It is also important to understand any related planning efforts by the New Jersey Office of Emergency Management (NJOEM) as well as requirements of the federal government regarding hazard mitigation plans. In addition, this section provides definitions for key terms used throughout the Plan.

3.2 Geography, Climate, and Population of Gloucester County

3.2.1 Geography

Gloucester County is located in southern New Jersey and stretches from the Delaware River in the west, to Atlantic County in the east. Located approximately 50 minutes from Trenton and two hours from New York City and Baltimore, Gloucester County is 324 square miles in size and consists of 24 municipalities. Gloucester County is home to industrial, office, and residential areas.

Major roadways in Gloucester County include the New Jersey Turnpike, I-295, US Highway 322, State Highway 42/Atlantic City Expressway, State Routes 55, 44, 45, and 47.

Freight rail service is served by CSX, Norfolk Southern, Conrail, SMS, and Southern Railroad of New Jersey.[1]

[1] Facts About Gloucester County. 19 August 2008. Retrieved from http://www.co.gloucester.nj.us/plan/webbook/int_facts.htm

Figure 3.2.1-1: Gloucester County Map

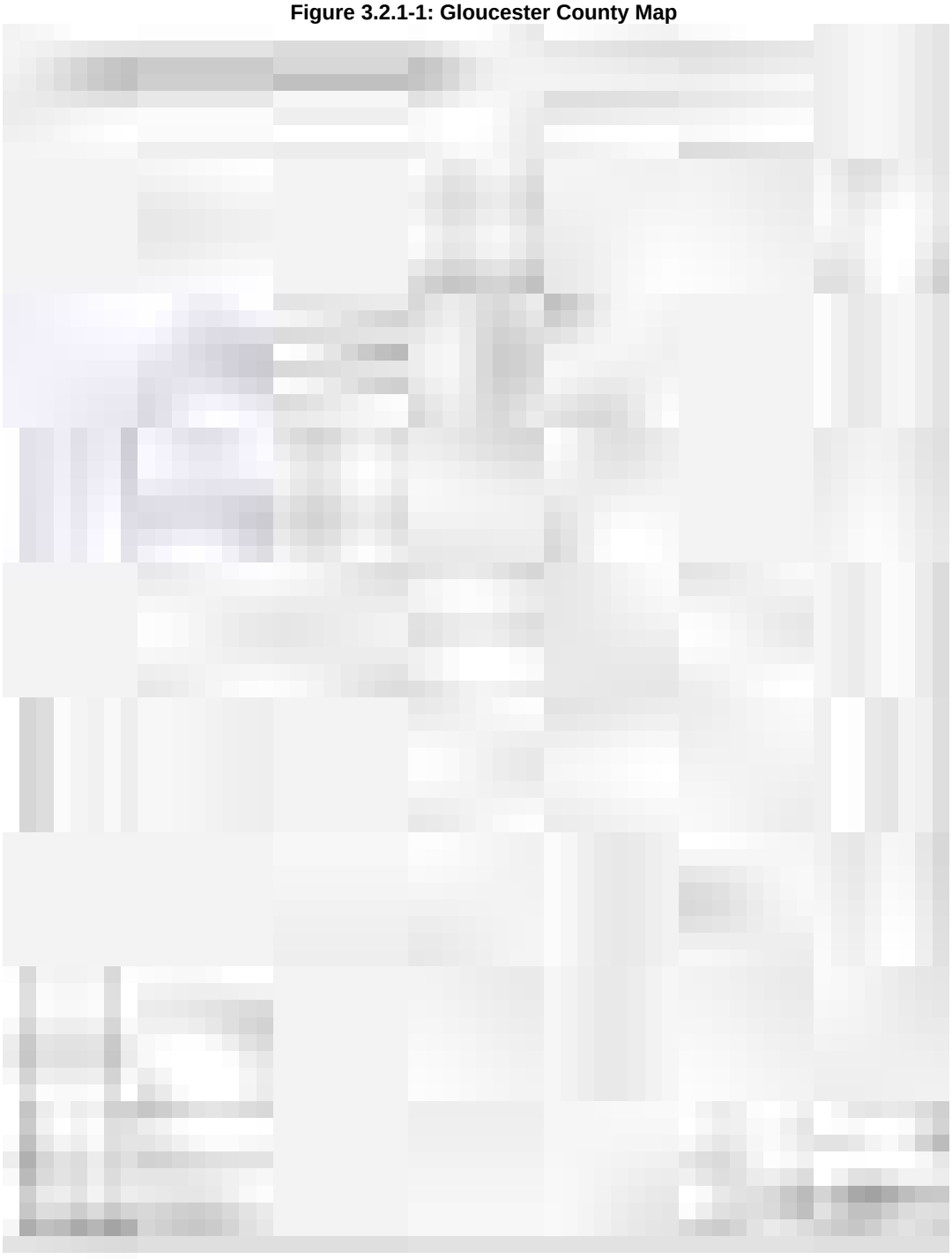


Figure 3.2.1-2:
Gloucester County Land Use Land Cover Map

As shown in Figure 3.2.1-2, land use in the county is primarily urban; 30.5% is considered as developed. Other prevalent land use types are agriculture (23.1%), forest (23.5%), and wetlands (16.7%).

3.2.2 Climate

Gloucester County's average maximum temperature is 63.3˚F, with the average highest temperature in July at 85.5˚F. The average minimum temperature is 44.1˚F, with the extreme low seen in January, 22.3˚F. Precipitation is evenly distributed throughout the year and averages 44.5" annually.[2] Spring and summer frontal systems can produce high rainfall amounts and spawn tornados. Tropical storm systems can affect the northern Atlantic seaboard from late summer to late fall.

3.2.3 Population

The population of Gloucester County has increased in recent years. As shown in Table 3.2.3-1, the population has increased at an annual rate of slightly more than 10%.

Table 3.2.3-1: US Census-Gloucester County, New Jersey Population
(Sources: 1990, 2000 Census; 2006 American Community Survey)

	1990	2000	2006
Population	**230, 082**	**254,673**	**282,031**

Building and development permit activity over the last few years (see Table 3-2) indicate that Gloucester County continues to grow, however the rate of growth appears to be leveling off. Although the number of permits issued in 2006 is a decrease from 2005, 2006 represents almost 10% of all permits issued between 2000 and 2006.

Table 3.2.3-2: Gloucester County Buildings Permits and Development Permits
(Source: DVRPC-Regional Data Bulletin 85)

Development Review Type	2004	2005	2006
New residential units authorized by permit	2,050	2,075	1,141

[2] World Climate–Glassboro Station. August 15, 2008. Retrieved from http://www.worldclimate.com/cgi-bin/data.pl?ref=N39W075+2200+283291C

A breakdown of the population of Gloucester County as collected by the United States Census is compiled in the Table 3.2.3-3:

Table 3.2.3-3
United States Census Population Characteristics for Gloucester County, New Jersey, 2006
(Source: 2006 Census-American Factfinder)

General Characteristics	Gloucester	New Jersey	United States
Total population	282,031	5,871,240	299,398,485
Male (%)	48.8%	48.8%	49.2%
Female (%)	51.2%	51.2%	50.8%
Median Age	37.5	38.2	36.4
Under 5 years (%)	5.6%	6.4%	6.8%
18 years and over (%)	76.8%	76.0%	75.4%
65 years and over (%)	11.6%	12.9%	12.4%
Housing Characteristics	**Gloucester**	**New Jersey**	**United States**
Total housing units	105,502	3,472,782	126,311,823
Occupied housing units (%)	94.1%	90.3%	88.4%
Owner-occupied housing units (%)	82.0%	67.3%	67.3%
Renter-occupied housing units (%)	18.0%	32.7%	32.7%
Vacant housing units (%)	5.9%	9.7%	11.6%
Social Characteristics	**Gloucester**	**New Jersey**	**United States**
High school graduate or higher (population 25 years and over)	88.5%	86.1%	84.1%
Bachelor's degree or higher (population 25 years and over)	26.1%	33.4%	27.0%
Disability status (population 5 years and over)	13.2%	12.3%	15.1%
Foreign born	4.7%	20.1%	12.5%
Economic Characteristics	**Gloucester**	**New Jersey**	**United States**
In labor force (population 16 years and older)	68.4%	66.2%	65.0%
Median household	$66,759	$64,470	$48,451

Gloucester County's median household income is the most notable difference between Gloucester County, the rest of New Jersey, and the United States as a whole. Gloucester County's median household income is 3.5% higher than New Jersey and 37.8% higher than the national average.

Figure 3.2.3-1: Population Density by Census Tract, Gloucester County Map

3.2.4 Special Consideration Communities

It is important to determine if any municipalities within the Gloucester County would qualify as *special consideration communities*. Special Consideration Communities are often eligible for grants for hazard mitigation and other community improvements on a preferential basis or with less stringent requirements for the non-federal, local share of grants.

The federal government defines a Special Consideration Community as one with 3,000 or fewer individuals that is a rural community, and is not within the corporate boundaries of a larger municipality. To be categorized as a Special Consideration Community, a municipality must be economically disadvantaged, with residents having an average per capita annual income not exceeding 80% of the national per capita income based on best available data. Further, Special Consideration Communities must have a local unemployment rate that exceeds–by one percentage point or more–the most recently reported average national unemployment rate.

Although Gloucester County is included in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area, several municipalities qualify by the United States Department of Agriculture (USDA) standards as rural. From the list of USDA identified communities, two municipalities meet all of the criteria to be considered Special Consideration Communities.

In addition to these Special Consideration Communities, 10 other Gloucester County municipalities have lower per capita incomes than the threshold, but all exceed the population threshold and/or would be considered urban areas. Also, four additional communities have less than the maximum population; however the per capita income exceeds the threshold. Although these municipalities do not qualify for the federal definition of Special Consideration Community, these circumstances are considerations for implementation strategies for these municipalities.

3.3 The New Jersey State Hazard Mitigation Plan Update

On April 28, 2008, NJOEM received approval from the Federal Emergency Management Agency (FEMA) for an update of the New Jersey State Hazard Mitigation Plan Updated (SHMPU). NJOEM describes the plan and its purpose as follows[3]:

"The purpose of the State Hazard Mitigation Plan Update is to rationalize the process of identifying and implementing appropriate hazard mitigation actions. … The present plan update document [2008] constitutes a comprehensive re-write of the original 2005 document. …"

"The development of state and local multi-hazard mitigation plans is key to maintaining eligibility for future Pre-Disaster Mitigation (PDM) funding for:

- Property acquisition or relocation of hazard prone property for conversion to open space in perpetuity;
- Structural and non-structural retrofitting … ;
- Minor structural hazard control or protection projects …
- Localized flood control projects, such as certain ring levees and floodwall systems, ..."

[3] New Jersey State Hazard Mitigation Plan. Retrieved from (http://www.state.nj.us/njoem/mitigation-plan08.html)

"The document includes:

- Characterization of natural hazards statewide, including occurrences, impacts, and probability
- Vulnerability assessment and loss estimation
- Identification of jurisdictions most at risk
- Goals, objectives, strategies and actions that will guide the state's mitigation activities
- A comprehensive evaluation of progress towards achieving the original 2004 goals, strategies, and actions
- A process for implementing and monitoring the Plan"

"The state provides assistance and guidance to local jurisdictions for developing their hazard mitigation Plans. … Information from the state and local Plans is linked and integrated, and … the state prioritizes funding opportunities for local jurisdictions."

Wherever possible, the Plan has incorporated information and recommendations consistent with the New Jersey State Hazard Mitigation Plan Update.

3.4 Federal Planning Requirements

According to the federal rules describing the Disaster Mitigation Act of 2000 (FR 8848, February 26, 2002, as amended at 67 FR 61515, October 1, 2002), "The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards." Local plans serve "as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the state to provide technical assistance and to prioritize project funding."

Relevant federal planning requirements include establishing minimum standards for grant program eligibility and outlining a planning process.

3.4.1 Grant Program Eligibility

The various federal mitigation grant programs and their planning requirements are listed below:

Hazard Mitigation Grant Program (HMGP)

According to 44 CFR §201.3, "For disasters declared after November 1, 2004, a local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants."

Pre-Disaster Mitigation (PDM)

According to 44 CFR §203, "By November 1, 2003, local governments must have a mitigation plan approved pursuant to this section in order to receive a project grant through the PDM program, authorized under Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5133. PDM planning grants will continue to be made available to all local governments after this time to enable them to meet the requirements of this section."

Flood Mitigation Assistance (FMA)

According to 44 CFR §78.4, "To be eligible for Project Grants, an eligible applicant will develop, and have approved by the FEMA Regional Director, a Flood Mitigation Plan in accordance with §78.5."

Severe Repetitive Loss (SRL)

According to the 2008 SRL guidance, "all subapplicants must have a FEMA-approved hazard mitigation plan by the application deadline to be eligible to receive project grant funding under the SRL program."

Public Assistance (PA)

State and local governments are eligible to receive assistance in the *emergency* categories of the PA program (Categories A and B). However, an approved state hazard mitigation plan is required for any applicant, state or local, to be eligible to obtain funding assistance for any categories of *permanent work* under the FEMA Public Assistance Program [Categories C through G].

According to 44 CFR §206.226, " In order to receive assistance under this section, as of November 1, 2004 (subject to 44 CFR 201.4(a)(2)), the State must have in place a FEMA approved State Mitigation Plan in accordance with 44 CFR part 201."

3.4.2 Planning Process Requirements

The following excerpts from the Interim Final Rule outline the required planning process. The process used to develop this Plan for Gloucester County is consistent with these requirements.

"Multi-jurisdictional plans may be accepted … as long as each jurisdiction has participated in the process and has officially adopted the plan. Statewide plans will not be accepted as multi-jurisdictional plans."

"In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies, … businesses, academia, and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information."

"The plan shall include the following:

(1) Documentation of the *planning process* [see Section 5 of this Gloucester County Plan, plus appendices] used to develop the plan …
(2) A *risk assessment* [see Sections 6 and 7 of this Gloucester County Plan, plus appendices] that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. … The risk assessment shall include:
(i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. …
(ii) A description of the jurisdiction's vulnerability to the hazards described. …
(iii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

(3) *A mitigation strategy* [see Section 9 of this Gloucester County Plan, plus appendices] that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment. … This section shall include:
   (i) A description of mitigation goals, …
   (ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects, …
   (iii) An action plan describing how the actions … will be prioritized, implemented, and administered by the local jurisdiction. …
   (iv) For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

(4) A *plan maintenance process* [see Section 10 of this Gloucester County Plan, plus appendices] that includes:
   (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
   (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms …
   (iii) Discussion on how the community will continue public participation in the plan maintenance process.

(5) *Documentation* [see Section 4 of this Gloucester County Plan, plus appendices] that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan … For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

This Gloucester County hazard mitigation plan further details and explicates federal requirements for each section or element of the plan by quoting the requirements in their entirety at the start of each relevant section.

The federal requirements continue, "Plans must be submitted to the State Hazard Mitigation Officer for initial review and coordination. The state will then send the Plan to [the FEMA Region II office] for formal review and approval. The Regional review will be completed within 45 days after receipt from the state, whenever possible.

"Plans must be reviewed, revised if appropriate, and resubmitted for approval within five years in order to continue to be eligible for HMGP project grant funding."

3.5 Key Terms

100-Year Flood: The flood event that has a 1% chance of being equaled or exceeded each year (see also BFE, SFHA). Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance.

500-Year Flood: The flood event that has a .02% chance of being equaled or exceeded each year.

Base Flood Elevation (BFE): The height at which there is a 1% change or greater of flooding in a given year (see also 100-year flood, SFHA). The BFE is used for flood insurance policy rating. An Advisory Base Flood Elevation (ABFE) is issued when new elevations are being established but have yet to be adopted.

Disaster Mitigation Act of 2000 (DMA 2000): This legislation established a requirement that jurisdictions nationwide must develop and implement natural hazard mitigation plans in order to remain eligible for various FEMA grant programs, including those that provide funding for hazard mitigation projects.

Federal Insurance Administration: A division of FEMA responsible for administering the flood insurance aspects of the NFIP.

Flood Insurance Rate Map (FIRM): The official map of a community for which FEMA has delineated both the special hazard areas (100-year floodplain) and the risk premium zones applicable to the community.

Flood Insurance Study (FIS): A study that is produced by FEMA and evaluates flood hazard areas, describes its causes, and identifies flood protection measures. Depending on the area studied, the FIS may include water surface elevations. An FIS is developed in conjunction with a Flood Insurance Rate Map (FIRM).

Fujita Scale: The Fujita Scale measures tornado damage severity by assigning numerical values based on wind speeds. Tornadoes are categorizes from 0 to 5 depending on wind speeds. The letter *F* often precedes the numerical value.

Hazard Mitigation Grant Program (HMGP): Provides grants to states and local governments to implement long term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

HMGP Expanded Mitigation Strategies Planning Grant Pilot: After Hurricanes Katrina, Rita, and Wilma in 2005, FEMA developed a process that expanded the allowable scope of mitigation planning activities that are funded through the HMGP. The Pilot provides funds for eligible HMGP Applicants to identify and plan feasible mitigation projects, and incorporate those projects into their mitigation plans. The purpose of the Pilot is to utilize the mitigation planning strategies identified during the Plan Update to implement actual mitigation projects as part of the long term disaster recovery.

Local Coordinators: Individuals designated by each municipality, as required by the State of New Jersey, to coordinate and carry out emergency management functions.

National Flood Insurance Program (NFIP): A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

New Jersey Office of Emergency Management (NJOEM): New Jersey State agency responsible for the comprehensive planning for and responding to all manner of disasters, whether manmade or natural. NJOEM may also be requested to provide consequence management for large special events.

Palmer Drought Index: This index was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index. The Palmer Index is most effective in determining long term drought.

Sea Lake and Overland Surges from Hurricanes (SLOSH) Model: Computer modeling software used to model storm surge heights from historical or hypothetical storms. The model can be used to estimate storm surge heights and winds by considering the pressure, size, forward speed, track, and winds.

Special Flood Hazard Area (SFHA): A high risk area defined as any land that would be inundated by a flood having a 1% chance of occurring in any given year (see also BFE, 100-year flood). The SFHA is commonly identified on NFIP Flood Insurance Rate Maps (FIRMs). A structure located within a SFHA shown on a FIRM has a 26% chance of suffering flood damage during the term of a 30-year mortgage.

Steering Committee: A group comprised of a cross section of individuals from emergency management, government, and non-governmental organizations to guide the planning process

Section 4
Adoption and Approval

Contents of this Section

4.1 Interim Final Rule Requirement for Adoption and Approval

Requirement §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council). For multi-jurisdictional plans, each jurisdiction requesting approval of the plan ***must*** *document that it has been formally adopted.*

Requirement §201.6(a)(3): Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.

4.2 Authority

In the State of New Jersey, counties are empowered to manage their own affairs via a governing body known as the Board of Chosen Freeholders. The following is an excerpt from the relevant portion of the New Jersey Statutes Annotated (NJSA 40:20 et seq.)[1]:

The property, finances and affairs of every county shall be managed, controlled and governed by a board elected therein, to be known as "the Board of Chosen Freeholders of the county of [Gloucester County] and the executive and legislative powers of the county shall be vested in that Board of Chosen Freeholders, except where by law any specific powers or duties are imposed or vested in a Constitutional officer.

The Board of Chosen Freeholders of any county which has created the office of county administrator, pursuant to the provisions of NJS 40A:9-42, may, by resolution, delegate to that office such executive and administrative powers, duties, functions, and responsibilities as the board may deem appropriate.

[1] New Jersey Office of the Attorney General.

4.3 Adoption and Approval Procedure

On June 17, 2009, FEMA Region II determined that the Plan was *approvable pending adoption*. On July 11, 2009, the Gloucester County Hazard Mitigation Working Group met and recommended that Gloucester County and the participating municipalities should adopt the Plan. The Plan was submitted to the Gloucester County Board of Chosen Freeholders as well as the appropriate entity for each participating municipality for review and adoption. The resulting Adoption Resolutions were then submitted to FEMA Region II for approval. FEMA subsequently issued formal approval letters to NJOEM for Gloucester County and each participating municipality that adopted the Plan. NJOEM, in turn issued approval letters to the approved jurisdictions.

4.4 Adoption Resolutions

Appendix H contains the signed Adoption Resolutions for Gloucester County and the participating municipalities.

4.5 Approval Letters

Appendix I contains the formal Approval Letters from FEMA Region II for Gloucester County and the participating municipalities.

Section 5
Planning Process

Contents of this Section

5.1 Interim Final Rule Requirements for the Planning Process

Requirement §201.6(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Requirement §201.6(b): An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

5.2 Description of the Planning Process

5.2.1 How the Plan was Prepared (Overview)

The Gloucester County Multi-Jurisdictional Hazard Mitigation Plan (the Plan) was prepared in accordance with the process established in the State and Local Mitigation Planning *How-to Guides* (FEMA Publication Series 386) produced by the Federal Emergency Management Agency (FEMA), and the requirements of the February 26, 2002 Interim Final Rule (IFR). The process established in the FEMA 386 guides includes four basic steps.

- Step 1: Organize resources
- Step 2: Assess risks
- Step 3: Develop a mitigation plan
- Step 4: Implement the plan and monitor progress

5.2.2 Step 1: Organize Resources

The Gloucester County Office of Emergency Management (GCOEM) was the lead agency for the development of the Plan, which was completed in cooperation with Hazard Mitigation Plans for Camden, Cumberland, and Salem counties, collectively referred to as the Southern Delaware Valley Region for the purposes of this planning effort. At the beginning of the process, a consultant firm, James Lee Witt Associates (JLWA), was hired to provide technical support to all four counties. In addition, several individuals and organizations worked together to develop the Plan. These participants were organized into two different committees including:

- Southern Delaware Valley Region Hazard Mitigation Steering Committee
- Gloucester County Hazard Mitigation Working Group

The Southern Delaware Valley Region Hazard Mitigation Steering Committee (HMSC) was comprised principally of the county Office of Emergency Management (OEM) coordinators of the four participating counties–Camden, Cumberland, Gloucester, and Salem. This committee was formed to provide focus and leadership on behalf of the four participating counties in the development of these Plans. In addition to the four county OEM coordinators, HMSC meetings were regularly attended by other key county agency staff, including representatives from departments of planning, public works, and additional emergency management staff; in addition to New Jersey Office of Emergency Management (NJOEM) staff. The HMSC met monthly during the duration of the planning process to receive progress reports from the consultant, review and comment upon draft documents and procedures, and implement relevant tasking and coordinate efforts within their own counties.

The Gloucester County Hazard Mitigation Working Group (HMWG) is comprised of the county OEM coordinator and all municipal OEM coordinators in Gloucester County. The HMWG is a function of the local emergency management coordinators group, which has regular interaction with the GCOEM. The HMWG is comprised of representatives from each participating municipality's Office of Emergency Management, related agencies within the county, and public entities that wished to participate in the planning effort. The duties and responsibilities of the HMWG consisted of: representing their communities' interests, serving as the point of contact between their communities and the HMSC, and completing necessary planning tasks, including data collection, identification of local mitigation actions, and reviewing the plan products of the HMSC. With input and consensus from the HMWG, the HMSC identified the six most significant countywide hazards for a risk assessment to be completed.

Table 5.2.2-1a shows the primary membership of the HMSC.

Table 5.2.2-1a
Southern Delaware Valley Region Hazard Mitigation Steering Committee (HMSC) Members

Name	Organization
Len Clark	Gloucester County OEM
James Manski	Cumberland County OEM
David Polk	Salem County OEM
Sam Spino	Camden County OEM

Additionally, a number of other individuals attended HMSC meetings on an as-needed basis, as shown in Table 5.2.2-1b.

Table 5.2.2-1b
Additional Southern Delaware Valley Region Hazard Mitigation Steering Committee (HMSC) Meeting Attendees

Name	Organization
Anthony Buono	Cumberland County Planning/ Economic Development
Bill Craney	NJOEM
Dominic Juliano	Salem County Planning Board/ Geographic Information System (GIS)
Robert Kelly	Camden County Engineer/ Department of Public Works
Stacey Murphy	NJOEM
Tom Rafferty	NJOEM
Pat Spring	Salem County OEM
Rick Westergaard	Gloucester County Planning Division
Greg Westfall	United States Department of Agriculture−National Resources Conservation Services (NRCS)

Table 5.2.2-2 lists the membership of the Gloucester County HMWG.

Table 5.2.2-2
Gloucester County Hazard Mitigation Working Group (HMWG) Members

Name	Organization
Sam Teague	Clayton Emergency Management Coordinator
Don Banks	Deptford Emergency Management Coordinator
Milton Sahms	Elk Emergency Management Coordinator
Michael DiGiorgio	Franklin Emergency Management Coordinator
Troy Armstrong	Glassboro Emergency Management Coordinator
Al Silbaugh	Greenwich Emergency Management Coordinator
Ed Selb	Harrison Emergency Management Coordinator
Andy Lovell	Logan Emergency Management Coordinator
Rodney Sawyer	Mantua Emergency Management Coordinator
Frank McLaughlin	Monroe Emergency Management Coordinator
Dennis Kappler	National Park Emergency Management Coordinator
Glenn Roemmich	Paulsboro Emergency Management Coordinator
Scott Campbell	Pitman Emergency Management Coordinator
Tom Luchay	South Harrison Emergency Management Coordinator
Tim Michener	Rowan University Emergency Management Coordinator
Eric Voight	Swedesboro Emergency Management Coordinator
Frank Gursick	Washington Emergency Management Coordinator
Doug Raggio	Wenonah Emergency Management Coordinator
Tom Campo	West Deptford Administrator
Stephen Cope	Woodbury Emergency Management Coordinator
William Schweigart	Woodbury Heights Emergency Management Coordinator
Glenn Rambo	Woolwich Emergency Management Coordinator

Meeting Schedule

There were several meetings conducted during the development of the Plan per Table 5.2.2-3. The meetings focused primarily on the review of work-in-progress for the development of the Plan. However, in some cases, the meetings were essentially working sessions for identification of potential mitigation projects.

Table 5.2.2-3
Committee Meeting Schedule

Date	Meeting	Attendees
February 4, 2008	HM Steering Committee Meeting	HMSC, JLWA
February 19, 2008	HM Steering Committee Meeting	HMSC, JLWA
February 28, 2008	HM Working Group Kick-off Meeting	GCOEM, HMWG
March 18, 2008	HM Steering Committee Meeting	HMSC, JLWA
April 15, 2008	HM Steering Committee Meeting	HMSC, JLWA
May 20, 2008	HM Steering Committee Meeting	HMSC, JLWA
May 29, 2008	HM Working Group Meeting	GCOEM, HMWG, JLWA, members of the public
June 17, 2008	HM Steering Committee Meeting	HMSC, JLWA
August 5, 2008	HM Steering Committee Meeting	HMSC, JLWA
July-August 2008	One-on-one meetings/calls with HM Working Group members	HMWG, JLWA
August 19, 2008	HM Working Group Meeting	GCOEM, HMWG, JLWA, members of the public
September 19, 2008	HM Steering Committee Meeting	HMSC, JLWA
October 2, 2008	HM Working Group Meeting	GCOEM, HMWG, JLWA, members of the public
December 8, 2008	HM Steering Committee Meeting (to discuss NJOEM review comments)	NJOEM, HMSC, JLWA
March 23, 2009	HM Steering Committee Conference Call	HMSC, JLWA
May 19, 2009	HM Steering Committee Meeting	HMSC, JLWA

Appendix C.1 contains documentation for these meetings including agendas, sign-up sheets, presentation materials, and meeting notes where appropriate.

5.2.3 Step 2: Assess Risks

In accordance with general mitigation planning practice, as well as the process FEMA established in its *How-to Guides*, the risk assessment forms the basis for this Plan by quantifying and rationalizing information about how natural and manmade hazards affect Gloucester County and the participating municipalities.

The processes used to complete the hazard identification and risk assessments, and the results of these activities, are described in Sections 6 and 7 and Appendices D and E of this Plan. The assessment determined several aspects of the risks of hazards faced by the county and the participating municipalities:

- The natural hazards that are most likely to affect Gloucester County
- How often hazards are expected to impact Gloucester County
- The expected severity of the hazards
- What areas of Gloucester County are likely to be affected by hazards
- How Gloucester County's assets, operations, people, and infrastructure may be impacted by hazards

- How private and commercial assets, operations, infrastructure may be impacted by hazards
- The expected future losses if the risk is not mitigated

The HMSC first identified all hazards with the potential to impact the county. Next, using a rating system (explained in detail in Section 6), the HMSC reduced the initial list of hazards down to six countywide hazards that were considered the most relevant for this type of planning process, as well as one hazard that was relevant to selected municipalities. The results of this selection process were discussed and validated by the HMWG. These hazards are described in the Hazard Identification, Profiling, and Ranking portion of the Plan (Section 6).

As a result of in-depth examination of the characteristics of the reduced list of hazards, the HMSC was able to make qualitative determinations that allowed further refinement of the focus of this plan to six hazards: flood, high wind–straight-line wind, severe storms–winter storms, earthquake/geological, dam failure, and levee failure. Additionally, wildfire was identified as a relevant hazard for selected municipalities. These are considered by the HMSC to represent the most predominant risks to the area. The results of this secondary selection process were also discussed and validated by the HMWG.

For each of these hazards the consultants performed detailed risk assessments, i.e. calculations of future expected damages, expressed in dollars where appropriate. The results of the risk assessment were also made available to the public during the public presentations (see Section 5.3). The full process and results of this work is presented in the Risk Assessment portion of this Plan (Section 7).

5.2.4 Step 3: Develop the Mitigation Plan

The HMSC developed a series of goals and objectives in response to the results of the risk assessment. A capability assessment was also conducted to help determine the capacity of the county and the participating municipalities to implement hazard mitigation projects. In addition, the HMSC and the consultant worked with the participating municipalities, on an individual basis, to identify potential problems and hazard mitigation project solutions to include in the Mitigation Action Plan. The Mitigation Action Plan was discussed and validated by the HMWG. The results of these efforts are detailed in Sections 8 and 9.

5.2.5 Step 4: Implement the Plan and Monitor Progress

Finally, the HMSC identified a process for on-going monitoring and revisions to the Plan over the next five years. Section 10 details the resulting monitoring, evaluation and plan update procedures. This step was also reviewed and validated by the HMWG.

5.3 Involvement by the Public and Other Interested Parties

During the development of this Plan, public participation was actively solicited. The HMWG hosted three public presentations/meetings, provided drafts of the Plan for review, and invited comments on the contents of the Plan. For each meeting, the public and interested parties were notified of the meetings via public notice in area newspapers, notice on the Hazard Mitigation Plan website, and emails to interested groups.

These public outreach efforts are detailed in Table 5.3-1. In addition, attendance lists, presentation materials and meeting notes are compiled in Appendix C.2.

Response to this outreach was less than hoped for, as the attendance lists document; however, future outreach by Gloucester County and municipal coordinators, including proposed public education and work with stakeholders and other interested parties over the next 5 years will improve public involvement for the next Plan update.

Table 5.3-1
Public Involvement

Date	Type of Involvement	Meeting Location
May 22, 2008	Website with hazard mitigation and Plan development information posted	n/a
May 22, 2008	Press release regarding hazard mitigation and Plan development issued	n/a
May 23, 2008	Citizen Survey posted on website	n/a
May 29, 2008	Public meeting with presentation and open discussion	Gloucester County Fire Academy
August 19, 2008	Public meeting with presentation and open discussion	Gloucester County Fire Academy
September 9, 2008	Plan posted to website for public comment	n/a
October 2, 2008	Public meeting with presentation, open discussion, and public comment	Gloucester County Fire Academy

As part of the development of the Plan, Floodplain Administrators were engaged in Plan development and review in many municipalities. In some cases, the Municipal Coordinator who led work on this Plan was also the Floodplain Administrator for the community. Involvement of Floodplain Administrators in the development of the Plan is shown in Table 5.3-2. Proposed efforts to increase outreach to Floodplain Administrators will result in enhanced participation in the next Plan update.

Table 5.3-2
Gloucester County Floodplain Administrator Involvement

Municipality	Floodplain Administrator Name	Method of Involvement in Plan
Clayton	Mark Brunermer	Not involved with HMP
Deptford	Fred Fritz	Not involved with HMP
Elk	Milton Sahms	Main point of contact for HMP
Franklin	Michael DiGiorgio	Main point of contact for HMP
Glassboro		
Greenwich	Joseph D. Capasso	Provided input / reviewed HMP
Gloucester County	n/a (1)	n/a
Harrison	Carole Rieck	Not involved with HMP
Logan	Dave McCormick	Provided input / reviewed HMP
Mantua		
Monroe	Frank McLaughlin	Main point of contact for HMP
National Park	William Cattrell	Provided input / reviewed HMP
Paulsboro		
Pitman		Provided input / reviewed HMP
Rowan University	n/a (2)	n/a
South Harrison		
Swedesboro		Not involved with HMP
Washington	Annina Hogan	Provided input / reviewed HMP
Wenonah		
West Deptford	Joseph R. Gill	Main point of contact for HMP
Woodbury	Stephen Cope	Main point of contact for HMP

Municipality	Floodplain Administrator Name	Method of Involvement in Plan
Woodbury Heights	William Schweigart	Main point of contact for HMP
Woolwich		Not involved with HMP

Notes:
1.) Gloucester County does not include any unincorporated land not governed by municipalities and as a result does not have a floodplain management program per se.
2.) Rowan University is an institution and as such does not have a floodplain management program per se.

Beyond this, email and phone solicitation of involvement by potential stakeholders and interested parties including non-profits, area utilities, school boards, major employers, and others was solicited during Plan development and reviews. Relevant correspondence is contained in Appendix C.3. Response to this outreach was sparse, but outreach by Gloucester County and municipal coordinators, including public education and work with stakeholders and other interested parties between now and the five-year Plan update, should improve such involvement during the Plan update.

In addition, notice was sent to adjacent jurisdictions and other interested parties that the Draft and Final Plans were available for review prior to adoption by the county and the participating municipalities. Copies of relevant correspondence are included in Appendix C.3.

5.4 Review and Incorporation of Plans, Studies, Reports, and Other Information

5.4.1 Federal Government

Selected key federal sources of information and pre-existing planning work are presented in Table 5.4.1-1. Additional sources and detail can be found in Appendix B.

Table 5.4.1-1
Federal Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
FEMA Disaster Declarations database and other general hazard data	Used in hazard identification and risk assessment (HIRA) development and history of loss data for multiple hazards
FEMA/National Flood Insurance Program Flood Maps (Flood Insurance Rate Maps, Digital Flood Insurance Rate Maps, "Q3"data)	Used in developing HIRA, strategies, and mitigation actions
FEMA Hazards US (HAZUS) v.1.1	Used in developing various risk assessments and critical facilities inventories
FEMA Benefit Cost Analysis modules	Used in developing various risk assessments
FEMA Community Status Book, Community Rating System Eligible Communities	Used in developing capability assessments and mitigation actions
FEMA Tornado Activity in the United States	Used in developing HIRA and history of loss data
National Oceanic and Atmospheric Administration (NOAA)/ National Climatic Data Center database	Used in developing history and description of major hazard events for multiple hazards
NOAA Coastal Service Center–Historic Hurricane Tracks Database	Used in developing HIRA, strategies, and mitigation actions

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
NOAA National Hurricane Center–Hurricane Preparedness, Storm Surge	Used in developing HIRA, strategies, and mitigation actions
USACE (Philadelphia Office)–New Jersey Hurricane Evacuation Study Transportation Analysis, including storm surge mapping	Used in developing HIRA, strategies, and mitigation actions
United States Census Bureau data	Used in developing various risk assessments, establishing planning context
United States Department of Agriculture–New Jersey Eligible Communities	Used in identifying Special Circumstance Communities
United States Geological Survey (USGS) National Hazard Seismic Mapping Project	Used in developing HIRA and history of loss data
USGS Summary of July 12, 2004 Flooding in Southern New Jersey	Used in developing HIRA and history of loss data
United States Environmental Protection Agency Toxic Release Inventory	Used in developing hazard identification, strategies, and mitigation actions
United States Department of Transportation Hazardous Materials Incident Data	Used in developing hazard identification, strategies, and mitigation actions

5.4.2 State of New Jersey

Selected state sources of information and pre-existing planning work are presented in this section.

New Jersey State Hazard Mitigation Plan

New Jersey completed the current 2008 State Plan update to meet the requirements of IFR Section 201.4(d), which mandates that states update their mitigation plans every three years, *to reflect changes in development, progress in statewide mitigation efforts, and changes in priorities.*

The State Hazard Mitigation Plan Update (SHMPU) is the demonstration of New Jersey's commitment to reduce risks from natural hazards and serves as a guide for both state and local decision makers as they commit resources to reducing the effects of natural hazards on lives and property. It is designed to outline a strategy to reduce risks from natural hazards in New Jersey, and to aid state and local emergency management officials in developing hazard reduction programs.

It is NJOEM's intent to use the SHMPU as a way to provide data to local and regional governments to support their mitigation planning processes, and to provide guidance on best practices. For each on-going plan development effort, NJOEM attends at least one mitigation core team meeting, one stakeholder meeting, and one public meeting to be a resource to the municipality or county, to answer any questions and to direct planners to state resources or tools. NJOEM staff also is available during the draft plan development to answer any questions or provide guidance and assistance.

The statewide mitigation strategies, goals and objectives, methods of incorporating a varied cross section of relevant disciplines, hazard specific information, and specific data sources are present within the SHMPU and were utilized in the development of the Gloucester County Multi-Jurisdictional Hazard Mitigation Plan.

Other State of New Jersey Information

In addition to the SHMPU, selected state sources of information and pre-existing planning work are presented in Table 5.4.2-1. Additional sources and detail can be found in Appendix B.

Table 5.4.2-1
Other State Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
New Jersey Administrative Code–Dam Safety Standards (NJAC: 7-20), Dam Classifications	Used in developing HIRA
New Jersey Geologic Survey (NJGS) Map of Landslides in New Jersey	Used in hazard profiling and loss estimation
New Jersey Division of Community Affairs (NJDCA), Division of Codes and Standards–Bulletin No. 3-4 Wind Speed Map	Used in developing HIRA, strategies, and mitigation actions
NJDCA–State Development and Redevelopment Plan	Used in future development analysis
NJDCA, Office of Smart Growth–GIS) data	Used in future development analysis, development of HIRA, and strategies
NJDEP, Department of Dam Safety and Flood Control data	Used in developing loss history and HIRA
NJDEP–Landslides in New Jersey report, Landslide Susceptibility/Incidence maps and geodata	Used in developing loss history and HIRA
NJDEP–County Land Use Land Cover data	Used in developing hazard profiling and loss estimation
New Jersey Forest Fire Service–wildfire mapping and data	Used in developing hazard profiling and loss estimation
NJOEM Summary of Presidentially Declared Disasters 1992-2000	Used in developing hazard profiling and loss estimation
NJOEM–Hazard Analysis New Jersey	Used in developing hazard profiling
New Jersey Office of the State Climatologist (at Rutgers University)	Used in developing hazard profiling
NJGS–Earthquake Loss Estimation Study for Gloucester County	Used in developing hazard profiling and loss estimation
Workforce New Jersey Public information Network – Residential Building Permits Authorized 2000-2006	Used in establishing planning context and to validate future development analysis

5.4.3 Gloucester County

New Jersey is a *home rule* state, which means that the authority to create laws and control land use resides within the municipal governments, and not with the county governmental entities. Counties throughout New Jersey are expected to act in the best interest of, and for the protection of, the citizens residing within the confines of the county. State statutes do give limited authorities to the counties, but the more significant authorities rest with the individual municipalities.

Selected key county sources of information and pre-existing planning work are presented in Table 5.4.3-1. Additional sources and detail can be found in Appendix B.

Table 5.4.3-1
County Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
American Red Cross mass care surveys (1995)	Reviewed for relevant data
Construction Permits Data	Used in establishing planning context and development of mitigation actions
Critical Facilities Inventory and Data	Used in development of HIRA and mitigation actions
Comprehensive Economic Development Strategy Report (2008)	Used to validate data used in future development analysis
County GIS data, including: parcels, soils, base mapping, developments, land use 2000, census tract, 2' contours, septic and sewer, etc.	Used to validate data used in risk assessment and future development analysis
Cross−Acceptance Report (2004)	Used to validate data used in future development analysis
Dams inventory and data	Used in development of HIRA and mitigation actions
Emergency Management Windstorm/Wind Peril surveys (1996)	Used to validate data used in HIRA
Emergency Operations Plan	Used in hazard identification
NJDEP−Comprehensive Environmental, Response, Compensation, and Liability Act: Priority List of Hazardous Substances Report for Gloucester County (2007)	Used to validate data used in hazard identification
Northeast Region Strategic Plan (2005)	Used to validate data used in future development analysis
Photographs of critical facilities	Used in development of risk assessments and mitigation actions
Repetitive Loss /Severe Repetitive Loss (RL/SRL) inventory and data	Used in development of risk assessments and mitigation actions
Stormwater Management Plan	Used to develop mitigation actions, also to validate data used in HIRA development
Various county website materials	Used to establish planning context

5.4.4 Municipalities

Upon initiating the plan development process, the county OEM point of contact made initial contacts to form the HMWG. Concurrent with that effort, all of the local OEM coordinators were made aware of the significance this planning effort. A comprehensive *wish list* of documents, data sources, maps, studies, Emergency Operations Plans, land use data, laws, and ordinances was provided with the task of collecting as much of the items as possible. The HMWG and GCOEM regularly provided guidance and support in this gathering effort through the use of e-mail inquiries, phone contact and agenda items at the Local Coordinator meetings.

Selected key municipal sources of information and pre-existing planning work that were used in the development of the Plan are presented in Tables 5.4.4-1 and 5.4.4-2. Additional sources and detail can be found in Appendix B.

In some cases, as noted in Table 5.4.4.2, information that may exist at the municipal level was not uniformly provided or available for this initial Plan. During the next 5 years, GC OEM and the municipal coordinators will be taking steps to locate, review and incorporate all the indicated documents in the next Plan update.

Table 5.4.4-1
Municipal Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
Critical Facilities Inventory and Data	Used in development of HIRA and mitigation actions
Dams inventory and data	Used in development of HIRA and mitigation actions
FEMA Flood Insurance Study (FIS), Borough of Paulsboro, September 2, 1082	Used in development of HIRA and mitigation actions
Mitigation 20/20 reports	Used in development of planning context, hazard identification, risk assessment, and critical facilities identification/mitigation actions
RL/SRL inventory and data	Used in development of risk assessments and mitigation actions

Table 5.4.4-2
Complete Inventory (per FEMA Region II "Tool Kit") of Potential Municipal Documents and Data, and Status of Inclusion in Plan

Document or Data (for all Municipalities in Gloucester Co.)	Available for Plan	Status of Incorporation in Plan
Comprehensive plan	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Growth Management plan	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Capital Improvement plan	N	To be reviewed (if available) and included in plan update
Flood Damage Prevention Ordinance	N	To be reviewed (if available) and included in plan update
Floodplain Management plan	N	To be reviewed (if available) and included in plan update
Open Space program plan	N	To be reviewed (if available) and included in plan update
Flood Insurance Studies, DFIRMs or engineering studies for streams	N	To be reviewed (if available) and included in plan update
Hazard Vulnerability Analysis (by the local Emergency Management Agency)	Y	Reviewed. See Table 5.4.4-1
Emergency Management Plan/ Emergency Operations Plan	Y	Reviewed. See Table 5.4.3-1
Zoning Ordinance	N	To be reviewed (if available) and included in plan update
Building Code	Y	Reviewed. Standard UCC for all of NJ
Drainage Ordinance	N	To be reviewed (if available) and included in plan update
Critical Facilities maps	Y	Reviewed. See Table 5.4.4-1
Existing Land Use maps	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Elevation Certificates	N	To be reviewed (if available) and included in plan update
State plan	Y	Reviewed. See Table 5.4.2.1
HAZUS study	Y	Reviewed. See Table 5.4.1-1
SLOSH Studies	Y	Reviewed. See Table 5.4.1-1 (USACE Evacuation Study)
Hurricane Evacuation Plan	Y	Reviewed. See Table 5.4.1-1 (USACE Evacuation Study)

5.4.5 Other Resources

Selected other key sources of information and pre-existing planning work, including regional and academic resources, are presented in Table 5.4.5-1. Additional sources and detail can be found in Appendix B.

Table 5.4.5-1
Other Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of Incorporation into the Plan
Delaware River Basin Commission–basin mapping	Used in developing hazard profiling
Delaware Levee Estuary Organization–Delaware River Levees and Dikes map and inventory	Used in developing hazard profiling
Delaware Valley Regional Planning Commission–Data Bulletin 85	Used to establish planning context
New Jersey Association of County Tax Boards–parcel data	Used to validate data used in risk assessment
Public Entity Risk Institute–Presidential Disaster Declarations	Used in developing hazard profiling and loss estimation
Right-to-Know (RTK) Network–biennial reporting, emergency response notification database	Used in developing hazard profiling
World Climate website, Glassboro Station	Used to establish planning context

Section 6
Hazard Identification, Profiling, and Ranking

Contents of this Section

6.1 Interim Final Rule Requirement for Hazard Identification and Profiling

Requirement §201.6(c)(2)(i): [The risk assessment shall include a] description of the type…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Note that Appendix D includes general descriptions of all selected hazards that can affect Gloucester County. The present section addresses the specific requirements of the Interim Final Rule (IFR) with regard to hazards in the planning area.

6.2 Hazard Identification

In accordance with IFR requirements, and as part of its efforts to support and encourage hazard mitigation initiatives, Gloucester County's Hazard Mitigation Working Group (HMWG) prepared this general assessment of the hazards that have potential to impact the county. The following subsections provide an overview of past hazard events in the County and brief descriptions of the potential for future losses. Section 7 (Risk Assessment) includes much more detailed information about past and potential losses (risk) from a subset of the most significant hazards in Gloucester County.

The term *planning area* is used frequently in this section. This term refers to the geographic limits of Gloucester County. The Risk Assessment section addresses the effects of hazards on Gloucester County and its citizens.

Overview of Gloucester County's History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The United States Army Corps of Engineers (USACE) and the Natural Resources Conservation Service collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database collects and maintains data about natural hazards in summary format. The data includes occurrences, dates, injuries, deaths, and costs.

According to the NCDC database, between 1950 and 2007, Gloucester County has experienced the following hazard events:

- 170 thunderstorm and high wind events (eight exceeding 69 mph)
- 89 winter storms (four major blizzards/ severe winter storms)
- 44 floods/flash floods
- 25 hail storms (four of which had greater than 1" diameter hail)
- 18 significant lightning events
- 13 extreme heat events
- 13 hurricanes or tropical storms
- 7 droughts
- 7 extreme cold temperature events
- 7 tornadoes (four F0s, four F1s, and one F2)
- 4 wildfires
- 2 ice storms (32 wintry mix events)
- 1 storm surge event (13 coastal flooding events)

In addition to the events recorded in the NCDC database other sources identified three earthquakes, three significant crop loss events, one dam failure, and one partial levee failure. A number of these events caused property damage, injuries, and loss of life.[1] These figures are discussed in more detail in the hazard-specific subsections that follow.

[1] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

In the absence of definitive data on some of the hazards that may occur in Gloucester County, illustrative examples are useful. Table 6.2-1 provides brief descriptions of particularly significant hazard events occurring in Gloucester County's recent history. This list is not meant to capture every event that has affected the area, rather lists some of the more significant events that have occurred here in the past.

Gloucester County has received seven major Presidential Disaster Declarations and seven Emergency Declarations since 1950. Four of the seven major disaster declarations were the result of significant flooding. All of the major and emergency disaster declarations, as well as one non-declared event, are included as part of the summary in Table 6.2-1 below.

Table 6.2-1
Recent Hazards and Declared Emergency and Major Disasters in Gloucester County, New Jersey, 1950-2007
(Sources: NOAA/NCDC, FEMA, NJOEM, Public Entity Risk Institute)

Date and Disaster (DR) #	Nature of Event
3/09/1962 (DR-124)	SEVERE STORMS, HIGH WINDS, AND FLOODING–Statewide, the event resulted in damages estimated at $88.4 million (damage estimate adjusted to dollar figures for the year of 2003).
8/18/1965 (DR-205)	WATER SHORTAGE–Statewide, the event resulted in damages estimated at $6.4 million (damage estimate adjusted to dollar figures for the year of 2003).
9/04/1971 (DR-310)	HEAVY RAINS AND FLOODING–Statewide, the event resulted in damages estimated at $55.8 million (damage estimate adjusted to dollar figures for the year of 2003).
7/23/1975 (DR-477)	HEAVY RAINS, HIGH WINDS, HAIL, AND TORNADOES–Statewide, the event resulted in damages estimated at $22 million (damage estimate adjusted to dollar figures for the year of 2003).
2/08/1977 (DR-528)	ICE CONDITIONS–Statewide, the event resulted in damages estimated at approximately $989,000 (damage estimate adjusted to dollar figures for year of 2003).
10/19/1980 (DR-3083)	WATER SHORTAGE (Emergency Declaration) −Statewide, the event resulted in damages estimated at $5 million (damage estimate adjusted to dollar figures for the year of 2003).
3/13/1993 (DR-3106)	SEVERE STORMS AND FLOODING (Emergency Declaration) – Event known as the *Storm of the Century* affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States. The *Storm of the Century* label was given to the event due to the record low pressure, wind speeds, temperature, and snowfall. All 21 counties in New Jersey were included in the Presidentially Declared Disaster, including Gloucester County.

Date and Disaster (DR) #	Nature of Event
1/7/1996 (DR-1088)	BLIZZARD−A State of Emergency was declared for the blizzard that hit the state. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. This blizzard also brought on coastal flooding with the high tides of Sunday evening and Monday morning, and there were reports of damage to dunes and beaches from the heavy wave activity. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Gloucester County snowfall totals ranged from 18″-27″. Similar to other heavy snow events, the heaviest snow totals were in the northwestern part of the county. Statewide, damages were estimated at $42.7 million (damage estimate adjusted to dollar figures for the year 2003).
9/16/1999 (DR-3148)	HURRICANE FLOYD (Emergency Declaration)–This downgraded fall hurricane put the entire eastern seaboard on flood watch, including every county in New Jersey. The storm lasted approximately 18 hours and resulted in rainfall totals between 7″ and 8.5″ in parts of Gloucester County. The highest rainfall total in Gloucester County was 8.5″ in Pittman Township. The combination of winds funneling into the Delaware Bay and the Delaware River and the record runoff from inland waterways produced minor to moderate tidal flooding at the times of high tide in the counties of Cumberland, Salem, Gloucester, Camden, and Burlington, forcing evacuations in low lying areas. Across the southern half of New Jersey, the heaviest rain and the most widespread flooding occurred in townships along the Delaware River. The worst flooding occurred along some of the larger waterways in the area (Cooper River in Camden County, Rancocas Creek in Burlington County) and along tidal sections of tributaries to the Delaware River. In Gloucester County, about 40 persons were evacuated in Gibbstown after the Gibbstown Levee partially gave way and sent water from the Delaware River and Repaupo Creek into Gibbstown.
11/01/2000 (DR-3156)	WEST NILE VIRUS (Emergency Declaration)–Statewide, the event resulted in damages estimated at approximately $2.9 million (damage estimate adjusted to dollar figures for the year 2003).
09/19/2001 (DR-3169)	FIRES AND EXPLOSIONS (Emergency Declaration)–Statewide, the attacks of September 11, 2001 resulted in damages estimated at approximately $100 million (damage estimate adjusted to dollar figures for the year of 2003).
2/16/2003 (DR-3181)	HEAVY SNOW (Emergency Declaration)–The most powerful storm to affect New Jersey since the Blizzard of 1996. The combination of the very cold temperatures and the approach of a strong storm system caused widespread snow to break out, starting before sunrise on Sunday, February 16. Snow continued during the day Sunday, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in Gloucester County ranged from 21″ to 30″. New Jersey requested and was granted a Snow Emergency Declaration for all 21 counties. The President's Day snowstorm tied or set records in all 21 New Jersey counties including Gloucester County. Statewide, the event resulted in damages estimated at approximately $30.2 million (damage estimate adjusted to dollar figures for the year of 2003).

Date and Disaster (DR) #	Nature of Event
7/12/2004	FLASH FLOOD−During the afternoon and early evening of the July 12, a series of thunderstorms with torrential downpours and heavy rain moved across Gloucester County. The heavy rainfall was caused by a warm front approaching from the southwest that stalled over the area as a low pressure system developed along the front. The heavy rain caused widespread poor drainage flooding and scattered stream and lake flooding. In Gloucester County, the hardest hit areas were townships west of the New Jersey Turnpike. Rainfall amounts were greatest in West Deptford Township where storm totals were 6.14″. The heavy rain caused the roof a commercial building in West Deptford to collapse. The building suffered severe water damage. Throughout the County there were about two dozen calls of flooded basements.[2]
4/19/2005 (DR-1588)	SEVERE STORMS AND FLOODING−For the second time within seven months a greater than 50-year storm affected the Delaware River Basin and its tributaries. In all, about 6,000 persons were evacuated along the Delaware and Passaic River Basins in New Jersey with about 3,200 homes damaged. In Gloucester County, most of the problems occurred along tributaries to the Delaware River as the combination of the heavy rain and the impeded runoff because of the higher than normal Delaware River caused flooding. In West Deptford Township, the Woodbury Creek flooded the Willow Trailer Park, forcing the evacuation of several residents. Tidal flooding problems persisted along other tributaries of the Delaware including Raccoon Creek. A Presidential Disaster Declaration was declared in six New Jersey Counties (for Individual Assistance only), including, Gloucester County.
9/19/2005 (DR-3257)	HURRICANE KATRINA EVACUATION
4/15/2007 (DR-1694)	SEVERE STORMS AND INLAND AND COASTAL FLOODING–A seven day nor'easter deluged New Jersey with over 9″ of rain, causing millions of dollars of damage and killing three residents. Statewide damage was estimated at $180 million dollars. In Gloucester County the highest precipitation totals were near the center of the county where about 6″ fell in Glassboro. In Monroe Township about 35 homes were evacuated along the North Shore Drive after the causeway bordered by Timer Lakes flooded. Flooding also closed roads along the Great Egg Harbor River. In addition, roads were closed in Deptford, Washington, and Westville. In West Deptford, about 6' of water accumulated in backyards and basements. The Raccoon River crested about 2' above flood stage at 14.9' near Swedesboro Township. Statewide damage was estimated at $180 million. Gloucester County. A Presidential Disaster Declaration was declared for 12 counties in New Jersey. In Gloucester County the declaration included Individual Assistance only. The event caused approximately $3 million in damages in Gloucester County.[3]

Weather-Related Deaths and Injuries

According to the National Climatic Data Center, Gloucester County has experienced 54 deaths and 327 injuries from natural hazards in the period from 1950 to 2007.[4]

[2] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html
[3] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html
[4] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

6.3 Overview of the Type and Location of Hazards That Can Affect Gloucester County

In the initial phase of the planning process, Gloucester County's HMWG considered 32 natural and technological hazards and the risks they create for the County and its material assets, operations, and staff. The hazards initially considered are shown in Table 6.3-1.

Table 6.3-1
Preliminary Hazard List: Gloucester County

Hazard	Type (1)	PDM Application	Gloucester EOP	Mitigation 20/20	NJ SHMPU (2)	JLWA RFP (3)	Include in GC HMP?
Aircraft Incidents	T		✓				N
Air Pollution	T						N
Civil Disturbance	I		✓	✓			N
Crime	I			✓			N
Dam Failure	**T**	✓	✓			✓	**Y**
Drought	**N**	✓	✓	✓	✓	✓	**Y**
Earthquake/Geological (4)	**N**			✓	✓		**Y**
Economic Crisis	T			✓			N
Enemy Attack/Terrorism	I		✓	✓			N
Erosion–Hurricane/Nor'easter/Coastal Storm	**N**	✓		✓	✓	✓	**Y**
Extreme Temperature–Cold	**N**				✓		**Y**
Extreme Temperature–Heat	**N**				✓		**Y**
Flood (5)	**N**	✓	✓	✓	✓		**Y**
Hail	**N**			✓	✓		**Y**
Hazardous Materials Release–Fixed Site	**T**		✓	✓			**Y**
Hazardous Materials Release–Transportation	**T**		✓	✓			**Y**
High Wind–Straight-Line Winds (6)	**N**	✓	✓	✓	✓	✓	**Y**
High Wind–Tornado	**N**	✓	✓	✓	✓		**Y**
Ice Storm	**N**	✓					**Y**
Landslide (non-seismic)	**N**			✓			**Y**
Levee Failure	**T**	✓				✓	**Y**
Losses, fishing	**N**	✓					**Y**
Losses, crops	**N**	✓					**Y**
Pandemic Disease/Infestation	B			✓			N
Radiological Incident	T		✓	✓			N
Railroad Incidents	T		✓				N
Severe Storm–Lightning	**N**			✓		✓	**Y**
Severe Storm–Winter Weather	**N**	✓	✓	✓	✓	✓	**Y**
Storm Surge–Hurricane/Nor'easter/Coastal Storm	**N**	✓		✓	✓	✓	**Y**
Utility Failure (gas, power, sewer, telecom, water)	T		✓	✓			N
Urban Fire	I		✓	✓			N
Wildfire	**N**	✓	✓	✓	✓	✓	**Y**

Table Notes:

1. Type Legend: B = Biological; I = Intentional Acts; N = Natural; T = Technological/Manmade.
2. NJ SHMPU =State of New Jersey Hazard Mitigation Plan Update (approved by FEMA in April 2008)

3. James Lee Witt Associates' (JLWA) response to the four-county Request for Proposals (RFP) for this Plan
4. Earthquake / Geological includes effects of surface faulting, ground shaking, earthquake induced landslides and liquefaction.
5. Includes tidal, flash, and riverine flooding.
6. High Wind–Straight-Line Winds includes winds due to hurricanes, tropical storms, nor'easters, coastal storms, and other severe storms, excluding tornados.

In the initial identification process, the Gloucester County HMWG catalogued potential hazards to identify those with the most chance to significantly affect the county. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used in the investigation. These included national, regional, and local sources such as emergency operations plans, the State Hazard Mitigation Plan Update (SHMPU), websites, published documents, databases, and maps, as well as discussion with the HMWG staff.

The Gloucester County HMWG reviewed the 32 hazards and determined that 21 posed the greatest threat to Gloucester County. The following hazards were selected for inclusion in the plan by the HMWG:

1. Dam Failure
2. Drought
3. Earthquake/Geological
4. Erosion–Hurricane/Nor'easter/Coastal Storm
5. Extreme Temperature–Cold
6. Extreme Temperature–Heat
7. Flood
8. Hail
9. Hazardous Materials Release–Fixed Site
10. Hazardous Materials Release–Transportation
11. High Wind–Straight-Line Winds
12. High Wind–Tornado
13. Ice Storm
14. Landslide (non-seismic)
15. Levee Failure
16. Losses, Crops
17. Losses, Fishing
18. Severe Storm–Lightning
19. Severe Storm–Winter Weather
20. Storm Surge−Hurricane/Nor'easter/Coastal Storm
21. Wildfire

The following section profiles the 21 hazards listed above, and includes a description of the hazard, location and extent of the hazard, severity of the hazard, impact on life and property, and past occurrences.

6.3.1 Dam Failure

Description of the Dam Failure Hazard

A dam is defined by the New Jersey Department of Environmental Protection (NJDEP) as any artificial dike, levee, or other barrier that is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of-dam.[5]

Dam failures can result from a variety of causes including lack of maintenance, seismic activity, improper design or construction, or the effects of large storms. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows and failure may occur.[6] See Appendix D for a more detailed description and definition of the dam failure hazard.

To prevent, or reduce the probability of a failure, existing dams are periodically inspected by professional engineers on a regular basis. Table 6.3.1-1 summarizes the dam inspection schedule for New Jersey, including Gloucester County.

Table 6.3.1-1
New Jersey Dam Inspection Schedule
(Source: NJDEP–Dam Safety and Flood Control)

Dam Class	Regular Inspection	Formal Inspection
Class I Large Dam	Annually	once every three years
Class I Dam	once every two years	once every six years
Class II Dam	once every two years	once every 10 years
Class III Dam	once every two years	only as required
Class IV Dam	once every two years	only as required

Location of the Dam Failure Hazard

According to the NJDEP there are a total of 62 dams in Gloucester County. The following table lists the dams, including the municipality name, hazard classification, the river or stream the dam is located along, the last inspection date and the name of the dam. The table is ordered by hazard classification which ranks the potential for infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard (H), significant (S), and low (L) and are defined at the bottom of the table.

In Gloucester County four dams are classified as high hazard by the NJDEP−Bureau of Dam Safety and Flood Control; Wadsworth Lake Dam, Franklinville Lake Dam, Sterling Lake Dam, and Lake Gilman Dam. The New Jersey Department of Environmental Protection database does not include the data points listed as *na* in the table.

[5] NJDEP. Retrieved from http://www.state.nj.us/dep/
[6] NJDEP. Retrieved from http://www.state.nj.us/dep/

Table 6.3.1-2
Inventory of Gloucester County Dams, Ordered By Hazard Classification
(Source: NJDEP–Bureau of Dam Safety and Flood Control)

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (ft)	Length (ft)	Last Date Inspected
Glassboro Borough	Wadsworth Lake Dam	H	Mantua Creek	19.5	350	2/1/2002
Franklin Township	Franklinville Lake Dam	H	Little Ease Run Branch	8	800	3/22/2007
Washington Township	Sterling Lake Dam	H	Duffield Run	14.5	150	10/21/1997
Elk Township	Lake Gilman Dam	H	Raccoon Creek	14	350	4/12/2007
Swedesboro Borough	Narraticon Lake Dam	S	Church Run	19.5	250	3/7/2001
Woolwich Township	Lake Basgalore Dam	S	Racoon Creek-TR	13	180	11/29/2006
Harrison Township	Mullica Hill Pond Dam	S	Raccoon Creek	19	250	5/12/2004
South Harrison Township	Harrisonville Dam	S	Oldmans Creek	15	425	1/30/2008
Pitman Borough	Alcyon Lake Dam	S	Chestnut Branch Mantua Creek	12	480	10/4/2000
Monroe Township	Cranes Lake Dam	S	Hospitality Branch	10	1050	12/14/2007
Monroe Township	Upper Victory Lake Dam	S	White Hall Branch	6	400	7/12/2007
Monroe Township	Sunset Lake Dam	S	White Hall Branch	8	820	7/12/2007
Monroe Township	Lower Victory Lakes #1 Dam	S	White Hall Branch	8	600	11/7/2007
Franklin Township	Village Dock Lake Dam	S	Scotland Run	7	1325	12/20/2007
Elk Township	Lake Hackney Dam	S	Raccoon Creek	11	200	7/7/2004
Franklin Township	Malaga Dam	S	Scotland Run	21.5	11625	6/5/2006
Franklin Township	Iona Lake Dam	S	Still Run	11	800	12/28/2006
Clayton Borough	Wilson Lake Dam	S	Scotland Run	6	650	4/18/2007
Washington Township	Bells Lake Dam	S	South Branch Timber Creek	22	500	1/14/2008
Washington Township	Grenloch Lake Dam	S	South Branch Timber Creek	21	250	3/15/2007
Washington Township	Bethel Lake Dam	S	Mantua Creek	16.4	175	4/12/2007
Washington Township	Kandle Lake Dam	S	Branch Mantua Creek	9	400	10/13/2004
Harrison Township	Kincaid Lake Dam	S	Big Clems Run	16	100	na
Elk Township	Lake Garrison Dam	S	Reed Branch of Still Run	6.8	500	3/11/2006
Woolwich Township	Porches Mill Dam	L	Oldmans Creek-TR	20	350	9/17/2004
East Greenwich Township	Hendrickson's Mill Dam	L	Little Timber Creek	10	230	na
Woolwich Township	Warrington Mill Dam	L	Repaupo Creek	20	800	12/13/2004
Harrison Township	Hess Pond Dam	L	Branch of Raccoon Creek	14	140	7/19/2005

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (ft)	Length (ft)	Last Date Inspected
East Greenwich Township	Peaslee Dam	L	Still Run Branch of Repau	14	385	na
Woolwich Township	Kirschling Dam	L	Oldman's Creek-TR	na	310	na
Logan Township	New Jersey No Name # 33 Dam	L	Raccoon Creek	na	13000	na
East Greenwich Township	Jessups Mill Road Dam #1	L	Edwards Run	15	na	2/28/2007
Woodbury City	Woodbury Creek Dam	L	Woodbury Creek	6	300	3/20/1998
Monroe Township	Timber Lakes Dam	L	Hospitality Branch	8	700	10/31/2003
National Park Borough	New Jersey No Name # 3 dam	L	Woodbury Creek-OFFSTREAM	25	11500	na
Monroe Township	Crystal Springs Dam	L	Four Mile Run-TR	6	250	na
Franklin Township	Idle Acres Dam	L	Reed Branch Run	7	850	na
Monroe Township	Caines Mill Pond Dam	L	Hospitality Branch	10	200	na
Franklin Township	Cedar Lake Dam	L	Hospitality Branch-TR	8.5	860	1/9/2007
Deptford Township	Westville-Almonesson Dam	L	Almonesson Creek-TR	na	na	na
Washington Township	Spring Lake Dam	L	Mantua Creek-TR	6	na	na
Washington Township	Jones Lake Dam	L	South Branch Big Timber Creek	9	200	10/26/2000
Woodbury City	Bell Lake Dam	L	Matthews Branch of Woodbury Creek		na	2/24/2003
Washington Township	Ward Dam	L	Mantua Creek-TR	8	na	8/25/1993
Washington Township	Saddlebrook Dam	L	S. Branch Big Timber Creek	10	165	10/24/2001
Pitman Borough	Glen Lake Dam	L	Chestnut Branch-TR	6	150	3/8/2001
Clayton Borough	Silver Lake Dam	L	Still Run	6	540	5/18/2007
Harrison Township	Heritage Hunt Dam	L	Miery Run	10	100	12/15/1999
Mullica Township	Ewans Mill Dam	L	Mullica River	15	350	na
Glassboro Borough	Camelot Dam #1	L	Raccoon Creek	7	175	2/1/2003
Glassboro Borough	Camelot Dam #2	L	Raccoon Creek	8	285	2/1/2003
Washington Township	Wedgewood Country Club Dam	L	South Branch of Timber Creek-TR	11	na	na
Wenonah Borough	Wenonah Lake Dam	L	Mantua Creek-TR	21	200	2/26/2001
Washington Township	County Farm Dam	L	South Branch of Timber Creek	4	125	5/22/2006
Deptford Township	Almonesson Lake Dam	L	Almonesson Creek	24	300	10/4/2001
Deptford Township	Bankbridge Dam	L	Monogehela Brook-TR	21	300	10/27/2007
Washington Township	Lakeland Dam	L	Timber Creek S. Branch	13.9	240	5/22/2006
Woodbury Heights Borough	Glen Lake Dam	L	Woodbury Creek	25	200	3/29/2006
Glassboro Borough	Hidden Acres Dam	L	Chestnut Branch Mantua Creek	16	60	na

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (ft)	Length (ft)	Last Date Inspected
Glassboro Borough	Lake Oberst Dam	L	Mantua Creek	9	180	na
Monroe Township	Diamond Lake Dam	L	Hospitality Branch	10.5	600	1/11/1979
Monroe Township	Spruce Lake Dam	L	Hospitality Branch	9	850	6/25/2007

Hazard Classes (Source: New Jersey Administrative Code - Dam Safety Standards (NJAC: 7-20): Dam Classifications)

H = High Hazard: Loss of life likely (if failure were to occur)
S = Significant Hazard: Loss of life not likely but the potential for significant property damage
L = Low Hazard: Loss of life not likely and minimal infrastructure or property damage other than the structure itself

The following map identifies the location for 53 of the 62 dams in Gloucester County. The inventory of dams was provided by the NJDEP−Bureau of Dam Safety and Flood Control. The latitude and longitude coordinates were missing for nine of the dams and therefore not identified on the map.

Figure 6.3.1-1
Gloucester County Dams
(Source: NJDEP–Bureau of Dam Safety and Flood Control)

Note: Nine dams without latitude and longitude coordinates were excluded from the map: Peaslee Dam, Westville Almonesson Dam, Spring Lake Dam, Bell Lake Dam, Ward Dam, Heritage Hunt Dam, Wedgewood Country Club Dam, County Farm Dam, and Lake Oberst Dam.

Severity of Dam Failure Hazard

In 1921, the New Jersey Legislature created the Bureau of Dam Safety and Flood Control, which instituted laws relating to the construction, repair, and inspection of existing and proposed dam structures. The law was amended in 1981, and became known as the Safe Dam Act. New Jersey's Dam Safety program is administered by NJDEP's Division of Engineering and Construction, Dam Safety Section.[7]

The severity of a dam failure event can depend on various aspects related to the size of the dam, the extent of the failure, the velocity of the floodwaters released, and the intensity of the downstream development.

Impact on Life and Property

According to the National Inventory of Dams, as of 2005 there were 79,500 dams in the United States. Approximately one third of these pose a *high* or *significant* hazard to life and property if failure occurs. Dam failure has the potential for catastrophic impact on life and property. This risk can be reduced by proper design, construction and routine maintenance and inspection.

Occurrences of the Dam Failure Hazard

The NJDEP indicates there have been no previous catastrophic dam failures in New Jersey, but the number of small failures has risen over the past few years. This has been primarily due to a combination of lack of inspection and the number of dams nearing the end of their design life.[8]

The NJDEP–Bureau of Dam Safety and Flood Control lists dam failures in New Jersey from several major flooding events including Hurricane Floyd in 1999 and the Sparta storm in 2000. For these two events no dam failures were listed for Gloucester County.[9] No failures were identified from other events. Based on one previous dam failure event in Gloucester County, the likelihood of a major failure occurring in the future is presumably low.

[7] NJDEP. Retrieved from http://www.state.nj.us/dep/
[8] NJDEP. Retrieved from http://www.state.nj.us/dep/
[9] NJDEP–Dam Safety and Flood Control. Retrieved from http://www.state.nj.us/dep/damsafety/

6.3.2 Drought

Description of the Drought Hazard

A drought is an extended dry climate condition when there is not enough water to support urban, agricultural, human, or environmental water needs. It usually refers to a period of below-normal rainfall, but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions. See Appendix D for a more detailed description and definition of the drought hazard.

Location of the Drought Hazard

Droughts may occur anywhere in the United States. Effects seen in different regions vary depending on normal meteorological conditions such as precipitation and temperature, as well as geological conditions such as soil type and subsurface water levels.

Drought is possible throughout the planning area, but the data has revealed no significant drought history since 1950.

Severity of the Drought Hazard

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Impact on Life and Property

There are no known deaths or injuries from droughts in the planning area. The NCDC database indicates no property damage from drought, but does identify $80 million in crop damages from a single event in the summer of 1999 (See Section 6.3.16 for a description of crop losses in Gloucester County).

Occurrences of the Drought Hazard

According to the NCDC database, Gloucester County has experienced 36 drought events in the period from 1950 to 2006. All 36 events are between 1995 and 2005. The database provides no indication as to why there are no events prior to 1995, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list. The events are listed by month. For example, if a drought lasts several continuous months, it is listed in the database as separate events. If the continuous months are combined into single events, the number of events is reduced from 36 to seven events.

Based on previous occurrences, it is reasonable to assume that droughts will continue in Gloucester County, but with no injuries, deaths, or property damage the impact will continue to be reasonably low.

6.3.3 Earthquake/Geological

(Includes surface faulting, ground shaking, earthquake induced landslide, and liquefaction)

Description of the Earthquake Hazard

An earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Tectonic plates become stuck, putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground, which may lead to loss of life and destruction of property. Size of an earthquake is expressed quantitatively as magnitude and local strength of shaking as intensity. The inherent size of an earthquake is commonly expressed using a magnitude. See Appendix D for a more detailed description of the earthquake hazard.

Location of the Earthquake Hazard

The entire planning area is susceptible to the effects of earthquakes. Figure 6.3.3-1 displays the northeast portion of a United States Geological Survey (USGS) earthquake hazard map produced in October of 2002. The map shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years is highest in northeastern NJ (6%g) and decreasing to the south (2%g). The *FEMA How-To guidance, Understanding Your Risks*, FEMA 386-2, p. 1-7, suggests the earthquake hazard should be profiled if the pga is greater than 3%g. The map shows Gloucester County is located in the 3%g range, a reasonably low risk area.

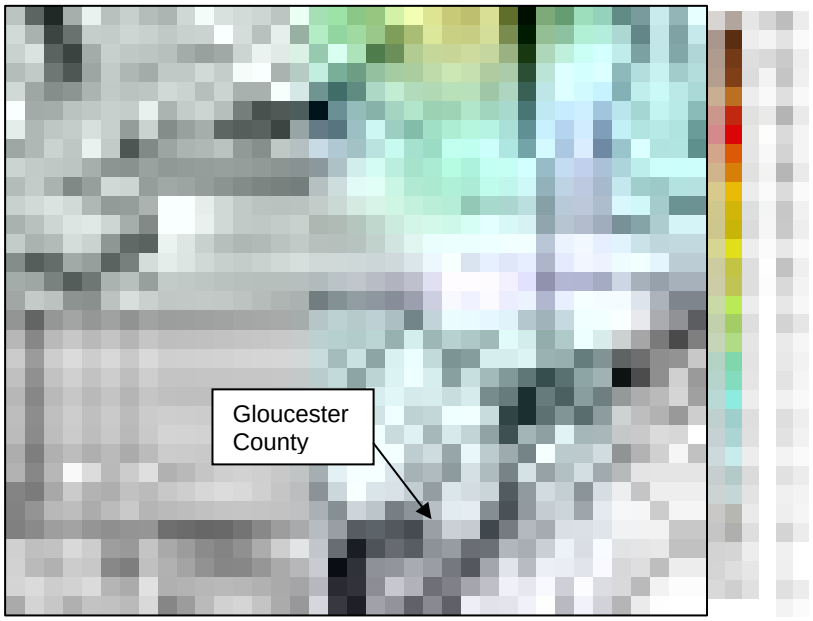


Figure 6.3.3-1

New Jersey Seismic Hazard Map, Showing Peak Ground Acceleration In Percent of *g*, With 10% Exceeded In 50 Years.
(Source: United States Geologic Survey, October 2002)

Severity of the Earthquake Hazard

Relatively low on magnitude and intensity scales for past events, Gloucester County has experienced few and minor earthquakes, on average, over the past 75-plus years.[10] As shown in Figure 6.3.3-1, the probability of any severe earthquake in the area is considered low. As discussed in Appendix D, the severity of earthquakes is influenced by several factors, including the depth of the quake, the geology in the area, and the soils. The severity of soil liquefaction is dependent on the soils grain size, thickness, compaction, and degree of saturation.[11]

Impact on Life and Property

There are no known deaths or injuries from earthquakes in Gloucester County. Some of the past earthquake events were severe enough to cause minor property damage such as broken windows or contents falling from shelves. The effects on life and property in the area could be significant if a large earthquake were to occur, because of the nature of the built environment. However, the very low probability of an event suggests that potential for these impacts is minimal.

Occurrences of the Earthquake Hazard

To identify past earthquake occurrences that have potentially impacted Gloucester County, the map titled *Earthquake Epicenters 1737-1986* displaying historical earthquakes was reviewed. Figure 6.3.3-2 displays historical earthquake epicenters spatially across the Northeast from 1737 to 1986. Although the map highlights historical earthquakes in New York State, the map also shows earthquake occurrences for surrounding States, including northern New Jersey. The map indicates there have been six historical earthquakes of 5.0 magnitude, or greater, within the New Jersey region during the period of record. This map was prepared by the Geographical Information System (GIS) division of the New York State Emergency Management Office (SEMO) using NYS Geological Survey/National Institute of Building Sciences data.

[10] USGS and NJGS. Retrieved from http://www.usgs.gov/ and http://www.state.nj.us/dep/njgs/
[11] NJGS. Retrieved from http://www.state.nj.us/dep/njgs/

Figure 6.3.3-2
Earthquake Epicenters for the Northeast U.S., 1737-1986
(Sources: NYS Geological Survey, National Institute of Building Sciences)

In addition to the *Earthquake Epicenters* map prepared by the New York SEMO, the USGS also offers earthquake history for each State. The USGS earthquake history for New Jersey indicates there have been nine earthquakes statewide since 1927. Of the nine events in New Jersey, the earthquake descriptions provided by the USGS indicate that three have affected Gloucester County. Table 6.3.3-1 below summarizes the past earthquake events that have impacted the planning area.

Table 6.3.3-1
Gloucester County Earthquake History
(Source: USGS)

Event Date	Epicenter	Description
August 22, 1938	Central New Jersey	Central New Jersey was disturbed on August 22, 1938, by a shock somewhat stronger than the 1933 event. The earthquake caused minor damage at Gloucester City and Hightstown (intensity V). The total felt area was about 13,000 square kilometers, including bordering portions of Delaware and Pennsylvania. Glassware was broken at Gloucester City and Hightstown and some furniture was displaced at Pitman Borough. A few windows and some glassware were reported broken at Ardmore, Pennsylvania. Four smaller shocks occurred on August 23rd and one on August 27.
March 23, 1957	High Bridge, New Jersey	On March 23, 1957, a shock affected west-central New Jersey, near the site of the 1895 earthquake. Chimneys cracked (intensity VI), windows and dishes broke, and pictures fell at Lebanon. A cracked chimney was also reported from Hamden. At Long Valley some walls were cracked and plaster fell. The felt area was small in comparison with the other shocks previously described.
February 28, 1973	Salem County, New Jersey	Most of New Jersey and adjoining portions of Delaware, Maryland, and Pennsylvania experienced a moderately strong earthquake on February 28, 1973. The magnitude 3.8 tremor was centered in northwestern Salem County, near the Delaware River border with the State of Delaware.

The probability of earthquakes occurring in the future is considered relatively low, based on previous data. On average, an earthquake has impacted Gloucester County every 23 years. Section 7 of this plan includes a much more detailed discussion of the earthquake risk in Gloucester County, including probability-based risk estimates that were performed using the FEMA Full-Data Earthquake Benefit-Cost Analysis Module.

6.3.4 Erosion

(Including Hurricane/Nor'easter/Coastal Storm)

Description of the Erosion Hazard

Coastal erosion is a dynamic process that is constantly occurring at varying rates along the coasts and shorelines of the United States. Numerous factors can influence the severity and rate of coastal erosion including human activities, tides, the possibility of rising sea levels, and the frequency and intensity of hurricanes. Strong storms and hurricanes can erode large sections of coastline with a single event. The process of coastal erosion results in permanent changes to the shape and structure of the coastline. Human activities such as poor land use practices and boating activities can also accelerate the process of coastal erosion. See Appendix D for a more detailed description and definition of the erosion hazard.

Location of the Erosion Hazard

The State of New Jersey has over 130 miles of coastline, most of which is within close proximity to major metropolitan centers of the mid-Atlantic. Gloucester County is located in the southwestern part of New Jersey, bordered by Camden County to the north, Atlantic County to the east, Salem County to the south and the State of Pennsylvania to the west. The center part of the county is located approximately 55 miles from the Atlantic coastline and not impacted by the coastal erosion effects of hurricanes, nor'easters, and coastal storms. However, it is susceptible to minor erosion along the Delaware River which runs along the western edge of the county.

Severity of the Erosion Hazard

Episodic storm erosion generates the most significant erosion along the New Jersey coast. Typically these storms can impact the coast over periods of hours (tropical cyclones) to several days (nor'easters). Although the storm events are short-lived, the resulting erosion can be equivalent to decades of long-term coastal change. As mentioned above, Gloucester County is landlocked by three surrounding counties and Pennsylvania to the west. The planning area is not affected by the coastal erosion hazard, but is subject to minor shoreline erosion along the Delaware River due to strong storm events.

A greater threat related to shoreline erosion is posed by development in the floodplain. Development within the floodplain along the Delaware River is accompanied by diminished vegetation, which leaves waterways more susceptible to stream bank erosion, particularly during floods. Severe erosion can convert a narrow, deep, clear, and cold channel that is resistant to flooding, into a wide, shallow, turbid and warm one that is increasingly flood prone.[12]

Impact on Life and Property

Erosion from coastal storms has the potential to cause significant property damage particularly to more densely populated beach communities that are directly exposed to the Atlantic coast. Potentially billions of dollars of coastal development may be damaged or destroyed by the effects of erosion. There is no coastline in Gloucester County, but erosion from these large storm events could potentially threaten property located along the Delaware River.

[12] Delaware River Basin–Flood Mitigation Task Force: January 2007.

Occurrences of the Erosion Hazard

Gloucester County has experienced no major erosion events along the Delaware River. However, the one storm surge event and 13 coastal flooding events identified in Section 6.3.20 most likely included minor erosion along parts of the Delaware River shoreline. Based on past history, future storm events such as nor'easters, hurricanes, and coastal storms will most likely result in minor erosion along the Delaware River. The impact to life and property in the planning area will most likely be minimal.

6.3.5 Extreme Temperature−Cold

Description of the Extreme Temperature (Cold) Hazard

Temperatures that are significantly below normal are considered extreme cold temperatures. What constitutes extreme cold and its effect varies across different areas of the United States. In areas unaccustomed to winter weather, near freezing temperatures are considered *extreme cold.* Freezing temperatures can cause severe damage to citrus fruit crops and other vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. In the northeast, below zero temperatures may be considered as *extreme cold*.[13] The consequences of extreme cold on humans are intensified by high winds which increase the rate of heat loss and has the effect of making it feel colder than the actual air temperature. Extreme cold temperatures combined with high winds can lead to frostbite, permanent damage to the body, or even death. See Appendix D for a more detailed description and definition of the erosion hazard.

Location of the Extreme Temperature (Cold) Hazard

The entire planning area is subject to the hazards associated with extreme cold temperatures.

Severity of Extreme Temperature (Cold)

The severity of extreme cold temperature events are measured by temperature, duration, and humidity. Most events are of less than a week in duration but can occasionally last for longer periods up to several weeks.

Impact on Life and Property

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been one death and seven injuries from one extreme cold event that occurred from January 13-29, 2003. During this event low temperatures were reported near or below zero. In Gloucester County, the lowest recorded temperature during the event was 9˚F in West Deptford Township. Damages from extreme cold temperatures are generally confined to effects on humans (described above), although occasionally there may be relatively minor effects on infrastructure such freezing pipes or electric grids.

Table 6.3.5-1 lists the extreme temperature events from the NCDC that have resulted in injuries or death in Gloucester County. Periodically throughout Section 6.3, the output from the NCDC database queries has been included to summarize past events for specific hazards.

[13] NOAA–Winter Storms. The Deceptive Killers.

Table 6.3.5-1
Reported Deaths and Injuries From Temperature Extremes, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query.

Several of the column headings (the five farthest to the right) within the NCDC table above have been abbreviated and are defined as follows:

- Mag = Magnitude of the event for applicable hazards (Hailstorms, Tornadoes, etc.)
- Dth = Number of deaths
- Inj = Number of Injuries
- PrD = The dollar amount of reported property damage
- CrD = The dollar amount of reported crop damage

Occurrences of Extreme Temperature (Cold)

The NCDC database indicates there have been seven recorded extreme cold temperature events in Gloucester County during the period 1950-2007. As shown in Table 6.3.5-1 above, one of these events was severe enough to result in seven injuries and one death. The database includes other *unseasonably* cold events, but these were excluded from the total, only counting the extreme cold events. On average, an extreme cold temperature event occurs approximately once every eight years. Based on the historical data from the NCDC database, the probability of future extreme cold temperature events is relatively low.

6.3.6 Extreme Temperature−Heat

Description of the Extreme Temperature (Heat) Hazard

Temperatures that are significantly above normal are considered extreme temperatures. There is no specific point when air temperatures are defined as significantly above normal. However, the National Weather Service (NWS) will initiate alert procedures such as special weather statements when the heat index is expected to exceed 105ºF-110ºF (depending on local climate), for at least two consecutive days.[14] Heat stress can be indexed by combining the effects of temperature and humidity. See Appendix D for a more detailed description and definition of the extreme heat hazard.

Location of the Extreme Temperature (Heat) Hazard

The entire planning area is subject to the hazards associated with extreme temperatures from high heat.

Severity of Extreme Temperature (Heat)

The severity of extreme temperature events are measured by temperature, duration and humidity. Most events are less than a week in duration. In the northeastern United States periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years or so where maximum daily temperatures exceed 100˚F for an extended period of time. The passing of a cold front usually moderates temperatures after a few days to a week.

Impact on Life and Property

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been 17 deaths and 246 injuries in Gloucester County from excessive heat-related events. All 17 reported deaths were from one event that occurred from July 4-6, 1999. From the description provided in the NCDC database, the 17 deaths appear to cover all parts of New Jersey impacted by the event. During the July 4-6 heat wave, the NCDC database indicates no deaths occurred in Gloucester County. The combination of the temperature and humidity during this event produced heat indices of around 110˚F during the afternoon of each day. Damages from the extreme high temperature hazard are generally confined to effects on humans, although occasionally there may be relatively minor effects on infrastructure such as electric grids.

[14] NOAA-Heat Wave Description.

Table 6.3.6-1
Reported Deaths And Injuries From Temperature Extremes, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of Extreme Temperature (Heat)

The NCDC database indicates there have been 13 recorded extreme temperature events related to high heat in Gloucester County during the period 1950-2007. The database includes other *unseasonably* warm events, but these were excluded from this total. Events that were listed for consecutive months were combined into single events. On average, an extreme heat event occurs approximately once every four years. Based on the historical data from the NCDC database, the probability of future extreme heat events is likely to occur but with relatively minor impacts on life and property.

As mentioned above, one of the worst extreme heat-related events occurred in July 1999. A very strong and oppressive high pressure system that extended from the surface to aloft gave New Jersey a brutal heat wave that included the entire Independence Day weekend. High temperatures reached the 90s for the first time on the July 3, but sweltering humidity and record breaking maximum temperatures of around 100˚F occurred from Independence Day through July 6.[15]

[15] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

6.3.7 Flood

(Includes Tidal, Flash, and Riverine Flooding)

Description of the Flood Hazard

Flooding is defined as a condition of partial or complete inundation of normally dry land, typically in a floodplain, due to a variety of conditions. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding.

Hundreds of floods occur each year in the United States, including overbank flooding of rivers and streams and shoreline inundation along lakes and coasts. Flooding typically results from large-scale weather systems generating prolonged rainfall. Flooding in Gloucester County can be the result of the following weather events: hurricanes, thunderstorms (convectional and frontal), flash flood, storm surge, or winter storms. See Appendix D for a more detailed descriptions and definitions of the flood hazard.

Location of the Flood Hazard

Gloucester County is bordered on the northwest by the Delaware River which divides the States of New Jersey and Pennsylvania. Two tributaries of the Delaware River form the northern and southern borders with neighboring counties. The Oldmans Creek divides a portion of Gloucester County with Salem County to the south and Big Timber Creek creates the border with Camden County to the north. Within Gloucester County, the two major tributaries of the Delaware River are the Mantua Creek and the Raccoon Creek. All four creeks generally meander in a northwesterly direction before emptying into the Delaware River.

Although there are other isolated places in the county and each of the municipalities that are subject to flooding via overland flow or ponding, most flood issues are related to the Delaware River and Mantua Creek. To a lesser degree flooding has occurred along the other two tributaries of the Delaware River, the Oldmans Creek and Big Timber Creek. As described below, there have been several fairly severe floods in recent years, and county and New Jersey state agencies have implemented public works and mitigation projects to reduce the future effects of flooding. This section highlights several of the significant flood areas throughout Gloucester County. The specific causes and effects of flooding from the Delaware River and Mantua Creek are discussed in more detail in Section 7 (Risk Assessment).

Figure 6.3.7-1 is a map displaying the different flood zones found throughout Gloucester County and each of the municipalities. The flood zones identified on the map include the A, AE (1 % annual chance of flooding), X500 (0.2% chance of flooding) and X zones (see flood zone descriptions following the map). FEMA originally provided the flood data which was used by the county's consultant to develop a Digital Flood Insurance Rate Map (DFIRM). The majority of the 100-year floodplain areas roughly follow the Delaware River and its tributaries in the northwestern part of Gloucester County.

Figure 6.3.7-1
Floodplain Map of Gloucester County
(Sources: FEMA and NJDEP)

The flood zone designations are defined as follows:

- Zone A (1% annual chance flooding). Shaded light blue. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
- Zone AE (1% annual chance flooding). Shaded dark blue. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- X500 (0.2% annual chance of flooding). Shaded green. Represents areas between the limits the 1% annual chance flooding and 0.2% chance flooding.
- Zone X. Un-shaded white area. Areas outside the 1% annual chance floodplain and 0.2% chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1', areas of 1% annual chance stream flooding where the contributing drainage area is less than one square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone.[16]

Delaware River Flooding

The Delaware River basin extends into five states including New York, Pennsylvania, Delaware, and Maryland. In Gloucester County the Delaware River basin covers the majority of Gloucester County. In Figure 6.3.7-2 the area shaded in white displays a portion of the Delaware River basin.

Figure 6.3.7-2
Portion of The Delaware River Basin
(Source: Delaware River Basin Commission)

[16] FEMA. Retrieved from http://www.fema.gov/

Not surprisingly, the Delaware River has been a major cause of flood problems in Gloucester County. As is typical for such a large river, there are many influences on water levels, including rainfall amount and rate, development in the watershed, the speed of snow and ice melt, and upstream releases from reservoirs and impoundments, among others. In the past, various combinations of these factors have occasionally caused increased volume in the Delaware River and flooding in adjacent areas. Along the Delaware River in Gloucester County major flood events have occurred in 1999, 2004, 2005, and 2007.

In Gloucester County, the municipalities adjacent to the Delaware River are most susceptible to flooding. These municipalities include; Logan, Greenwich, and West Deptford Townships and the Boroughs of Paulsboro and National Park. Major flooding can occur at any time of year within these municipalities. The flood threat is perhaps greatest in late summer and early fall when above average high tides are generated in the Upper Delaware Bay and Delaware River by hurricanes and tropical storms moving up the Atlantic coastline.

Mantua Creek Flooding

Mantua Creek, a tributary to the Delaware River, forms the municipality border between East Greenwich and West Deptford Townships. As the creek flows toward the Delaware River it divides the municipalities of Paulsboro and West Deptford. From its headwaters near Glassboro, Mantua Creek flows northwest for 18.6 miles to the Delaware River at the Borough of Paulsboro. Mantua Creek includes two major tributaries, Edwards Run and Chestnut Branch. In its upper reaches, the creek flows through gently rolling, wooded terrain marked by a number of small lakes. Further downstream the creek flows through a relatively broad, flat valley which is part of the creek's floodplain. It finally flows through low, tidal marshland from the New Jersey Turnpike to the Delaware River.[17]

Development along the Mantua Creek has been mostly concentrated near Pitman Borough and downstream where Mantua Creek passes through developed areas of Deptford, West Deptford, and Mantua Townships. This development resulted in flooding as early as 1940 when a September storm caused severe damage to the homes in Mantua Terrace in West Deptford Township. Further downstream, residential, commercial, and industrial development within the 100-year floodplain increases in Paulsboro. This area is adjacent to low, tidal marshland that is susceptible to flooding from high water flowing down Mantua Creek.[18] In Paulsboro the majority of drainage leads to Mantua Creek.

A large portion of the land in Paulsboro Township has the potential to be flooded from Mantua Creek. Below the Conrail Bridge most of the flooding is confined to the undeveloped areas east of Mantua Avenue and around some of the oil storage facilities located in this area of town.[19]

[17] Gloucester County Stormwater Management.
[18] Gloucester County Stormwater Management.
[19] Borough of Paulsboro Flood Insurance Study: September 2, 1982.

Figure 6.3.7-3
Northwest Portion Of Gloucester County, Floodplain Map
Mantua Creek And Other Tributaries Of The Delaware River
(Sources: FEMA and NJDEP)

In the past, extremely heavy rain events that result in runoff from streams have caused significant flooding along parts of the Mantua River particularly in the areas of Paulsboro, Deptford, and West Deptford. Similar to past occurrences along the Delaware River, floods have occurred along the Mantua River in 1999, 2004, 2005, and 2007.

Severity of the Flood Hazard

Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Gloucester County. Most recently, the county has been impacted by six significant flood events: in 1999, 2004, 2005, and 2007. Flood severity is measured in several ways, including frequency, depth, velocity, duration, and contamination, among others. In Gloucester County, characterizing the severity of the flood hazard depends on what part of the county is being considered, but generally speaking the issues relate to how often floods occur.

Impact on Life and Property

Figures maintained by NCDC indicate that Gloucester County has experienced no injuries or deaths due to flood events.[20] Section 7 of this plan includes a much more detailed discussion of flood impacts on the county, in particular the history of National Flood Insurance Program (NFIP) claims, and the number of FEMA *repetitive loss* properties.

Occurrences of the Flood Hazard

The National Climatic Data Center (NCDC) database indicates that there have been 44 flood events in Gloucester County in the period from 1950 to 2007, with damages slightly under $9 million. Of these 44 events, four flood events between 1994 and 2007 have resulted in property damage. Flooding events causing property damage have occurred in 1994, 1999, 2005, and 2007. These events are listed in Table 6.3.7-1 below. Note: additional flood events listed in the NCDC database may have resulted in property and infrastructure damages. Estimated property damages for these floods may not have been listed in the database because either the data was unavailable, or the damages were only minor and therefore not reported to the NCDC.

[20] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

Table 6.3.7-1
Flood Events Resulting In Property Damage, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

The four floods listed above, and one additional event in 2005, are summarized below. Federally Declared events are indicated by the disaster number (DR).

- 7/14/1994–Flash Flood. Thunderstorms on the evening of July 14, with torrential downpours remained nearly stationary over the eastern Philadelphia Suburbs for about two hours. Rainfall amounts were around 3" in northeast Gloucester County. In Deptford Township, New Jersey State Road 32 was closed due to flooding. The even caused an estimated $500,000 in damages in Gloucester County[21].
- 9/16/1999–Hurricane Floyd. This downgraded fall hurricane put the entire eastern seaboard on flood watch, including every county in New Jersey. The storm lasted approximately 18 hours and resulted in rainfall totals between 7" and 8.5" in parts of Gloucester County. The highest rainfall total in Gloucester County was 8.5" in Pitman Borough. The combination of winds funneling into the Delaware Bay and the Delaware River and the record runoff from inland waterways produced minor to moderate tidal flooding at the times of high tide in the Counties of Cumberland, Salem, Gloucester, Camden, and Burlington, forcing evacuations in low lying areas. Across the southern half of New Jersey, the heaviest rain and the most widespread flooding occurred in townships along the Delaware River. The worst flooding occurred along some of the larger waterways in the area (Cooper River in Camden County, Rancocas Creek in Burlington County) and along tidal sections of tributaries to the Delaware River. In Gloucester County, about 40 persons were evacuated in Gibbstown after the Gibbstown Levee partially gave way and sent water from the Delaware River and Repaupo Creek into Gibbstown.[22]
- 7/12/2004–Flash Flood. During the afternoon and early evening of the July 12, a series of thunderstorms with torrential downpours and heavy rain moved across Gloucester County. The heavy rainfall was caused by a warm front approaching from the southwest that stalled over the area as a low pressure system developed along the front. The heavy rain caused widespread poor drainage flooding and scattered stream and lake flooding. In Gloucester County, the hardest hit areas were townships west of the New Jersey Turnpike.

[21] NOAA/NCDC database: Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html
[22] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

Rainfall amounts were greatest in West Deptford Township where storm totals were 6.14". The heavy rain caused the roof a commercial building in West Deptford to collapse. The building suffered severe water damage. Throughout the county there were about two dozen calls of flooded basements.[23]

- 4/2/2005 (DR-1588)–Severe Storms and Flooding. For the second time within seven months a greater than 50-year storm affected the Delaware River Basin and its tributaries. In all, about 6,000 persons were evacuated along the Delaware and Passaic River Basins in New Jersey with about 3,200 homes damaged. In Gloucester County, most of the problems occurred along tributaries to the Delaware River as the combination of the heavy rain and the impeded runoff because of the higher than normal Delaware River caused flooding. In West Deptford Township, the Woodbury Creek flooded the Willow Trailer Park, forcing the evacuation of several residents. Tidal flooding problems persisted along other tributaries of the Delaware including Raccoon Creek. A Presidential Disaster Declaration was declared in six New Jersey counties, including, Gloucester County.[24] The Declaration included Individual Assistance only for Gloucester County.
- 4/15/2007 (FEMA DR-1694)–Severe Storms and Inland and Coastal Flooding. A seven-day nor'easter deluged New Jersey with over nine inches of rain, causing millions of dollars of damage and killing three residents. In Gloucester County the highest precipitation totals were near the center of the county where about 6" fell in Glassboro Township. In Monroe Township, about 35 homes were evacuated along the North Shore Drive after the causeway bordered by Timer Lakes flooded. Flooding also closed roads along the Great Egg Harbor River. In addition, roads were closed in Deptford, Washington, and Westville. In West Deptford, about 6' of water accumulated in backyards and basements. The Raccoon River crested about 2' above flood stage at 14.9' near Swedesboro Township. Statewide damage was estimated at $180 million. A Presidential Disaster Declaration was declared for 12 counties in New Jersey, including Gloucester County. In Gloucester County the Declaration included Individual Assistance only. In total, the event caused approximately $3 million in damages in Gloucester County.[25]

NFIP information provides an indication of the potential for flooding in Gloucester County, and the amount of damage it has caused in the past. Review of prior NFIP flood claims can also help reveal areas of the county that are vulnerable to damages from flooding. In recent years, FEMA has focused considerable attention to insured, repetitive loss properties. By NFIP standards, these properties had to have received two or more claim payments of at least $1,000 each over a 10-year period. In Gloucester County, 17 residential and commercial properties have been identified as repetitive loss properties. Collectively, claim holders have received payments of just over $400,000 (includes claim payments for building damage and contents damage).

Based on past and recent history, certain parts of Gloucester County clearly have a high probability of flooding repeatedly in the future. Several areas adjacent to the Delaware River (including parts of the Delaware River Basin) and portions of the Mantua River area of the county have flooded several times in the past few years alone. Severe flooding in Gloucester County four out of the last eight years and the two out of the last three suggests that the repeated flooding in certain areas may continue.

[23] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html
[24] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html
[25] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

6.3.8 Hail

Description of the Hail Hazard

Hail is a form of precipitation comprised of spherical lumps of ice. Known as hailstones, these ice balls typically range from 5 mm–50 mm in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of hailstones is a direct function of the severity and size of the storm. See Appendix D for a more detailed description and definition of the hail hazard.

Location of the Hail Hazard

Hailstorms occur more frequently during the late spring and early summer, when the jet stream migrates northward across the Great Plains. This period has extreme temperature changes from the ground surface upward into the jet stream, which produces the strong updraft winds needed for hail formation. The land area affected by individual hail events is not much smaller than that of a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

The potential for hail exists over the entire planning area, although the probability is relatively low compared to other parts of the United States. There are at least a few incidences of hail almost every year in the planning area, although for the most part they are minor.

Severity of the Hail Hazard

The severity of hailstorms is measured by duration, size of the hail itself, and geographic extent. All of these factors are directly related to the weather phenomena that create the hail, thunderstorms. There is wide potential variation in these severity components. The planning area has a relatively low potential for significant hail events, based on previous records.

Impact on Life and Property

There are no known instances of injuries or death from hail events in Gloucester County. The NCDC database indicates there has been no reported property damage in Gloucester County from hail events. Presumably there are some damages, but most of these are likely addressed by citizens or insurance companies, and therefore there is no readily accessible record of damages. Damages that do occur are presumably orders of magnitude less than other hazards such as floods or hurricane winds.

Occurrences of the Hail Hazard

The NCDC reported 25 hail events in Gloucester County from the period 1950 through 2007. Hailstone sizes from the 25 events ranged in diameter from 0.75" to 2.0". Beginning with the 1994 event, the NCDC database identifies the municipality within the county where the event occurred. Table 6.3.8-1 summarizes all Gloucester County hail events.

Table 6.3.8-1
Hail Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: See bullets following Table 6.3.5-1 for column heading definitions.

Based on historical records from the NCDC database, the future probability of hail events in Gloucester County is reasonably high. On average, a hail event occurs every two years based on past records. However, property damage and impact to life in Gloucester County is considered minimal compared to the potential damage from other hazards.

6.3.9 Hazardous Materials Release–Fixed Site

Description of the Hazardous Material Release–Fixed Site Hazard

Hazardous materials come in the form of explosives, flammable and combustible substances, toxic releases and waste materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section deals those hazardous materials that occur at facilities which are known as fixed site. The next section, 6.3.10 deals with hazardous materials as they relate to transportation routes (off-site). See Appendix D for a more detailed description of the hazardous materials–fixed site hazard.

Location of the Hazardous Material Release–Fixed Site Hazard

There are several sources of information regarding the locations of hazardous materials. There does not appear to be a single comprehensive source that identifies all hazardous materials. There are several open sources of information about hazardous materials. These include the FEMA Hazards US (HAZUS) software, the Right-to-Know (RTK) Network (which also acts as a switchboard for access to several other related databases), and local officials responsible for administering the Right to Know Hazardous Substance List (RTKHSL) under the New Jersey Worker and Community Right to Know Act. The paragraphs below describe sources of information about hazardous materials in New Jersey.

Right to Know Hazardous Substance List (RTKHSL)

The 2007 RTKHSL contains 2,455 hazardous substances and can be found on the State of New Jersey Department of Health and Senior Services website at located at: http://web.doh.state.nj.us/rtkhsfs/rtkhsl.aspx.

FEMA HAZUS

In the spring of 2008 HAZUS version MR1 (v.1.1) was queried to identify hazardous materials for each county in New Jersey. Review of the HAZUS technical manual indicates that the source data for the hazardous materials is from the EPA Toxic Release Inventory (TRI) database queried for the year 1999 (see description under Right-to-Know subsection below and past occurrences of *Hazardous Materials–Fixed Site*). The HAZUS database of hazardous material facilities is limited to facilities where large quantities of chemicals that are considered highly toxic, flammable or highly explosive are stored.[26] The technical documentation recommends that the database be supplemented by local information about hazardous material sites to perform a more detailed vulnerability assessment.

Table 6.3.9-1 summarizes the HAZUS results for cities identified as having hazardous material facilities in Gloucester County. Although the HAZUS database includes specific chemical and company names, the results have been summarized to include only the city name, number of facilities, and chemical quantities (in pounds). More detailed information about the results of the HAZUS query can be obtained from the New Jersey Office of Emergency Management (NJOEM).

[26] HAZUS-Technical Manual: Chapter 10-Hazardous Materials Release.

It should be noted that because of the processes involved in updating HAZUS, data included in periodic updates is frequently not as current as what is available on various state databases. HAZUS is used in this case because it offers the only single countywide database of materials inventories. The RTK Network (described below) supports more detailed site-specific data searches, and is the recommended resource for most planning purposes.

Table 6.3.9-1
Gloucester County: HAZUS Hazardous Material Inventory
(Source: HAZUS version MR1 (v.1.1))

City Name	No. of Facilities	Chemical Quantities (Pounds)
Bridgeport (Logan)	3	343
Clayton	1	7
Deptford	1	6
Gibbstown	5	54
Glassboro	1	0
Hurffville (Washington)	1	6
Mantua	1	0
Mickleton (Woodbury)	1	3
Newfield	1	21
Paulsboro	9	224
Pitman	2	10
Swedesboro	3	15
Thorofare (Woodbury)	3	42
West Deptford	2	42
Westville	2	95
Williamstown (Monroe)	1	3
Woodbury	1	49
Total	**38**	**920**

The Right-to-Know Network

The Right-to-Know (RTK) network contains data related to hazardous materials that has been compiled from various EPA databases. Several databases from the RTK site include the following

- Toxic Release Inventory (TRI). Releases and transfers of toxic chemicals from large facilities. See *Occurrences of Hazardous Materials Release–Fixed Site* for additional details about the TRI database and releases for Gloucester County.
- Comprehensive Environmental Response, Compensation, and Liability Information System. Information on potential and actual Superfund Sites. The majority of the sites listed for Gloucester County are labeled as having an United States Environmental Protection Agency (EPA) status of *No further Remedial Action Planned* on the National Priority List.

- Emergency Response Notification System. Toxic Chemicals and spills reported to the National Response Center. See past *Occurrences of Hazardous Materials Release–Transportation* for additional details about this database and a list of past transportation accidents in Gloucester County.
- Facility Registry System. Names, addresses, and ID numbers of all facilities regulated by the EPA.
- Biennial Reporting System (BRS). The BRS is one of EPA's primary tools for tracking the generation, shipment, and receipt of hazardous waste. The BRS appears to be the best United States hazardous waste tracking database. It contains information from the Hazardous Waste Reports that must be filed every two years under the Resource Conservation and Recovery Act program. RCRA is the federal statute that regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous waste. Facilities must report their activities involving hazardous waste to BRS if they fulfill one of two criteria: they are a Large Quantity Generator (LQG) of waste, or they treated, stored, or disposed of RCRA hazardous waste on site in units subject to RCRA permitting requirements. A Large Quantity Generator is defined as any site that generates more than 2,200 lbs of RCRA waste in a single month, accumulates more than 2.2 pounds of RCRA acute hazardous waste in any single month, or accumulates more than 220 pounds of spill cleanup material contaminated with RCRA acute hazardous waste in any month. The RTK site includes BRS records from 1989 through 2005.

Each of the databases listed can be queried from the following website: http://www.rtknet.org/

Table 6.3.9-2 provides a summary of the waste generated in Gloucester County for the years 2001, 2003, and 2005 from the BRS. The table identifies federal tons managed and generated for each of these reporting years. The database identifies the total and federal waste generated. Federal waste includes only those wastes that have a federal EPA waste code−those that do not are wastes regulated by an individual state only.

Table 6.3.9-2
Hazardous Waste-Tons Generated and Tons Managed By Municipality: Gloucester County, 2001-2005
(Source: The Right-to-Know Network–Biennial Reporting System)

City Name	2001			2003			2005		
	# of Facilities	Federal Tons Generated	Federal Tons Managed	# of Facilities	Federal Tons Generated	Federal Tons Managed	# of Facilities	Federal Tons Generated	Federal Tons Managed
Bridgeport	6	2,322.70	14,189.48	4	95.28	95.53	6	2,688.90	2,495.77
Clayton	3	4,069.78	8,049.74	1	31.33	28.51	1	53.23	53.23
Deptford	2	8.59	8.59	0	0.00	0.00	0	0.00	0.00
Franklinville (Franklin)	1	67.09	67.09	0	0.00	0.00	1	3.35	3.35
Gibbstown (Greenwich)	6	1,341.68	1,341.68	3	128.11	128.11	3	139.99	139.99
Glassboro	0	0.00	0.00	1	231.87	231.87	2	6.06	6.06
Mantua	1	50.90	5.90	1	53.38	53.38	1	47.97	47.97
Mickleton (East Greenwich)	0	0.00	0.00	1	226.14	226.14	1	178.51	178.51
Mullica Hill (Harrison)	0	0.00	0.00	0	0.00	0.00	1	91.30	91.30
Newfield	2	37.13	37.13	0	0.00	0.00	1	0.17	0.17
Paulsboro	7	5,633.41	5,636.51	9	4,680.20	4,683.31	10	5,459.25	5,464.01
Pitman	1	19.69	19.69	1	143.47	143.47	1	47.71	47.71
Swedesboro	2	36.71	33.95	0	0.00	0.00	1	28.79	28.79
Thorofare (West Deptford)	3	1,793.26	1,728.26	2	709,618.36	709,687.71	3	678,524.37	678,551.84
West Deptford	2	1,104.67	1,421.67	2	1,681.77	2,024.58	1	2,834.51	3,058.34
Westville	2	1,996.55	1,994.38	1	1,198.07	1,338.31	2	2,531.58	2,531.58
Woodbury	1	2.90	2.90	0	0.00	0.00	0	0.00	0.00
Total	**39**	**18,485.05**	**34,536.98**	**26**	**718,087.98**	**718,640.92**	**35**	**692,635.67**	**692,698.61**

Figure 6.3.9-1 is a map of the Gloucester County toxic releases and hazardous waste facilities identified within the TRI and BRS databases for years 2001, 2003, and 2005. Facilities with an average waste in excess of 1,000 tons generated and average toxic releases of 50,000 pounds over the three reporting years are shown with a circle to capture the population, housing units and number of acres in the floodplain within a 0.5 mile radius.

Figure 6.3.9-1
Gloucester County: Toxic Release And Hazardous Waste Facilities, Reporting Years 2001, 2003, And 2005
(Source: The Right-to-Know Network–Biennial Reporting System)

Note: Three of the nine hazardous waste facilities with an average waste generated over 1,000 tons for the three reporting years could not be mapped because of inconsistencies in the public-source data from the BRS, and were therefore excluded from this version of the Hazard Mitigation Plan.

Table 6.3.9-3 summarizes the population, number of housing units, and number of acres in the floodplain within a 0.5 mile perimeter for seven of the 11 facilities with an average over 100 tons generated for reporting years 2001, 2003, and 2005. Each 0.5 mile perimeter displayed on the map is a total of 502 acres. The floodplain columns within the tables below identify the portion of the area inside this radius that is located within the 100-year and 500-year floodplain.

The table shows that Map Identification (ID) number 1 located in Gibbstown (Greenwich Township) has the highest population inside the 0.5-mile radius among the seven facilities with an average generated waste in excess of 1,000 tons. At this facility, the average tons generated over the three reporting years was 1,162 tons, which ranked lowest among the six facilities. The table also shows that Map ID number 3 has highest number of acres in the 100-year floodplain with just over 395 acres, or 79% of the 0.5 mile perimeter. This is closely followed by Map ID number 1 with 382 acres, or 76% of the land area, located within the 100-year floodplain.

Table 6.3.9-3
Hazardous Waste Facilities (BRS)
Gloucester County: Population And Housing Units Within A 0.5 Mile Perimeter For Facilities Generating An Average Of 1,000 Tons, Reporting Years 2001, 2003, And 2005, Ordered By Population Count
(Sources: The Right-to-Know Network–Biennial Reporting System, 2000 US Census Bureau)

Map ID	Population	Housing Units	Facility in Floodplain (Y/N)	# of Acres in 100-Year Floodplain	# of Acres in 500-Year Floodplain	Average Annual Waste Generated (in Tons)
1	1,811	726	Yes	382.16	67.98	1,162
2	341	145	No	68.68	17.37	1,563
3	299	126	Yes	395.28	76.55	1,589
4	299	126	Yes	0	0	2,528
5	24	7	Yes	202.05	127.64	1,606
6	24	7	Yes	202.05	127.64	339,518

Table 6.3.9-4 summarizes the population, number of housing units, and number of acres in the floodplain within a 0.5 mile perimeter for the six facilities with toxic releases averaging over 50,000 pounds for reporting years 2001, 2003, and 2005. This table shows that Map ID number 1 located in the Borough of Westville has the highest population of the six facilities with toxic releases averaging over 50,000 pounds. At this facility, the average releases over the three reporting years were 263,744 pounds, which ranked second among the six facilities. The table also shows that Map ID number 6 has the highest number of acres in the 100-year floodplain with just under 499 acres, or 99% of the .5 mile perimeter.

Table 6.3.9-4
Toxic Release Inventory (TRI) Facilities
Gloucester County: Population And Housing Units Within A 0.5 Mile Perimeter For Facilities Releasing An Average Of 50,000 Pounds, Reporting Years 2001, 2003, And 2005, Ordered By Average Releases
(Sources: EPA–Toxic Release Inventory Program, 2000 US Census Bureau)

Map ID	Population	Housing Units	Facility in Floodplain (Y/N)	# of Acres in 100-Year Floodplain	# of Acres in 500-Year Floodplain	Average Annual Releases (in Pounds)
1	2,806	1049	No	2.13	8.68	263,774
2	836	346	No	107.97	75.96	50,633
3	117	41	Yes	259.42	137.77	50,040
4	98	37	Yes	230.37	115.35	83,507
5	1	1	No	243.13	150.39	277,279
6	0	0	Yes	498.93	3.64	56,170

Severity of the Hazardous Material Release–Fixed Site Hazard

The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threat to Human Safety and Welfare

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Threat to the environment

- Injury or loss of animals or plants or habitats that are of economic or ecological importance such as; commercial, recreation, or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries
- Impact to recreational areas such as public beaches
- Impact to ecological reserves, forests, parks, archaeological, and cultural sites

One method of classifying incident severity is by ranking from 1 to 4, with a *Level 1* incident considered minor; a *Level 2*, moderate; a *Level 3*, major; and a *Level 4* severe. Thresholds depend on the sort of incident and hazards. Incidents categorized as minor or moderate are often associated with known hazardous materials and limited in the area impacted. Incidents categorized as major or severe are typically associated with a fire, explosion, or toxic cloud that impacts a large area, possibly disrupting essential services. Events of this magnitude present an immediate danger to the public, potentially causing deaths and injuries and may require the evacuation of large numbers of the population. Emergency response by local agencies will require assistance from outside resources to adequately respond to the incident.

In Gloucester County the severity of hazardous material releases can be ranked by several methods. The EPA Toxic Release Inventory (TRI) database within the Right-to-Know Network described above ranks the top cities for on-site releases, the top chemicals released, and the top companies for releases.

The following two tables (Tables 6.3.9-5 and 6.3.9-6) display the top five on-site releases and the top five chemicals released in Gloucester County between 1987 and 2006. The results from the TRI database show that Gibbstown released just over 13.5 million pounds during this time period, followed by the Borough of Paulsboro with 9.8 million pounds. The top chemical released during this same time period was Aluminum oxide (fibrous forms).

Table 6.3.9-5
Gloucester County: Top 5 Cities for On-Site Releases, 1987-2006
(Source: Right-to-Know Network–Toxic Release Inventory)

City Name	Quantity Releases (Pounds)
Gibbstown (Greenwich)	13,560,308
Paulsboro	9,816,994
Westville	8,246,246
Newfield	4,839,500
Bridgeport (Logan)	2,661,569

Table 6.3.9-6
Gloucester County: Top Chemicals for On-Site Releases, 1987-2006
(Source: Right-to-Know Network–Toxic Release Inventory)

Chemical Name	Quantity Releases (Pounds)
Aluminum oxide (fibrous forms)	8,240,951
Sodium sulfate (solution)	5,957,000
Ammonia	5,587,254
Aluminum (fume or dust)	4,822,197
Nitrate compounds	3,333,709

Impact on Life and Property

Hazardous materials incidents (fixed sites) refer to uncontrollable releases of hazardous materials at a facility, which poses a risk to the health, safety, property, and the environment. The most well-known example of a large-scale fixed-site hazardous materials incident is that which occurred at the Union Carbide plant in Bhopal, India in 1984. This incident caused 2,500 deaths and injuries to many others. Although incidences of this scale are fairly rare, smaller-scale incidents—those requiring a response and evacuation or other protective measures—are relatively common. Table 6.3.9-7 below illustrates the relatively small number of Hazardous Materials related incidents that led to a Presidentially-declared disaster.

Table 6.3.9-7
Hazmat Related Federal Disaster Declarations
(Source: FEMA)

Number	Declared	State	Description
3126	6/10/1998	Kansas	Kansas Grain Elevator Explosion
3094	9/16/1992	Rhode Island	Water Contamination
3092	9/04/1987	Wyoming	Methane Gas Seepage
636	3/17/1981	Kentucky	Sewer Explosion, Toxic Waste
3080	5/21/1980	New York	Chemical Waste, Love Canal
3066	8/07/1978	New York	Chemical Waste, Love Canal
139	11/05/1962	Louisiana	Chlorine Barge Accident
135	10/10/1962	Mississippi	Chlorine Barge Accident

The Office of Hazardous Materials Safety of the US Department of Transportation (USDOT) tracks hazardous materials incidents by state. New Jersey has had 65 major incidents since 2001, with 10 injuries reported and a damages totaling $5,739,540, an average of $819,934 per year.

Occurrences of the Hazardous Material Release-Fixed Site Hazard

To identify past occurrences for fixed sites in Gloucester County the Toxic Release Inventory (TRI) Explorer database was queried from the US Environmental Protection Agency's (EPA) website. Beginning in 1986, as part of the Emergency Planning and Community Right-to-know Act (EPCRA), certain industries as well as federal facilities have been required to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires the EPA and the states to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public as part of the Toxics Release Inventory (TRI).[27] In 1990, Congress passed the Pollution Prevention Act which required that additional data on waste management and source reduction activities be reported under the TRI program.

For Gloucester County, the TRI database was queried for the years 2000 through 2006, the most recent year available. For years 2000-2006, the results of the query are summarized below in Table 6.3.9-8. The total onsite and off-site disposal or releases is reported in pounds, and includes facilities for all industries and chemicals in Gloucester County. The table results show the number of facilities reported in the TRI database for Gloucester County has declined from a high of 37 in 2000 to a low of 26 in 2005. The quantity of the combined on and off-site disposal and releases has also declined from a high of 3,565,205 pounds in 2000 to a low of 1,363,517 pounds in 2003.

[27] EPA-TRI Program. Retrieved from http://www.epa.gov/tri/

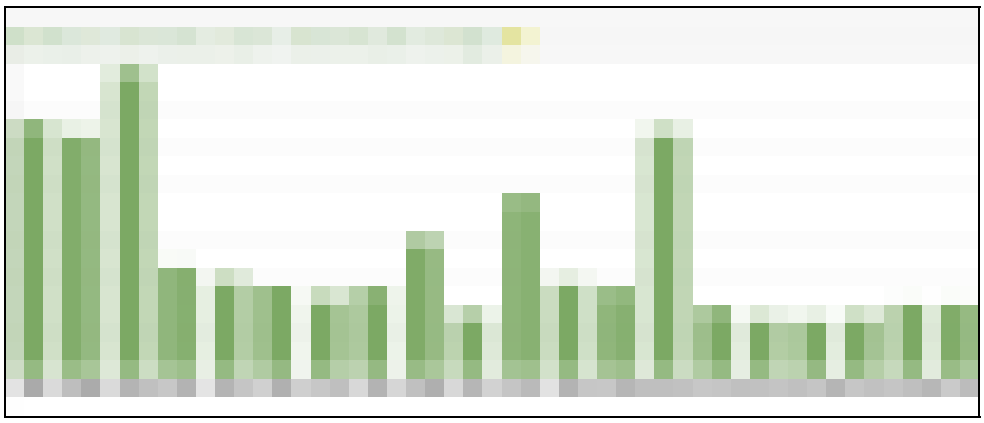
Table 6.3.9-8
Gloucester County Toxic Release Inventory, 2000-2006
Summary of On-Site and Off-Site Reported Disposed of or Otherwise Released (In Pounds)
(Source: US EPA–Toxic Release Inventory Database)

Year	# of Facilities Reported (TRI Explorer)	Total On-site Disposal or Other Releases (Pounds)	Total Off-site Disposal or Other Releases (Pounds)	Total On- and Off-site Disposal or Other Releases (Pounds)
2000	37	3,271,514	293,691	3,565,205
2001	35	1,168,802	226,048	1,394,850
2002	29	1,354,058	70,216	1,424,274
2003	28	1,247,910	115,607	1,363,517
2004	28	1,406,846	101,387	1,508,233
2005	26	1,314,769	107,938	1,422,707
2006	27	1,266,540	131,333	1,397,873
Total	**-----**	**11,030,439**	**1,046,220**	**12,076,659**

The details of the query for 2006 are included in Appendix E. The table includes the facility address, type of chemical disposed or released, and the quantity of on and off-site releases. The Gloucester County results for 2006 have been included as sample, the details for other years can be found by querying the TRI Explorer database within the EPA's website. To query the database, navigate to the EPA -TRI home page located at http://www.epa.gov/tri and select "Get TRI Data" from the menu on the left side of the page. Then select the link "TRI Explorer", and "Facility" from the reports menu.

The reduction in releases for Gloucester County can also be show graphically by displaying the TRI trend for a list of core chemicals during the period 1987 to 2006. For standard comparison purposes, the core chemical list excludes chemicals that have been added or removed within the reporting period. The core chemical restriction is applied to all RTK bar charts that display yearly trends. Figure 6.3.9-1 illustrates that with the exception of year 2000, over the past 20 years the pounds released in Gloucester County has significantly been reduced from the peak in the late 1980's. For the core chemicals, the pounds released have remained relatively constant between 2001 and 2006.

Figure 6.3.9-2
Gloucester County Toxic Release Inventory Trend (Core Chemicals), 1987-2006
(Source: Right-to-Know Network–Toxic Release Inventory)



6.3.10 Hazardous Materials Release–Transportation

Description of the Hazardous Material Release–Transportation Hazard

As described in section 6.3.9, hazardous materials come in the form of explosives, flammable and combustible substances, toxic releases and waste materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section deals those hazardous materials as they relate to transportation routes (off-site).

Hazardous materials release-transportation incidents refer to uncontrollable releases of hazardous materials during transport, which pose a risk to the health, safety, property, and the environment. Small-scale incidents –those that require a response and implementation of evacuation procedures or other protective actions–are somewhat common along major US highways, but can also occur through other modes of transportation including rail, water transport (shipping and ferries), air, and pipelines. Data collected by USDOT shows that transportation related hazardous materials incidents are much more likely to occur on highways than through any other mode of transport. See Appendix D for a more detailed description of the hazardous materials–fixed site hazard.

Location of the Hazardous Material Release–Transportation Hazard

In Gloucester County hazardous materials are transported along the counties highways, railways, utility transmission pipelines, and vessels traveling navigable waterways. In addition, chemicals can also be transported throughout Gloucester County and the region by air transportation. As shown in the list of past occurrences, the county is most vulnerable from accidents related to surface transportation.

Severity of the Hazardous Material Release–Transportation Hazard

Similar to the fixed site hazardous material releases, the severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threat to Human Safety and Welfare

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Threat to the environment

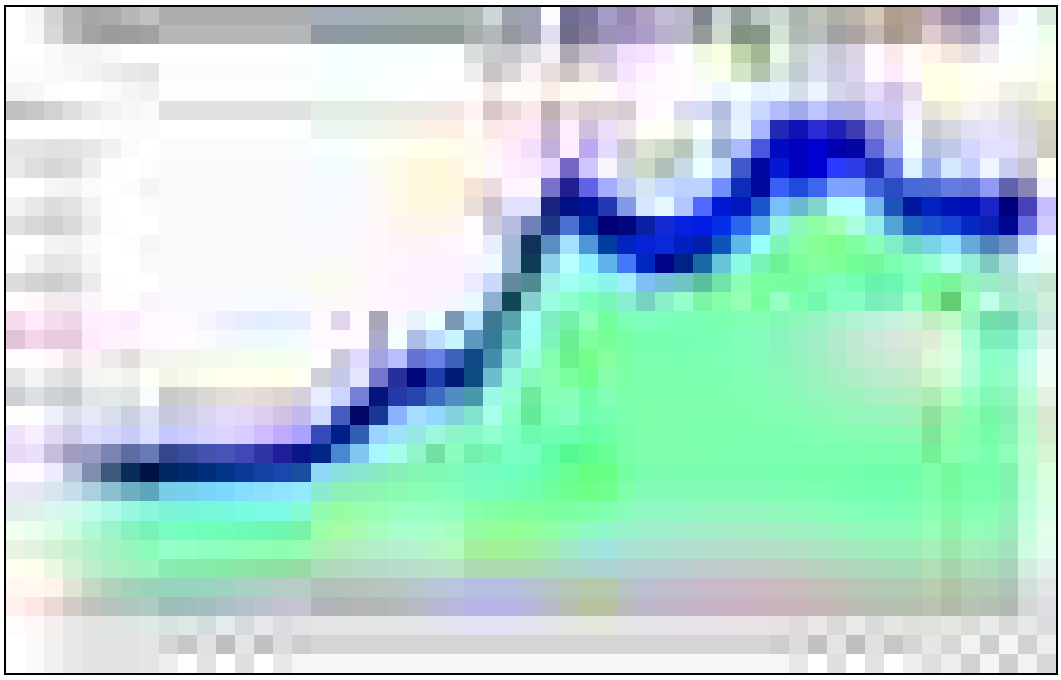
- Injury or loss of animals or plants or habitats that are of economic or ecological importance such as; commercial, recreation or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries
- Impact to recreational areas such as public beaches
- Impact to ecological reserves, forests, parks, archaeological and cultural sites

One method of classifying incident severity is by ranking from 1 to 4, with a *Level 1* incident considered minor; a *Level 2*, moderate; a *Level 3*, major; and a *Level 4* severe. Thresholds depend on the sort of incident and hazards. Incidents categorized as minor or moderate are often associated with known hazardous materials and limited in the area impacted. Incidents categorized as major or severe are typically associated with a fire, explosion or toxic cloud that impacts a large area, possibly disrupting essential services. Events of this magnitude present an immediate danger to the public, potentially causing deaths and injuries and may require the evacuation of large numbers of the population. Emergency response by local agencies will require assistance from outside resources to adequately respond to the incident.

Impact on Life and Property

Table 6.3.10-1 shows the reported hazardous materials incidents nationwide between 1983 and 2005. Within the graphic, the transportation related incidents are shaded green. This data shows that the vast majority of hazardous materials incidents relate to highway born transport. The data also visually demonstrates that the number of hazardous materials incidents have been steadily increasing since the 1980s as the interstate commerce has increased. As southwestern New Jersey, and Gloucester County, continues to grow and maintain its importance as part of a transportation corridor, the likelihood for transportation related hazardous materials releases will continue to grow.

Table 6.3.10-1
Reported Hazardous Materials Incidents, 1983-2005
(Source: Office of Hazardous Materials Safety)



Occurrences of the Hazardous Material Release–Transportation Hazard

To identify past hazardous material transportation incidents for Gloucester County the EPA Emergency Response Notification System (ERNS) database was queried from the Right-to-Know website. The ERNS database is a database of incidents reported to the National Response Center. The National Response Center is operated by the US Coast Guard, and has become the central point of contact used for the reporting of many different kinds of incidents involving hazardous materials.[28] The database includes 12 incident types including vessels (ships), railroads, pipelines, and surface transportation.

Table 6.3.10-2 summarizes past hazardous materials transportation incidents for Gloucester County between 1990 and 2002. The table list seven prior incidents, which are all related to road traffic accidents. There are most likely additional incidents (and incident types) that are not reported in the database. However, this was the best available data at the time the plan was developed. Future plan updates will review the available data sources and integrate any additional incidents that may be identified.

[28] Right-to-Know Network–ERNS database.

Table 6.3.10-2
Gloucester County Transportation Incidents, 1990-2002
(Source: The Right-to-Know Network)

Incident Date	City Near Location	Incident Location	Amount Of Material Released	Name of Material	Remedial Action
January 4, 1994	Paulsboro	Nolte Road	40 gallons	Organic Defoamer	Absorbents and booms used to clean area
November 22, 1994	Thorofare (West Deptford)	1400 Imperial Way	15 gallons	Oil: Diesel	Used absorbents
September 3, 1997	Deptford	State Highway 55 Northbound Milemarker 60	80 gallons	Oil, Fuel: No. 2-D	Spill has been contained/Absorbents used to clean the spill
August 8, 1998	Newfield	Route 40 and Grubb Road	Unknown	Gasoline: Automotive (unleaded)	Unknown
February 26, 2001	Unknown	Unknown	50 gallons	Oil: Diesel	Unknown
March 20, 2002	West Deptford	Northbound I-295 Mile Marker: 21	200 gallons	Oil, Fuel: No. 2-D	Booms applied at outfall, absorbents applied
January 12, 2003	West Deptford	Interstate Highway 295	500 gallons	Unknown	Unknown

6.3.11 High Wind–Straight-Line Winds

(Includes Hurricane/Nor'easter/Tropical Storm/and Other Severe Storm)

Description of the Straight-Line Winds Hazard

For the purpose of this hazard mitigation plan, straight-line winds are defined as all winds that are not related to tornadoes. This includes winds from hurricanes, nor'easters, tropical storms, and thunderstorms. The first three hazards noted here can all be categorized as tropical cyclones, and are defined as originating over tropical/subtropical waters and having an organized, cyclonic surface wind circulation. As discussed elsewhere in this plan (in the present Section 6, and in Appendix D), hurricanes are defined as warm-core tropical cyclones with wind speeds of at exceeding 74 mph. Nor'easters are cyclonic storms that typically track up the east coast of the US, (often in winter) and often are first felt as a northeast wind. Tropical storms are warm-core tropical cyclones with sustained winds of at least 39 mph (but less than hurricane force winds). Thunderstorms are local storms produced by cumulonimbus clouds, and always accompanied by lightning and thunder. Notably, the first three of these hazards (in particular hurricanes and tropical storms) are measured and categorized primarily by their wind speed. This is also the case with thunderstorms, although as with the other hazards, their severity is also measured by rainfall. These four wind hazards are differentiated from tornadoes in that they are characterized by winds that tend to be in one general direction, rather than by highly localized, high-intensity cyclonic wind flows, as is the case with tornadoes (although in many cases the other events spawn tornadoes). See Appendix D for a more detailed discussion of high wind–straight-line winds.

Location of the Straight-Line Winds Hazard

The entire planning area is subject to the wind effects from hurricanes, nor'easters, tropical storms, other severe events. The hurricane and tropical storm risk in the United States extends along the entire east coast from Maine to Florida, the Gulf Coast (including Florida, Alabama, Louisiana, and Texas), and Hawaii. The northeast US is at a moderate risk based on historical storm tracks and the number of hurricanes that have made landfall along the Atlantic coastline. Figure 6.3.11-1 shows how the frequency and strength of extreme windstorms vary across the United States. The map is based on a combination of all past occurrences and shows that New Jersey falls within the hurricane susceptible region (shown as cross-hatching). New Jersey is also within wind Zone II, where wind speeds can reach as high as 160 mph.[29]

[29] FEMA, Wind Zone Map.

Figure 6.3.11-1
Wind Zones In The United States
(Source: FEMA)

The high wind risk from nor'easters extends along the entire east coast. Nor'easters typically occur during the winter months and wind speeds can potentially reach hurricane force. The entire planning area is equally at risk from severe thunderstorms.

Severity of the Straight-Line Winds Hazard

The severity of the wind hazard is measured primarily by velocity, although effects are clearly exacerbated by duration and the presence of windborne debris. As discussed in Section 7, inland New Jersey is not particularly prone to high wind hazards, but occasionally tropical storms or thunderstorms are severe enough to cause moderate damage in the area.

The geographic center point of Gloucester County is located approximately 55 miles from the Atlantic Coastline. Its interior location offers some protection from hurricanes, nor'easters, and tropical storms, which often follow along the coastline as shown by the historic hurricane tracks in Table 6.3.11-1. The southeastern part of Gloucester County is slightly more vulnerable from the high winds associated with these events.

Impact on Life and Property

The NCDC database indicates that Gloucester County has experienced 170 thunderstorm and high wind events between 1950 and 2007. During this period there were nine deaths, 38 injuries and just under $17 million in property damage. The information in the NCDC database, reflect a significant part of the costs of recovery from strong winds. However, there are also very significant costs associated with interrupted business, lost wages, lost tax base, etc. that are very difficult to quantify but are nevertheless important metrics for determining the severity of the risk. Of these 170 events, a total of eight events have exceeded 69 mph since 1960. These eight events are summarized in Table 6.3.11-1 below.

Table 6.3.11-1
High Wind Events Over 69 MPH, Excluding Tornado Winds, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

To protect life and property from wind events, all counties within the State of New Jersey, including Gloucester County, are required to comply with the design wind loads developed by the International Building Code (IBC) and the International Residential Code (IRC). The building code administered within the incorporated areas of Gloucester County require all new construction to be designed and constructed to 100 mph wind loads.[30] Figure 6.3.11-2 identifies the minimum design wind speeds for New Jersey.

[30] Department of Community Affairs–Division of Codes and Standards: Bulletin No. 3-4–Wind Speed Map.

Figure 6.3.11-2
American Society Of Civil Engineers (ASCE) New Jersey Wind Zone Map
(Source: ASCE Minimum Design Loads for Buildings and other Structures)

Occurrences of the Straight-Line Winds Hazard

Between 1950 and 2007, there have been numerous hurricanes, nor'easters, tropical storms, and severe storms that have impacted all or part of Gloucester County. The NCDC database identifies no hurricanes or tropical storm events in Gloucester County between 1950 and 2007. In addition to the NCDC database, NOAA's Historic Hurricane Tracks database was also queried to identify past hurricane events that have impacted Gloucester County between 1960 and 2007. The query results identified 13 hurricanes or tropical storms that impacted Gloucester County during this time period. Most of these events were downgraded to a tropical depression or less by the time they reached New Jersey.

The National Weather Service, NOAA, and the NCDC do not specifically track nor'easter events. However, the events listed for Salem County within the Ocean and Lake Surf category of the NCDC database along with other open data sources indicates there have been numerous nor'easters in the past that have impacted the planning area with high winds. Some of the larger nor'easter events occurred in years 1993, 1996, 2006, and 2007. As mentioned above, there have been 170 thunderstorm and high wind events between 1950 and 2007.

Several of the hurricane, tropical storm, and nor'easter events are highlighted below.

- September 27, 1985–Hurricane Gloria. After brushing the outer banks of North Carolina the storm moved northward just off the Atlantic coast until making landfall as a Category 2 Hurricane near western Long Island, New York. Along the coastline of northern New Jersey sustained winds were approximately 80 mph with gusts over 100 mph. Hurricane Gloria caused one of the largest single power outages at the time, including about 230,000 customers in New Jersey.
- March 16, 1993–Storm of the Century. One of the most intense nor'easters to ever effect the United States. The *Storm of the Century* label was given to the event due to the record low pressure, wind speeds, temperature and snowfall. Fallen trees from high winds left 3 million customers without electrical power.[31] Wind gusts of over 70 mph were reported at New York City's LaGuardia airport.
- October 18, 1996. A 5-day nor'easter that lasted from October 18-23. Record rainfall, flooding, and high winds effected parts of New Jersey from Morris County to Camden County to Hunterdon County.
- September 16, 1999–Hurricane Floyd. Hurricane Floyd battered New Jersey on September 16th and brought with it torrential and in some areas, unprecedented and record breaking rains and damaging winds. Throughout New Jersey the highest wind gusts were mainly less than 60 mph, but the combination of the heavy rain that loosened the ground and the persistent strong winds uprooted hundreds of trees. In Gloucester County the highest reported wind gusts were 58 mph at the Commodore Barry Bridge.[32]
- September 18, 2003–Tropical Storm Isabel. Isabel made landfall as a hurricane near Drum Inlet, North Carolina on the 18th and weakened as it tracked farther inland. Winds gusted were recorded up to 62 mph in New Jersey. This resulted in widespread downed trees, tree limbs and power lines. It was one of the worst power outages on record for area utilities. Jersey Central Power and Light reported that 220,000 of its customers lost power while Conectiv Energy reported about 162,000 of its customers lost power.
- February 12, 2006. A Nor'easter that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion.

The planning area has been impacted by 13 hurricanes or tropical storms over the last 47 years. On average, Gloucester County experiences the wind affects of a hurricane about every 3.5 years. However, as mentioned, almost all had been downgraded to tropical storm or tropical depression status by the time they reached New Jersey. In the future, Gloucester County can be considered at moderate risk from experiencing the high wind effects from hurricanes and tropical storms. The risk is also considered moderate from nor'easters. New Jersey experiences one or two storms every year that could potentially be classified as nor'easters, but not all of these are severe enough to cause significant damages or result in disaster declarations. Gloucester County has been impacted by high winds from four nor'easters over the past 15 years. The planning area is affected by a strong nor'easter on average about every four years. Note that Section 7 of this hazard mitigation plan includes a more detailed discussion about wind risk in Gloucester County.

[31] NOAA. Retrieved from http://www.noaa.gov/
[32] NOAA/NCDC. Retrieved from http://www.ncdc.noaa.gov/oa/ncdc.html

6.3.12 High Wind–Tornado

Description of the Tornado Hazard

A tornado is a rapidly rotating vortex or funnel of air extending ground ward from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction. Approximately 1,000 tornadoes are spawned by severe thunderstorms each year. See Appendix D for a more detailed description of the tornado hazard.

Location of the Tornado Hazard

An area covering portions of Texas, Oklahoma, Arkansas, Missouri, and Kansas is known as Tornado Alley, where the average annual number of tornadoes is the highest in the United States. Cold air from the north collides with warm air from the Gulf of Mexico, creating a temperature differential on the order of 35ºF-55ºF. Most tornadoes in this area occur in the spring.

From 1953 to 1993, Texas experienced the highest average annual number of tornadoes with 128, followed by Oklahoma (52), Kansas (47), Florida (46), and Nebraska (38). Figure 6.3.12-1 shows tornado activity in the United States. The map indicates that NOAA has recorded 1-5 tornadoes per 1000 square miles along the western half of New Jersey including the majority of Gloucester County.

Figure 6.3.12-1
Tornado Activity In The United States
(Source: FEMA)

People living in manufactured or mobile homes are most exposed to damage from tornadoes. Even if anchored, mobile homes do not withstand high wind speeds as well as permanent, site-built structures.

Severity of Tornado Hazard

Tornado damage severity is measured by the Fujita Tornado Scale (F-Scale), named after Dr. T. Theodore Fujita who first introduced the scale in 1971. The Fujita Scale assigns numerical values based on wind speeds and categorizes tornadoes from 0 to 5. The scale is based on damage caused by a tornado related to the fastest .25 mile wind speed at the height of a damaged structure.[33] The letter *F* often precedes the numerical value. Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. See Table 6.3.12-1 for a description of the Fujita Tornado Measurement Scale.

Table 6.3.12-1
Fujita Tornado Measurement Scale
(Source: NOAA)

Category	Wind Speed	Examples of Possible Damage
F0	Gale (40-72 mph)	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted trees; damage to sign boards.
F1	Moderate (73-112 mph)	Moderate damage. Peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	Severe (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	Devastating (207-260 mph)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through air in excess of 100 yards; trees debarked; incredible phenomena will occur.

In February of 2007 the F-Scale was replaced with a more accurate Enhanced Fujita Scale (Enhanced F-scale). It was the Jarrell, Texas tornado of May 27, 1997 and the Oklahoma City/Moore tornado of May 3, 1999 that brought to the forefront the problem that perhaps the wind estimates were too high in the F-Scale. The changes to the original scale were proposed by a committee of meteorologist and engineers searching for a more accurate method of assessing the magnitude of tornadoes. The modifications made to the F-scale were limited to ensure that the new Enhanced F-scale could continue to support the original tornado database found within the NCDC.

[33] NOAA. Retrieved from http://www.noaa.gov/

The Enhanced F-scale is a set of wind estimates (not measurements) based on observed damages after a tornado. Its uses three-second gusts estimated at the point of damage based on a judgment of eight levels of damage to 28 indicators that include various commercial and residential building types, transmission towers, poles and trees. Similar to the original scale, the new Enhanced F-scale includes five classes ranging from EF0 to EF5.[34] The wind speeds from the Fujita Scale were used as basis for development of the Enhanced F-scale. The following Table displays the wind speed ranges for the original Fujita Scale, the derived wind speeds (Enhanced F-scale), and the new Enhanced F-scale currently in use since February of 2007.

Table 6.3.12-2
Wind Speed Comparison Of The Fujita Scale And Enhanced Fujita Scale
(Source: NOAA-National Weather Service)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest .25 mile (mph)	Three Second Gust (mph)	EF Number	Three Second Gust (mph)	**EF Number**	**Three Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

Between 1975 and 1995, 106 major Federal disaster declarations included impacts caused by tornadoes. The states with the greatest number of tornado-related disasters were: Mississippi (14); Alabama and Illinois (9 each); Oklahoma (8); Wisconsin (7); Ohio (6); and Missouri, Minnesota, Louisiana, Georgia, and Arkansas (5 each).

New Jersey currently ranks 37th for frequency of tornadoes when compared to other states. Tornadoes have an impact on Gloucester County equally and uniformly. The severity of the tornadoes identified in the NCDC database for Gloucester County ranged from F0 to an F2.

Impact on Life and Property

The NCDC database reports there have been no deaths and seven injuries from tornadoes in Gloucester County. The tornadoes caused an estimated $675,000 in property damage. The low property damage is indication that tornadoes have had a relatively minor impact on the planning area.

Occurrences of the Tornado Hazard

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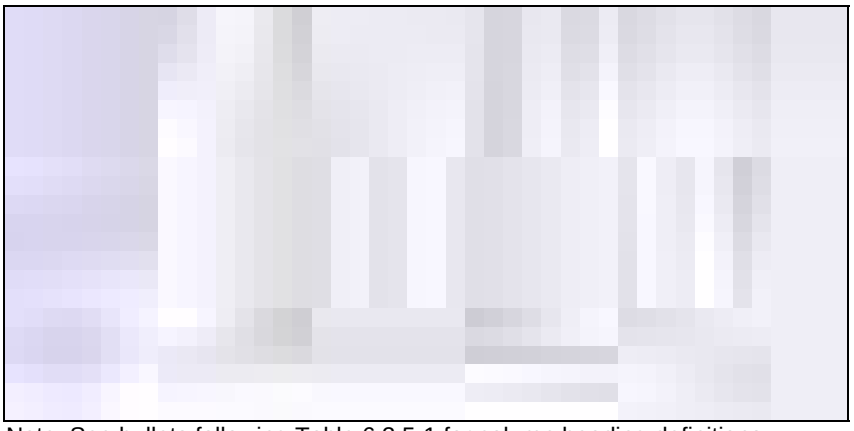
The NCDC reports that seven tornadoes have occurred in Gloucester County between 1950 and 2007. The database indicates there were four F0s, four F1s, and one F2 tornado.

[34] NOAA. Retrieved from http://www.noaa.gov/

Table 6.3.12-3
Tornado Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)



Note: See bullets following Table 6.3.5-1 for column heading definitions.

Based on previous occurrences, the probability of future tornado events in Gloucester County is one event every six years.[35] The overall impact to the planning area from tornadoes is low considering the frequency and low magnitude of the past occurrences.

[35] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/ncdc.html

6.3.13 Ice Storm

Description of the Ice Storm Hazard

Although snow is the weather phenomenon most commonly associated with winter, ice storms can cause significant disruption to business and create treacherous driving conditions (See Section 6.3.19, severe storm–winter weather, for a detailed discussion of winter weather). The freezing rain that coats all objects in a sheath of ice can cause power outages, structural damage, damaging tree falls. Ice storms occur when rain droplets fall through freezing air and but do not freeze until they touch objects such as trees, roads, or structures. A clear icy sheath, known as a glaze, forms around branches, structures and wires and has been known to bring down high-tension utility, radio, and television transmission towers. See Appendix D for a more detailed description of the ice storm hazard.

Location of the Ice Storm Hazard

All regions of Gloucester County have been subject to ice storms. Besides temperature, their occurrence depends on the regional distribution of the pressure systems, as well as local weather conditions. The distribution of ice storms often coincides with general distribution of snow. In Gloucester County, a cold rain may be falling near the Atlantic County border in the southeastern part of the county, changing to freezing rain in the central region, and snow over the northwestern portion as a coastal storm moves northeastward offshore. A locality's distance to the passing storm center is often the crucial factor in determining the temperature and type of precipitation during a winter storm.

The potential for ice storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure.

Severity of the Ice Storm Hazard

The severity of the ice storm hazard is dependent on a variety of factors including the surface temperature, duration of the event, and thickness of the ice.

Impact on Life and Property

The NCDC database indicates there have been no deaths, injuries or property damage from previous ice storms in Gloucester County. However, ice storms most likely have caused both infrastructure and property damage such as downed electrical power lines and trees falling on houses. In addition ice storms potential put lives at risk from automobile accidents on ice covered roadways. With no indication of past damages from ice storms, or events that included a wintry mix, this hazard was not selected as part of the more detailed risk assessment. The severe storm - winter weather hazard (profiled in Section 6.3.19) was chosen as part of the risk assessment based on past injuries, and property damages that occurred from several severe winter storms that impacted Gloucester County.

Occurrences of the Ice Storm Hazard

The NCDC database indicates there have been two ice storms that have impacted Gloucester County between 1950 and 2007. In addition to the two ice storms, the database indicates there have been 32 wintry mix events that include a combination of snow, sleet, and freezing rain.

One of the two events listed in the database occurred on February 15 and 16 1995 when a warm front associated with a storm system over the Great Lakes helped push warmer air aloft above a dome of cold, dry air near the ground. As warmer air moved in aloft, precipitation mainly fell as freezing rain the afternoon and evening of the 15. Once the sun set, many roadways in Gloucester County became slippery and ice covered.[36] Transportation and commerce were disrupted as driving on icy roadways became extremely hazardous.

Gloucester County experiences an event that includes freezing rain as part of a winter storm about once every two years if the past 32 wintry mix events are added to the two ice storms. Based on previous data, the probability of ice storms occurring in the future is relatively high. However the overall impact to life and property throughout the planning area will most likely be low to moderate.

[36] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/ncdc.html

6.3.14 Landslide (non-seismic)

Description of the Landslide Hazard

A landslide is a natural geologic process involving the movement of earth materials down a slope, including rock, earth, debris, or a combination of these, under the influence of gravity. However, there are a variety of triggers for landslides such as: a heavy rainfall event, earthquakes, or human activity. The rate of landslide movement ranges from rapid to very slow. A landslide can involve large or small volumes of material. Material can move in nearly intact blocks or be greatly deformed and rearranged. The slope may be nearly vertical or fairly gentle.[37] See Appendix D for a more detailed description and definition of the Landslide hazard.

Location of the Landslide Hazard

Landslides are usually associated with mountainous areas but can also occur in areas of generally low relief. In low-relief areas, landslides occur due to steepening of slopes: as cut and fill failures (roadway and building excavations), river bluff failures, collapse of mine waste piles, and a wide variety of slope failures associated with quarries and open-pit mines.[38]

In Gloucester County the area most susceptible to landslides is concentrated along the western county border. As shown in Figure 6.3.14-1, the area shaded orange shows the landslide susceptibility is considered moderate adjacent to a portion of the Delaware River.

[37] Delano and Wilshusen, 2001.
[38] USGS, Landslide Types and Process, 2004.

Figure 6.3.14-1
New Jersey Landslide Susceptibility/Incidence Map
(Source: NJGS)

Severity of the Landslide Hazard

Landslides are considered highly site specific events and are concentrated in areas of steep slopes. The severity of the landslide hazard depends on a combination of slope angle and the geologic material underlying the slope

Impact on Life and Property

According to the NJGS (as shown in the graphic above), the western portion of Gloucester County is moderately susceptible to landslides, and has experienced relatively few events in the past. There are no known instances of injuries or death from landside events in the county. The western part of the county is of relatively low population density. Given these factors, it is reasonable to presume that impacts on life and property will continue to be minimal, although future development must avoid areas where the hazard is present.

Occurrences of the Landslide Hazard

The New Jersey Geologic Survey indicates there have been 160 landslides in New Jersey since 1950. All of these events have occurred in the northern part of the state. No events were identified in Gloucester County (hence the low incidence rating on the figure above). Landslide probabilities are largely a function of surface geology, but are also influenced by both weather and human activities, as noted above. With no reported landslides in the past, the probability of future landslides having a significant impact on property and life in the planning area is considered low.

6.3.15 Levee Failure

Description of the Levee Failure Hazard

A levee is a natural or artificial slope or wall, either earthen or concrete and often parallels the course of a river. Levee failure can occur in numerous ways but the most common is the breaching a levee. The main purpose of a man made levee is to prevent flooding to adjacent development or farmland.

A breach occurs when part of the levee actually breaks away, leaving a large opening for water to flood the land protected by the levee. A breach can be a sudden or gradual failure that is caused either by surface erosion or by a subsurface failure of the levee. Failure can also occur when water overtops the crest of a levee. This is known as overtopping, where floodwaters exceed the lowest crest of a levee, flooding the surrounding area. See Appendix D for a more detailed description and definition of the levee failure hazard.

Figure 6.3.15-1
Earthen Levee Along The Delaware River
(Source: Delaware Estuary Levee Organization)

Location of the Levee Failure Hazard

Parts of southern New Jersey are protected by a system of over 35 earthen levees and tide gates originally constructed as early as the 1700's for purposes other than flood control. The Delaware Estuary Levee Organization (DELO) was formed in November, 2005 after Hurricane Katrina with the assistance of the South Jersey Resource Conservation and Development Council to identify, update, and ensure maintenance for the southern New Jersey levees located in Cumberland, Gloucester, Salem, and Cape May Counties. Figure 6.3.15-2 shows the location of the levees and dikes along the Delaware River in southern New Jersey.

Figure 6.3.15-2
Southern New Jersey Levees And Dikes
(Source: DELO)

According to the Delaware Estuary Levee Organization (DELO), there are six levees in Gloucester County that provide some level of flood control, mainly for agricultural purposes. The majority of the levees are located in the far western portion of Gloucester County, in close proximity to the Delaware Bay and River.[39] The levees can be broken down into several types including five agricultural levees and one levee from the Watershed Protection and Flood Prevention Program.[40] The levees are concentrated in the Townships of West Deptford, Greenwich, Logan, National Park Boro, and Woodbury City. Table 6.3.15-1 lists the municipality, location, type, and the reported area for each levee in Gloucester County.

Table 6.3.15-1
Gloucester County Levees And Dikes
(Source: DELO–Delaware River (NJ) Levees and Dikes Map)

Municipality	Location/Name	Levee Type	Reported Area (Acres)
Greenwich Township	Repaupo Creek/Gibbstown Levee	Watershed Protection/Flood Prevention	510
Logan Township	Oldmans Creek	Agricultural	42
Logan Township	Birch Creek	Agricultural	224
National Park Boro	Little Mantua Creek	Agricultural	31
West Deptford	Main Ditch	Agricultural	43
Woodbury City	Woodbury Creek	Agricultural	75

New Jersey's lowest land along the Delaware River is in Gloucester County, behind a dike known as the Gibbstown Levee. The Gibbstown Levee runs 4.5 miles along the Delaware River in Logan and Greenwich Townships in Gloucester County, New Jersey. It protects the 21-square-mile Repaupo Creek watershed inhabited by approximately 6,700 residents."[41] Most of this low area is considered freshwater wetlands, but there are also a few homes and a trailer park along Floodgate Road.

Figure 6.3.15-3 identifies the location of the six levees in Gloucester County. The levee types are color coded and identified with different size circles to indicate the extent of the reported area.

[39] Delaware Estuary Levee Organization.
[40] DELO-Delaware River (NJ) Levees and Dikes map.
[41] USACE, 2004.

Figure 6.3.15-3
Gloucester County Levees and Dikes
(Source: DELO)

DELO has requested a complete levee inventory for southern New Jersey, including the counties of Gloucester, Salem, Cumberland and Cape May. To complete the levee inventory project DELO has partnered with the following agencies:

- Natural Resources Conservation Service (NRCS)
- Philadelphia District of the US Army Corps of Engineers (USACE)
- New Jersey Department of Environmental Protection's (NJDEP) Dam Safety and Flood Control

The levee inventory project is being completed by the NRCS with funding provided by the NJDEP's Dam Safety and Flood Control section, through the Philadelphia District of the USACE's Delaware River Comprehensive, New Jersey Interim Feasibility Study. The goal of the project is to obtain a detailed levee inventory for these counties that at a minimum includes the identification, location, extent, vulnerability to people and property, condition, and ownership for each levee[42]. The project began at the end of 2008 and is scheduled to be complete in the spring of 2010. Future Gloucester County Hazard Mitigation Plan updates will incorporate the results of the levee inventory.

[42] DELO, South Jersey Levee Inventory presentation, October 28, 2008

Severity of the Levee Failure Hazard

The severity of the levee failure hazard can range from minor cracks along the levee wall to complete breaching of the levee. In January of 2007 the USACE indicated there were 146 levees in the United States that posed an unacceptable risk of failing in a major flood.[43] The USACE is in the process of inspecting these levees and the list will be released once the inspections are complete.

Occurrences of the Levee Failure Hazard

The NCDC database does not specifically track levee failures but review of the flood hazard identified one levee failure from Hurricane Floyd in 1999. This downgraded fall hurricane lasted approximately 18 hours and resulted in rainfall totals between seven and 8.5 inches in parts of Gloucester County. The combination of winds funneling into the Delaware Bay and the Delaware River and the record runoff from inland waterways produced minor to moderate tidal flooding at the times of high tide in Gloucester and neighboring counties. Across the southern half of New Jersey, the heaviest rain and the most widespread flooding occurred in townships along the Delaware River. Tidal storm surge flooding produced high water levels of more than 10 feet above typical mean low water elevation causing the Gibbstown Levee to partially give way in Greenwich Township. About 40 persons were evacuated after partial failure of the levee sent water from the Delaware River and Repaupo Creek into Gibbstown. In adjacent Logan Township, about 20 persons were evacuated near Floodgate Road. There were also additional voluntary evacuations in low-lying areas of both Logan and Monroe Townships.[44]

[43] USA Today, January 29, 2007.
[44] NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/ncdc.html

6.3.16 Losses, Crops

Description of the Crop Loss Hazard

Weather related crop loss occurs as a secondary result from events such as drought, extreme temperatures, flooding, high wind events (hurricanes and tornadoes) frost and hail. Crop loss can also occur from agricultural pests such as insects. Unfavorable weather conditions and pest infestation can undermine the diligent efforts of even the most experienced farmer, damaging or destroying fruits and vegetables, and lowering yields. See Appendix D for a more detailed description and definition of the crop loss hazard.

Location of the Crop Loss Hazard

There are five major fruit and berry crops grown in New Jersey: apples, blueberries, cranberries, peaches, and strawberries. Of the 215,000 acres in Gloucester County, about 58,000 acres are categorized as farmland. Much of the agricultural production in Gloucester County is devoted to vegetable and fruit production. In 2003, Gloucester County was the number one fruit tree producing county in New Jersey. Fruit trees grown include peaches, nectarines, apples, and plums. Vegetables are also widely grown across Gloucester County, with annual sales exceeding $54 million.[45]

The potential for crop loss equally affects all agricultural portions of the planning area.

Severity of the Crop Loss Hazard

The severity of crop loss depends on several weather variables including such factors as the duration of drought conditions, wind speeds (for hurricanes and tornadoes), temperature, and size of the hailstone. The New Jersey Department of Agriculture (NJDA) estimates that New Jersey Farmers lose an estimated $290 million in direct crop loss or damage caused by agricultural pests.

Impact on Life and Property

Crop loss has minimal or no impact on property, but can affect life in the planning area. Reduced crop yields have a direct impact on farmers and the income earned from growing various crops. Crop loss and reduced yields can also result in increased food cost for consumers.

Occurrences of the Crop Loss Hazard

The NCDC database does not directly track crop loss events, but information about these events can be found by searching within the drought hazard and other hazards that may affect crop production within Gloucester County. Table 6.3.16-1 summarizes three significant crop loss events that have impacted Gloucester County between 1999 and 2007. Based on previous events, crop losses will most likely occur in the future but will with a low impact to life and property in the planning area.

[45] Rutgers Cooperative Extension-Gloucester County.

Table 6.3.16-1
Gloucester County-Major Crop Loss Events
(Sources: NOAA/NCDC, USA Today)

Date /Timeframe	Event Type Causing Crop Loss	Description
1999 Growing Season (May to September)	Drought	Agricultural losses throughout New Jersey were estimated at $80 million. The 1999 corn harvest was only one third of 1998's (3 million vs. 9 million bushels). Other crops were also lower than 1998's harvest including wheat (down 17%) and hay (down 15%). The drought also dropped the apple, pumpkin and squash harvest by up to 50% as it not only decreased the harvest, but also the size of the crops.
2002 Growing Season (May to September)	Drought/ Extreme Heat	Crop damage was widespread, varying from a total loss to drops in yield of 20% to 50%, depending on the crop and when it was planted. Hardest hit was the many New Jersey farms growing field crops—hay, wheat, sorghum, soybeans and corn for animal feed—because almost none is irrigated. [46]
2005 Growing Season (May to September)	Drought	The heat damaged the leaves of temperature sensitive plants such as lettuce, parsley and cilantro. The lack of rain reduced the size of lettuce, cabbage, leeks and arugula. The sun caused blistering of tomatoes, peppers, squash and beans. Farming yields were down about 25%. The Governor of New Jersey requested Federal Disaster Aid for farmers, including Gloucester County.

[46] USA Today 9/1/2002.

6.3.17 Losses, Fishing

Description of the Fishing Loss Hazard

The fish loss hazard has been included in this Plan as a result of the hazard selection process discussed in the beginning of this section. The Gloucester County HMWG recognizes that fishing losses are not a direct hazard, but a secondary result of hazards and other environmental factors. Fishing losses have been included to ensure that the Steering Committee considered all potential hazards that could adversely affect the planning area. This section discusses some of the causes of commercial and recreational fishing losses in New Jersey and Gloucester County.

Commercial fishing is the harvesting of fish for sale or trade. In Gloucester County, losses from commercial fishing can result from a variety of causes and sources including reduced water quality, natural population cycles, overharvesting, and excess municipal wastewater discharges. Fish losses along the Delaware River can result from water quality degradation from a variety of causes including industrial and municipal effluent discharges, untreated storm sewer overflow, nutrient enrichment, agricultural runoff, industrial intake structures, and land use changes.[47] See Appendix D for a more detailed description and definition of the fishing loss hazard.

Location of the Fish Loss Hazard

In New Jersey some of the major fisheries include; blue crab, tuna, bluefish, striped bass, clams, and lobster. Most of these fisheries are harvested outside of Gloucester County. The potential for commercial and recreational fishing losses in Gloucester County is greatest along the Delaware River and its tributaries. The majority of fish losses occur as a result of cooling water intake structures of industrial sites along the Delaware River such as the Salem nuclear power plant which can result in significant fishing losses. The giant intakes continuously pump in and discharge river water to cool equipment and systems, sucking trillions of gallons from stretches of the Delaware that include nurseries and feeding grounds for some of the region's most valuable aquatic life, including striped bass and weakfish.[48] Some of the fish are trapped on the intake screens, others are de-scaled. The ones that are pulled through the screens are killed by heat or torn apart by the sheer force of the water.

Severity of the Fish Loss Hazard

The severity of fishing losses depends on a variety of factors including the extent to which point source and non-point source pollutants are introduced into the rivers and streams of Gloucester County. The severity of fish losses from cooling water intake structures can depend on a variety of factors including the depth of the intake, distance from the shoreline, type of intake screen system, and water temperature.

Impact on Life and Property

Fish loss has no impact on property, but can affect life in the planning area. Reduced fishing yields can have a direct impact on fisherman and the income earned fishing various species. Fishing losses and reduced harvests can also result in increased consumer's costs for fish and other seafood.

[47] The Delaware Estuary-Environmental Protection Agency Case Study.
[48] Delaware Riverkeeper Network.

Occurrences of the Fish Loss Hazard

No specific cases of fish losses were identified within Gloucester County. In 2002, the EPA completed a study analyzing fish losses from cooling water intake structures along the lower Delaware River basin. The case study completed by the EPA estimates annual fish losses from intake structures along the Delaware River at 616 million. The annual economic damages from only four of these sites are estimated at $49 million, mostly commercial and recreational fishing losses.[49] There are most likely other minor cases of fish losses that occur each year in the planning area.

Gloucester County will most likely experience commercial and recreational fish losses in the future. However, the overall impact to property and life in the planning area is considered low.

[49] The Delaware Estuary-EPA Case Study.

6.3.18 Severe Storm–Lightning

Description of the Lightning Hazard

Lightning events are generated by atmospheric imbalance and turbulence due to a combination of conditions. Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000º F. See Appendix D for a more detailed description of the lightning hazard.

Location of the Lightning Hazard

Lightning occurs over the entire planning area, particularly during the spring and summer months.

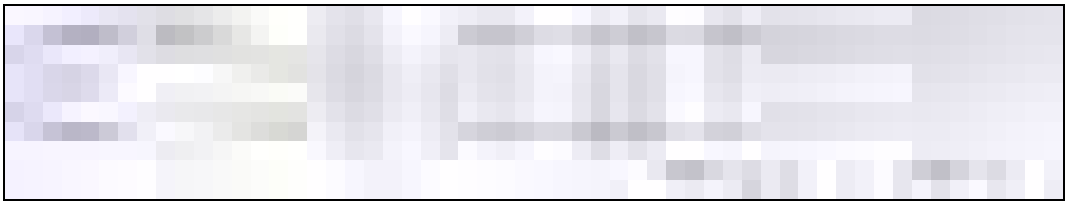
Severity of Lightning Hazard

Severe lightning events can occur in the planning area. Even during common events, the lightning current can branch off to strike a person from a tree, fence, pole, or other tall object. In addition, electrical current may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or other tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture. Lightning may use similar processes to damage property or cause fires.

Impact on Life and Property

About 100 deaths and 500 injuries are reported annually across the US from this hazard. In Gloucester County there were no deaths, five injuries, and approximately $1.6 million in property damages related to lightning from 1950 to 2007. Table 6.3.18-1 lists the lightning events that have resulted in injury in Gloucester County. See the following table (Table 6.3.18-2) for the total property damage from all 18 lightning events.

Table 6.3.18-1
Reported Injuries From Lightning, Gloucester County, 1950-2007
(Source: NOAA/NCDC)



Note: See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of the Lightning Hazard

There were 18 instances of lightning reported in the NCDC database for Gloucester County from 1950 to 2007. All 18 events occurred between 1993 and 2007.

Table 6.3.18-2
Lightning Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: See bullets following Table 6.3.5-1 for column heading definitions.

Based on the occurrences between 1994 and 2007, the probability of future lightning events in Gloucester County is about one significant event per year.

6.3.19 Severe Storm–Winter Weather

Description of the Winter Weather Hazard

Winter storms bring various forms of precipitation that occur only at cold temperatures, such as snow, sleet, or a rainstorm where ground temperatures are cold enough to allow icy conditions. These cold weather storms can also take the form of freezing rain or a wintry mix. See Section 6.3.13, Ice Storm, for a detailed discussion of the ice storm hazard.

Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines and hypothermia. See Appendix D for a more detailed description of winter weather hazard.

Figure 6.3.19-1
Heavy Snow From The 1993 Storm Of The Century
(Source: Popular Mechanics-Science)

Location of the Winter Storm Hazard

The potential for winter storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure.

Seasonal snowfall in New Jersey varies from an average of about 15" at Atlantic City to about 50" in Sussex County. There is, however, significant variation from year to year. February is the month when maximum accumulations on the ground are usually reached. In Gloucester County the average yearly snowfall is between 20" and 25". The southeastern third of Gloucester County receives slightly less snowfall most likely due to the coastal influences moderating temperatures slightly.

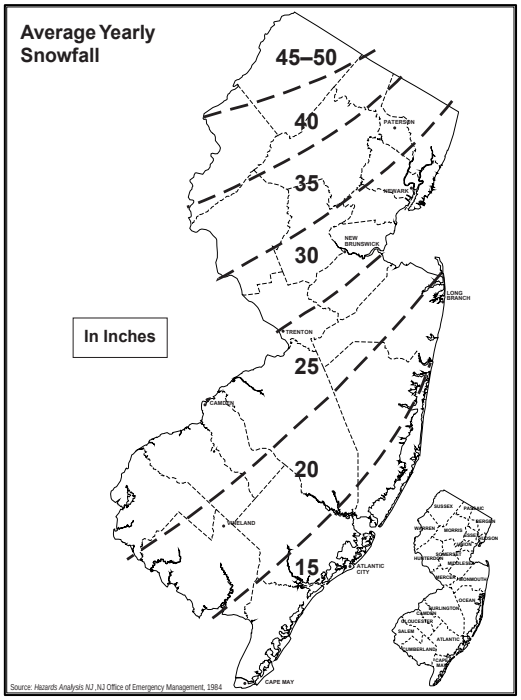


Figure 6.3.19-2
Average Annual Snowfall
In New Jersey
(Source: New Jersey Office of Emergency Management)

Severity of Winter Storm Hazard

Although the NCDC database has not categorized any previous storms in Gloucester County as blizzards, this is perhaps the most severe type of winter storm, characterized by low temperatures, strong winds, and heavy blowing snow. The NCDC database query results include winter storm events between 1994 and 2007. In mid-March 1993, the eastern US experienced one of the most intense winter storms on record. The event, know as the *storm of the century* caused blizzard conditions throughout most of New Jersey dumping as much three feet of snow in some parts of the state.

Impact on Life and Property

The NCDC reports there have been 31 injuries and no deaths due to snow and ice conditions. Approximately $27.5 million has been reported in property damages related to winter storms.

Table 6.3.19-1
Winter Storm Events Resulting In Property Damage, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under location or county column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Table 6-6.3.19-2
Injury-Related Winter Storm Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under location or county column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of the Winter Weather Hazard

Winter storms occur frequently enough in Gloucester County to be a threat to people and property. Generally, the winter storm season in the Gloucester County runs from December to March. The NCDC reports there have been 89 snow and ice events in Gloucester County between 1950 and 2007. Although the query results begin in 1950 the first reported event is in 1995. It is unclear why the database does not include any events prior to 1995. The probability of winter storms occurring in the future is relatively high, based on previous data. On average, seven winter storms occur every year in Gloucester County.

Table 6.3.19-3
Summary of Notable Winter Storm Events Impacting Gloucester County
(Sources: NOAA-National Weather Service, NCDC database)

Date(s)	Storm Type	Description
February 7, 1978	Blizzard	This blizzard caused an estimated $24 million in damage statewide, primarily to dunes, beaches, and public facilities along the beachfront.
March 13, 1993 (FEMA DR-3106)	Blizzard	Event known as the *Storm of the Century* affected as many as 26 states from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States. The *Storm of the Century* label was given to the event due to the record low pressure, wind speeds, temperature and snowfall. All 21 counties in New Jersey were included in the Snow Emergency Declaration. In Gloucester County snowfall totals ranged from 6"-15". The heaviest snow totals were in the northwestern part of the county.
January 7, 1996 (FEMA DR-1088)	Blizzard	A State of Emergency was declared for the blizzard that hit the state. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Gloucester County snowfall totals ranged from 18"-27". Similar to other heavy snow events, the heaviest snow totals were in the northwestern part of the county.
February 16, 2003 (FEMA DR-3181)	Snow Storm	The most powerful storm to affect New Jersey since the Blizzard of 1996. The combination of the very cold temperatures and the approach of a strong storm system caused widespread snow to break out, starting before sunrise on Sunday, February 16. Snow continued during the day Sunday, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in Gloucester County ranged from 18" to 24". New Jersey requested and was granted a Snow Emergency Declaration for all 21 counties. The President's Day snowstorm tied or set records in all 21 New Jersey counties including Gloucester County. The heavy snow caused several barns to collapse in Gloucester County.

6.3.20 Storm Surge

(Includes Hurricanes/Nor'easters/Coastal Storms)

Description of the Storm Surge Hazard

Storm surges occur with coastal storms caused by massive low-pressure systems with cyclonic flows that are typical of hurricanes. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15' or more. In addition, wind driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides.[50]

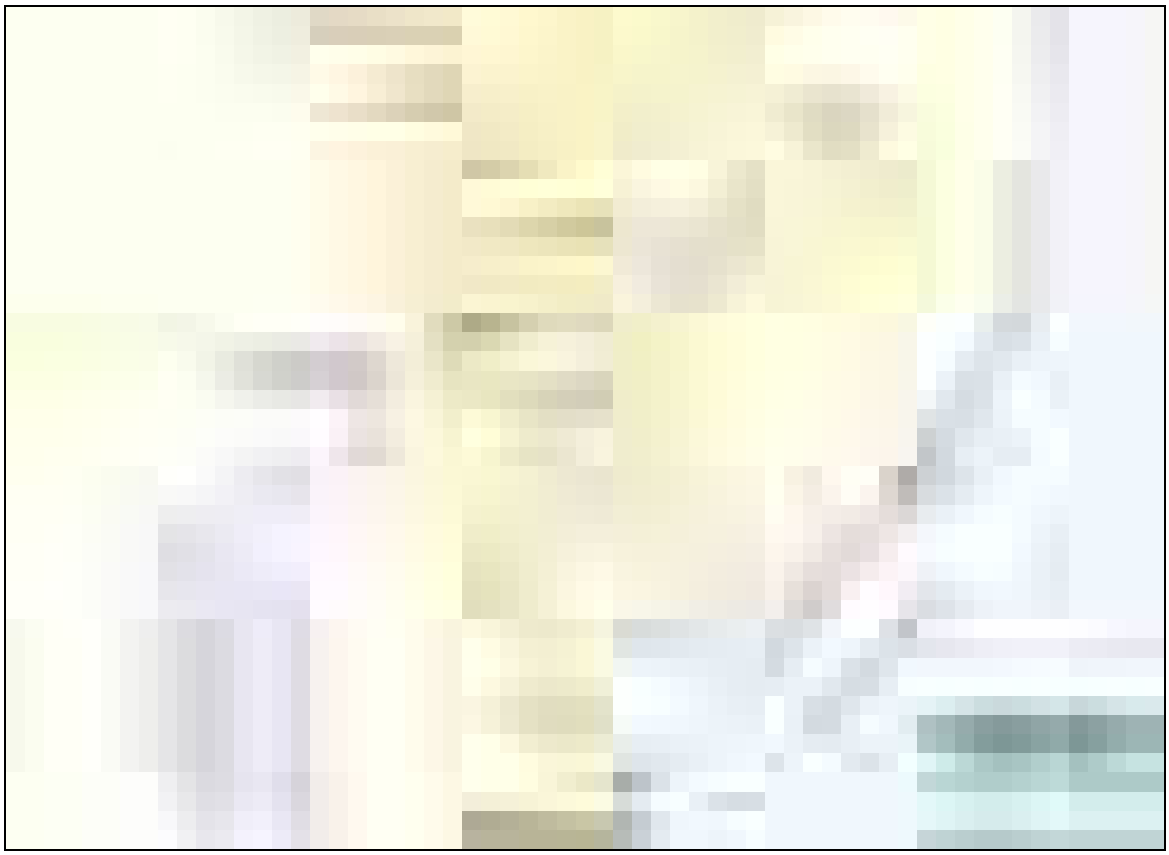
Storm surges are particularly damaging when they occur at the time of a high tide, combining the effects of the surge and the tide. This increases the difficulty of predicting the magnitude of a storm surge since it requires weather forecasts to be accurate to within a few hours. See Appendix D for a more detailed description of the storm surge hazard.

Location of the Storm Surge Hazard

The storm surge hazard associated with hurricanes and other severe storms are responsible for coastal flooding and erosion along the New Jersey coastline. Storm surge can also impact interior areas as high winds push water into bays and rivers located inland from the coast. In Gloucester County the storm surge hazard is concentrated along areas of the Delaware River and the tidal section of its tributaries near the western edge of the county. Flooding can occur in this area of the county as the counter-clockwise rotation of hurricanes, nor'easters or intense low pressure systems funnel southeast winds into the Delaware Bay pushing water up the Delaware River. Figure 6.3.20-1 is a map of the Delaware Bay and the southern portion of the Delaware River basin. This map is followed by Figure 6.3.20-2 which identifies the traffic evacuation zones and storm surge limits for Gloucester County.

[50] NOAA. Retrieved from http://www.noaa.gov/

Figure 6.3.20-1
Delaware Bay And The Southern Portion Of The Delaware River Basin
(Source: Delaware River Basin Commission)

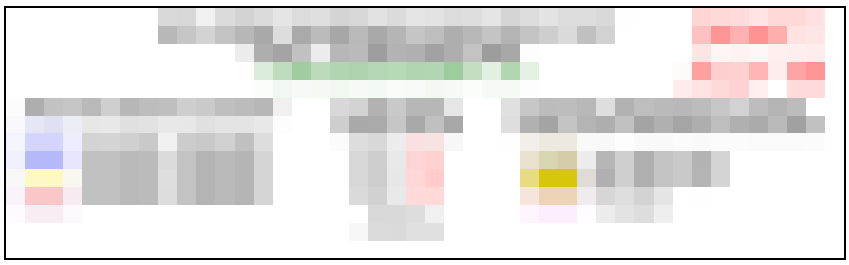


In June of 2007, the USACE- Philadelphia Office and FEMA completed the *New Jersey Hurricane Evacuation Study Transportation Analysis*. The study provided New Jersey with updated local and regional hurricane evacuation clearance times for the 2007 Hurricane Season. The document included storm surge maps for each county in New Jersey. Figure 6.3.20-2 is the traffic evacuation zones and storm surge limits for Gloucester County.

Figure 6.3.20-2
Gloucester County: Traffic Evacuation Zones and Storm Surge Limits
(Source: USACE)

The map is color coded to distinguish storm surge scenarios for hurricanes categories one through four and shows that areas bordering the Delaware River and its tributaries in northwestern Gloucester County are most susceptible to storm surge as high winds push water upstream from the Delaware Bay. The legend is difficult to view at the current map scale and is repeated below as a larger image.

Figure 6.3.20-3
Gloucester County: Legend Repeated From Storm Surge Limits Map
(Source: USACE)



Severity of the Storm Surge Hazard

Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and ports, and backwater flooding through coastal river mouths. Severe winds associated with low-pressure systems cause increase in tide levels and water surface elevations. Storm systems also generate large waves that run up and flood coastal areas. The combined effects create storm surges that affect the beach, marsh, and low-lying floodplains. Shallow offshore depths can cause storm driven waves and tides to pile up against the shoreline and inside bays. Table 6.3.20-1 highlights the factors that can influence the severity of coastal storms.

Table 6.3.20-1
Factors That Influence the Severity of Storm Surge

Factor	Effect
Wind Velocity	The higher the wind velocity the greater the damage.
Storm Surge Height	The higher the storm surge the greater the damage.
Coastal Shape	Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
Storm Center Velocity	Then slower the storm moves, the greater damage. The worst possible situation is a storm that stalls along a coast, through several high tides.
Nature of Coast	Damage is most severe on low-lying island barrier shorelines because they are easily over washed by wave action.
Previous Storm Damage	A coast weakened by even a minor previous storm will be subject to greater damage in a subsequent storm.
Human Activity	With increased development, property damage increases and more floating debris becomes available to knock down other structures.

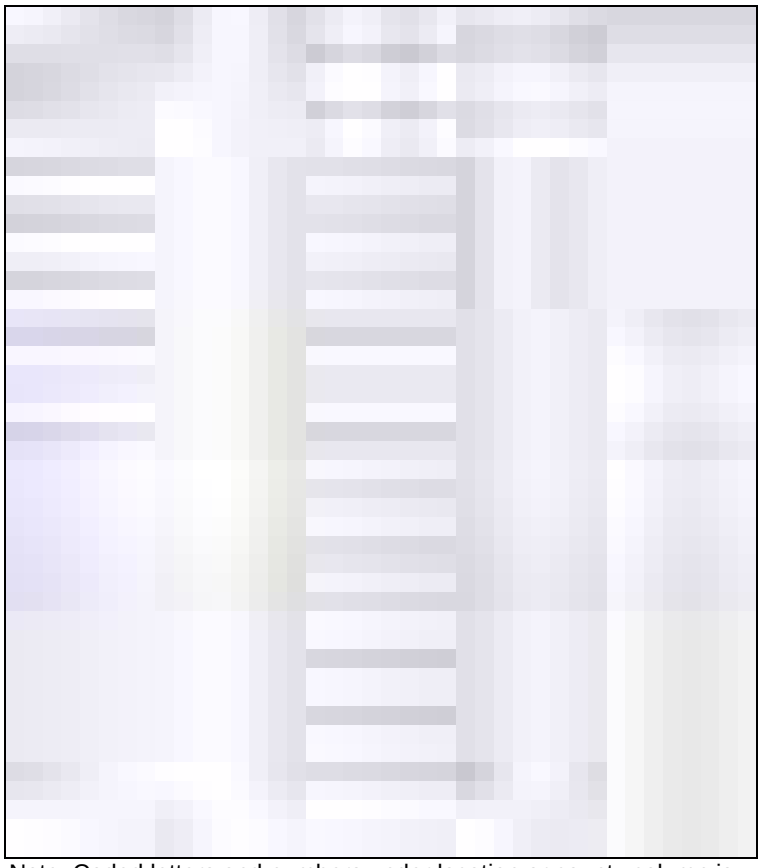
Impact on Life and Property

In Gloucester County the NCDC database indicates there have been no deaths, injuries, or property damage due to storm surge.

Occurrences of the Storm Surge Hazard

The structure of the NCDC database combines coastal flooding and storm surge events into a category titled *Ocean and Lake Surf*. The database indicates there have been one storm surge event and 13 coastal flooding events that have impacted Gloucester County between 1950 and 2007. All of the events occurred between 2003 and 2007. The database does not provide any indication as to why there are no events listed prior to 2003.These events are summarized in Table 6.3.20-2 below.

Table 6.3.20-2
Storm Surge Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)



Note: Coded letters and numbers under location or county column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

The storm surge event on September 18, 2003 was produced by Tropical Storm Isabel as it moved northward up the Atlantic coastline. In Gloucester County the storm produced moderate tidal flooding along the Delaware River and erosion and rough surf along the shoreline. The majority of the coastal flooding events listed were caused by extreme high tides or strong low pressure systems and not nor'easters or hurricanes. These events also resulted in minor tidal-influenced flooding along the Delaware River.

From the historical data provided in the NCDC database, the probability of storm surge occurring along the Delaware River in the future is relatively low. No property damage, injuries or deaths is an indication that the future impact on life and property in the planning area will most likely be low.

6.3.21 Wildfire

Description of the Wildfire Hazard

Wildfires are uncontrolled fires often occurring in wildland areas, which can consume houses or agricultural resources if not contained. Wildfires/urban interface is defined as the area where structures and other human development blend with undeveloped wildland. See Appendix D for a more detailed description and definition of the wildfire hazard.

Location of the Wildfire Hazard

The potential for wildfires exists over the entire planning area, although the probability is relatively low particularly in the urban areas due to the detection and suppression capabilities that exist in the county. The rural and forested areas of the county are at a greater vulnerability than the urban areas, particularly within the Wharton State Forest.

Severity of Wildfire Hazard

The frequency and severity of wildfires is dependent on weather and on human activity. In the planning area, severity has historically been very low, and duration a matter of hours to a day. The risk is increased and compounded by increasing development within the zone commonly referred to as the *urban-wildland interface.* Within this zone of natural landscape, buildings become additional fuel for fires when fires do occur. Most wildland fires are man-caused and occur in the interface of developed lands and forest and range lands. In particular, the dry conditions, high temperatures, and low humidity that characterize drought periods set the stage for wildfires.

Impact on Life and Property

There are no records of deaths or injuries and no recorded loss of property from wildfires in the planning area.

Occurrences of Wildfires

The NCDC database indicates there have been four wildfires in Gloucester County since 1950. All four events occurred between 2002 and 2007. These events are listed in the following table.

Table 6.3.21-1
Wildfire Events, Gloucester County, 1950-2007
(Source: NOAA/NCDC)

Note: Coded letters and numbers under location or county column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

The largest of the four wildfires occurred on May 6, 2007 at a Sunoco Refinery in West Deptford Township. The fire burned approximately 100 acres of brush and flames came within 100' of homes located on Ninth Street before it was contained. No injuries or property damage was reported from the event.

In the past, numerous wildfire events have occurred in parts of Gloucester County. The NCDC database records indicate these events have been relatively small and resulted in no injuries, deaths or property damage. However, data from the New Jersey Forest Fire Service (NJFFS) indicate there have been significantly more events, with 599 wildfire incidents in Gloucester County between 1996 and 2006. The wide difference in historical incidence between the NCDC database and the NJFFS may be due to a threshold for reporting incidents to the NCDC, but this cannot be determined from the database query results.

Tables 6.3.21-2 and 6.3.21-3 below provide the most recent available data for the number of fire incidents in New Jersey per year and the number of acres burned, for the period from 1996 to 2006. As shown in the tables, Gloucester County ranks eleventh in average annual fire incidents and eight in the number of acres burned per year. The same data are depicted graphically in Figures 6.3.21-1 and 6.3.21-2, following the tables.

Table 6.3.21-2
Number Of Fire Incidents Per Year By New Jersey County, 1996-2006
(Source: New Jersey Forest Fire Service)

County	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Totals	Annual Average
Atlantic	126	214	224	206	155	232	250	163	127	149	251	2,097	190.6
Bergen	1	7	8	8	6	13	4	5	5	5	10	72	6.5
Burlington	99	121	133	140	88	128	109	64	56	71	102	1,111	101.0
Camden	55	138	126	145	124	143	103	45	62	76	110	1,127	102.5
Cape May	59	86	71	84	50	92	80	40	62	52	55	731	66.5
Cumberland	93	151	206	173	100	140	102	58	88	111	117	1,339	121.7
Essex	0	0	0	0	0	0	0	0	1	0	2	3	0.3
Gloucester	**34**	**67**	**53**	**72**	**36**	**73**	**78**	**23**	**28**	**68**	**67**	**599**	**54.5**
Hudson	0	0	0	0	0	0	0	0	0	1	0	1	0.1
Hunterdon	21	37	28	69	44	66	41	26	14	30	48	424	38.5
Mercer	0	0	0	5	0	4	26	8	1	5	5	54	4.9
Middlesex	18	54	50	87	62	106	106	41	35	75	87	721	65.5
Monmouth	30	30	34	50	35	75	54	42	32	51	69	502	45.6
Morris	62	113	99	139	58	65	87	63	48	53	86	873	79.4
Ocean	196	347	304	412	265	374	287	227	213	228	325	3,178	288.9
Passaic	17	37	50	71	29	61	39	21	13	22	43	403	36.6
Salem	22	36	47	24	10	38	37	15	14	16	20	279	25.4
Somerset	6	50	17	65	15	50	86	41	20	60	59	469	42.6
Sussex	38	137	109	176	85	162	129	102	49	47	101	1,135	103.2
Union	0	0	0	0	0	0	0	0	2	2	4	8	0.7
Warren	33	56	94	129	75	90	144	55	37	107	71	891	81.0
Total	**910**	**1,681**	**1,653**	**2,055**	**1,237**	**1,912**	**1,762**	**1,039**	**907**	**1,229**	**1,632**	**16,017**	**1,456.1**

Table 6.3.21-3
State Of New Jersey Annual Number Of Acres Burned* By Wildfires County, 1996-2006
(Source: New Jersey Forest Fire Service)

County	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Totals	Annual Average
Atlantic	130	2,150	136	188	189	166	206	88	51	55	138	3,497	**318**
Bergen	0.25	49	42	103	8	98	10	2	13	5	12	342	**31**
Burlington	130	282	121	12,857	340	215	57	26	22	26	225	14,301	**1,300**
Camden	61	265	220	171	283	279	806	382	34	404	106	3011	**274**
Cape May	33	69	30	54	178	60	32	26	23	51	57	613	**56**
Cumberland	149	138	222	290	514	994	78	50	52	119	182	2,788	**253**
Essex	0	0	0	0	0	0	0	0	0.25	0	21	21	**2**
Gloucester	**44**	**134**	**117**	**173**	**36**	**110**	**111**	**12**	**8**	**359**	**114**	**1218**	**111**
Hudson	0	0	0	0	0	0	0	0	0	25	0	25	**2**
Hunterdon	7	38	44	108	12	30	21	7	14	10	68	359	**33**
Mercer	0	0	0	4	0	60	19	1	0.25	2	2	88	**8**
Middlesex	26	99	145	196	78	279	118	124	38	117	796	2,016	**183**
Monmouth	81	22	30	33	20	30	24	18	35	26	35	354	**32**
Morris	58	422	37	102	25	52	63	42	25	56	64	946	**86**
Ocean	136	1,023	138	712	123	1,806	4,089	109	141	95	240	8,612	**783**
Passaic	32	18	35	77	16	24	16	32	3	14	106	373	**34**
Salem	58	74	62	37	40	19	30	6	17	13	486	842	**77**
Somerset	2	30	6	164	5	43	32	9	9	26	19	345	**31**
Sussex	17	69	62	84	99	165	112	28	15	45	106	802	**73**
Union	0	0	0	0	0	0	0	0	.5	0.75	1	2	**0**
Warren	51	23	20	1,058	98	32	43	6	19	66	28	1,444	**131**
Total	**885**	**2,755**	**1,331**	**16,223**	**1,875**	**4,296**	**5,661**	**880**	**469**	**1,460**	**2,668**	**42000**	**3,818**

Note: (1) The number of incidents includes only those wildfires to which the New Jersey Forest Fire Service responded to in its designated response area. Numbers are rounded for clarity.

Figures 6.3.21-1 and 6.3.21-2 summarize by county the average annual wildfire incidents and acres burned in New Jersey between 1996 and 2006. The New Jersey Forest Fire Service indicates there have been an average of 55 wildfire incidents per year in Gloucester County in this reporting period, with an annual average 111 acres burned county-wide.

Figure 6.3.21-1
Average Annual Wildfire Incidents In New Jersey, 1996-2006
(Source: New Jersey Forest Fire Service)

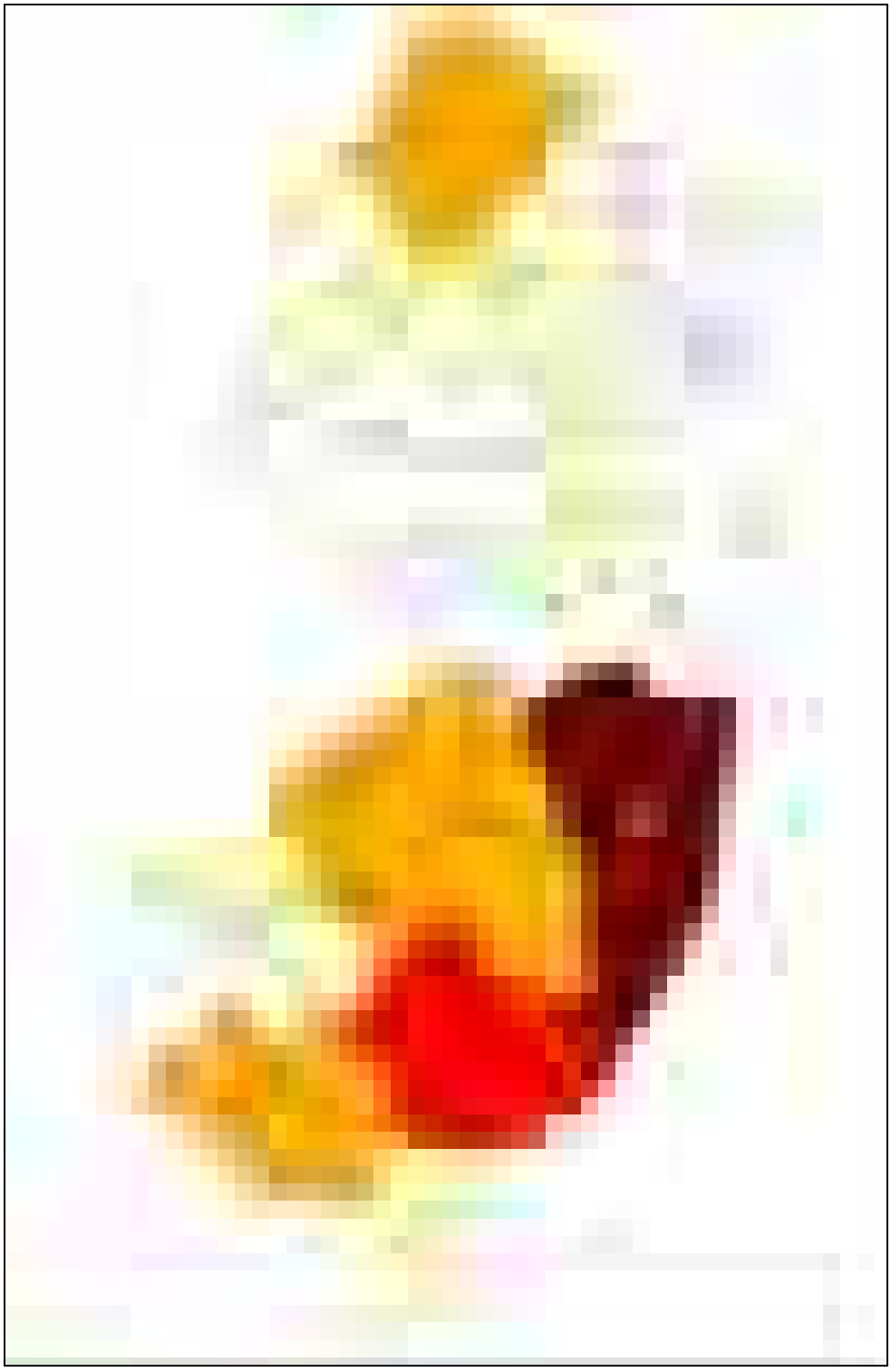


Figure 6.3.21-2
Average Annual Acres Burned From Wildfires In New Jersey, 1996-2006
(Source: New Jersey Forest Fire Service)

Data in Tables 6.3.21-2 and 6.3.21-3 indicate that for the reporting period 1996 through 2006 Gloucester County was near the average in New Jersey for both the annual numbers of wildfires and the acres burned by wildfires. Year-to-year variation in the numbers of incidents is relatively small, while variation in acres burned is somewhat greater. There is a high probability of wildfires occurring somewhere in the county every year, although the overall impact of the fires is assumed to be fairly low because the typical annual area burned is small. This trend could obviously change with variations in the weather and antecedent conditions. Note that Section 7 of this hazard mitigation plan includes a more detailed discussion about the wildfire risk in the Townships of Franklin and Monroe.

6.4 Methodology for Identifying Hazards of Concern

In accordance with the requirements of the Interim Final Rule all hazards with potential to affect Gloucester County are profiled in this section of the Plan. However, because this is a county level hazard mitigation plan it is useful to identify the hazards that are of the most concern countywide, so these can be the focus of a more detailed assessment. It is important to note, however, that many hazards and risks are very site-specific, so as local municipalities perform more detailed risk assessments and identify mitigation actions they should recognize that this process and the resulting table should be used only as a guide.

Various national, regional and local sources were used to identify and classify different hazards for Gloucester County. The criteria used were:

1. History–incorporating historical accounts and records that the hazard has affected the county often in the past, and that the hazard has occurred often and/or with widespread or severe consequences.
2. Potential for mitigation– acknowledging that there are ways to address the hazard, and that the methods are technically feasible and have the potential to be cost-effective (i.e. mitigation measures are available at a reasonable cost, and damages to property, lives and/or community functions would be reduced or eliminated.)
3. Presence of susceptible areas or vulnerability–indicating that Gloucester County has numerous facilities, operations, or populations that may be subjected to damage from the hazard.
4. Data availability–demonstrating that sufficient quality data is available to permit an accurate and comprehensive risk assessment.
5. Federal Disaster Declarations and local emergency declarations–noting that Gloucester County has received numerous disaster declarations for the particular hazard.

The table below lists the hazards, describes the rationale for identifying (or not identifying) hazards as significant, shows sources of information that were consulted for the determination, and the disposition of the hazard with regard to hazard identification and risk assessment in this plan. The initial hazards in the shaded portion of the table are those that were identified by Gloucester County's HMWG as significant enough to warrant a full risk assessment either countywide or for specific municipalities.

Table 6.4-1
Gloucester County Qualitative Hazard Ranking

Hazard	Rationale	Sources	Disposition
Flood	Widespread impacts, history of occurrences in the county, significant annual damages.	FEMA Flood Insurance Studies, FEMA Flood Insurance Rate Maps, FEMA Public Assistance records, FEMA National Flood Insurance Program claims data, US Army Corps of Engineers (USACE), and National Oceanographic and Atmospheric Administration (NOAA), studies and records.	Profile and risk assessment
High–Wind-Straight Line Winds (Includes: Hurricane, Nor'easter, Tropical Storm, and Severe Storm)	▪ Hurricanes: Relatively low historic probability; potential for widespread impacts. ▪ Tropical Storms: Low to moderate probability; potential for widespread impacts. ▪ Nor'easters: Moderate probability of more extreme events, potential for moderately widespread impacts. ▪ Severe Storms: High probability of occurrences, but losses are typically limited.	NOAA and NCDC records, New Jersey Department of Community Affairs-Division of Codes and Standards, New Jersey State Climatologist (Rutgers University)	Profile and risk assessment
Severe Storm–Winter Weather	High annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA, NCDC, NWS, New Jersey State Climatologist (Rutgers University)	Profile and risk assessment
Earthquake/Geological	Relatively low annual probability, but potential for significant consequences.	United States Geologic Survey (USGS), NJGS.	Profile and risk assessment
Dam Failure	Low annual probability based on historical data, but impacts potentially significant in site specific areas.	NJDEP–Dam Safety and Flood Control.	Profile and risk assessment
Levee Failure	Low annual probability based on historical data, but impacts potentially significant in site specific areas.	DELO	Profile and risk assessment
Wildfire (1)	High annual probability of site-specific events, but impacts generally limited.	NOAA, New Jersey State Forest Fire Service, NJDEP.	Profiled with risk assessment completed for specific municipalities
Erosion–Hurricane/Nor'easter/Coastal Storm (1)	Relatively high annual probability, but impacts are limited to northeastern coastal areas.	NOAA, The New Jersey Beach Profile Network (NJBPN), USACE	Profiled, but not part of detailed risk assessment

Hazard	Rationale	Sources	Disposition
Storm Surge–Hurricane/Nor'easter/ Coastal Storm (1)	Relatively low probability, impacts limited to northeastern coastal areas.	NOAA-NCDC,USACE	Profiled, but not part of detailed risk assessment
Hazardous Materials Release–Fixed Sites (2)	High annual probability with impacts potentially severe in site specific areas.	US Environmental Protection Agency, FEMA HAZUS (Hazards US) software, the Right-to-Know (RTK) Network, US Environmental Protection Agency (EPA)	Profiled, but not part of detailed risk assessment
Hazardous Materials Release–Transportation (2)	Moderate to high annual probability, but impacts limited in severity and area.	The RTK Network – Emergency Response Notification System (ERNS)	Profiled, but not part of detailed risk assessment
Ice Storm	Low to moderate annual probability with impacts relatively limited	NOAA-NCDC, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
Drought	High annual probability, but impacts generally limited.	NOAA-NCDC; New Jersey State Department of Agriculture, NJDEP	Profiled, but not part of detailed risk assessment
Extreme Temperature–Cold	Relatively high annual probability, but impacts are limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
Extreme Temperature–Heat	Relatively high annual probability, but impacts are limited.	NOAA-NCDC, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
Hail	High annual probability but impacts are limited in severity and area	NOAA-NCDC, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
High Wind–Tornado	High annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA-NCDC,, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
Landslide (non-seismic)	Low probability with losses typically limited	NJGS	Profiled, but not part of detailed risk assessment
Severe Storm–Lightning	High annual probability, but impacts generally limited	NOAA-NCDC, New Jersey State Climatologist (Rutgers University), NWS	Profiled, but not part of detailed risk assessment
Losses, Crops	Moderately high annual probability, but impacts generally limited	NOAA-NCDC, US Department of Agriculture	Profiled, but not part of detailed risk assessment
Losses, Fishing	High annual probability, but impacts generally limited	NJDEP-Division of Fish and Wildlife, EPA	Profiled, but not part of detailed risk assessment

Notes: The data in this table is intended only to give a general sense of the significance of hazards in the county, relative to each other. See Appendix B (Section 6) for a complete listing of all sources.
(1) This hazard will be assessed only in those municipalities where the hazard identification indicates the presence of the hazard.
(2) Hazmats are not being addressed as a primary hazard in this Hazard Mitigation Plan; however, secondary impacts of hazmats as they relate to other hazards are assessed.

Based on the qualitative ranking above, the HMWG recommended including four natural hazards and two technological/manmade hazards in the more detailed risk assessments in Section 7:

- Flood
- High Wind–Straight-Line Winds
- Severe Storm–Winter Weather
- Earthquake/Geological
- Dam Failure
- Levee Failure

Additionally, the HMWG recommended including the wildfire hazard as part of the more detailed risk assessments for the Townships of Franklin and Monroe.

Consistency with the New Jersey State Hazard Mitigation Plan

As part of the process of developing the Gloucester County Hazard Mitigation plan, the planning team carefully reviewed the updated New Jersey SHMPU, with the goal of ensuring consistency between the two documents, primarily in the areas of hazard identification, risk assessment and mitigation strategy. The SHMPU comprises a shorter list of hazards (and does not include hazardous materials), but the most significant hazards statewide are part of both documents, and are generally prioritized in the same way. However, the state plan process did not include a ranking methodology. The SHMPU includes all 21 New Jersey counties in the State, and the New Jersey Office of Emergency Management specifically wished to avoid suggesting that some hazards were potentially less significant than others. This was done in order to avoid the potential for local jurisdictions to accept the State ranking verbatim, and potentially fail to fully explore localized hazards that may be the basis for significant risks.

Summary Description of the County's Vulnerability to Hazards

The DMA 2000 legislation and related FEMA planning guidance require mitigation plans to include discussion of community vulnerability to natural hazards. Vulnerability is generally defined as the damage (including direct damages and loss of function) that would occur when various levels of hazards impact a structure, operation or population. For example vulnerability can be expressed as the percent damage to a building when it is flooded, or the number of days that a government office will be shut down after a wind storm, etc., assuming there is sufficient detailed data available to support the calculations.

Because this Plan includes many jurisdictions and the available data is not very detailed, it is not practical to complete vulnerability assessments on the many individual assets, operations and populations in individual jurisdictions. However, it is appropriate for participating municipalities to embark on a program of addressing these data deficiencies over the next five years in anticipation of the next Plan update. In addition, it is possible to make some general observations as follows based on the hazard identifications and risk assessments that are the subjects of Sections 6 and 7 of this plan.

As illustrated in Section 6 (Hazard Identification), Gloucester County is subject to numerous natural and manmade hazards, although in some cases the hazards have rarely impacted the area, or their effects have been relatively minor. As is the case with many parts of the mid-Atlantic, although relatively localized, flooding is the most frequent and most damaging natural hazard in central New Jersey and Gloucester County, However, it is important to recognize that several other hazards present significant risks (i.e. potential for future losses) to the County, even though they have occurred infrequently in the past, or have not caused much damage.

In particular, earthquakes (although improbable) present risks to various communities in the County because there are many relatively old structures that may be prone to failure if shaken by an earthquake. As noted in Section 7, in order to accurately characterize vulnerabilities (and hence risks) at a local level, it will be necessary to study assets on a site-specific basis. Section 7 of this plan also shows that there is some vulnerability to wind in the County, mainly from hurricanes and tropical storms. While severe hurricanes are rare events in this area of the country, tropical storms and nor'easters are fairly common, and many structures in the communities are vulnerable to extreme winds. However, as discussed in text, the vulnerability is widespread, hence the relatively large risk figure. Most of the other hazards are either localized or improbable, and therefore, while various elements in the communities may be vulnerable to such hazards, the likelihood of them occurring in any specific location is very small.

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Section 7
Risk Assessment

Contents of this Section

7.1 Interim Final Rule Requirement for Risk Assessments

Requirement §201.6(c)(2): *The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

Requirement §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

*Requirement §201.6(c)(2)(ii): [The risk assessment] **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.*

*Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area . .*

*Requirement §201.6(c)(2)(ii)(B): [The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate . .*

*Requirement §201.6(c)(2)(ii)(C): [The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

*Requirement §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

7.2 Overview and Analysis of Gloucester County's Vulnerability to Hazards

As discussed in Section 6 of this Plan (Hazard Identification), Gloucester County has at least some exposure to as many as 32 hazards, but most of them have such low probability of occurrence that there is little or no serious risk to the county. Section 6 described the process by which the county reduced the list of 32 possible hazards to the six countywide hazards that create the most risk to Gloucester County's citizens, assets and operations: flood, high wind−straight-line winds, severe storm−winter weather, earthquake/geological, dam failure, and levee failure. Additionally, the wildfire hazard was included for more detailed risk assessments for the Townships of Franklin and Monroe.

This section addresses risks related to these six countywide hazards (plus one municipality specific hazard), and provides projected future losses from them, in accordance with the Federal Emergency Management Agency (FEMA) requirements. The most significant natural hazard to which Gloucester County is exposed is clearly flooding. The county has a well-established history of floods, mainly along the Delaware River and Mantua Creek. Figure 7.2-1 below identifies the FEMA flood zones along these two rivers and other areas of western Gloucester County. In the Borough of Westville, the county has conducted limited activities to mitigate flood risk. The county's risk from high wind−straight-line winds, severe storm−winter weather, earthquakes/geological, dam failure, and levee failure is less than for floods, so the risk calculations are somewhat less detailed than those related to floods.

Figure 7.2-1
Northwest Portion of Gloucester County, Floodplain Map
Delaware River and Major Tributaries
(Source: FEMA and NJDEP)

7.3 Estimate of Potential Losses (Risk Assessment)

This section describes the risks to Gloucester County, including its citizens, residential, government, and commercial assets from a set of pre-identified countywide hazards. These include flooding, wind, and to a much lesser degree, winter storms, earthquakes, dam failure, and levee failure. .As noted above, risk is an expression of expected future monetary losses resulting from the impacts of natural hazards.

The Gloucester County Planning Division indicates the entire county comprises approximately 215,000 acres. Of this total, 55,100 acres were categorized as developed land in 2002. The U.S. Census Bureau estimated that there were 106,677 housing units in Gloucester County as of 2007. Table 7.3-1 summarizes the number of acres per land use category for Gloucester County.

Table 7.3-1
Gloucester County Estimated Land Use Inventory, 2002
(Source: Gloucester County Planning Division)

Land Use Category	Acres
Developed Land	55,100
Agriculture	55,600
Wetlands	12,600
Water	9,400
Preserved farmland, open space	17,200
Vacant Land	65,300
Grand Total	**215,200**

7.3.1 Flood Risk in Gloucester County

This subsection of the Plan provides estimates of future flood losses, i.e. risk. Each of the loss calculations is based on best available data, but they must be considered estimates because highly detailed engineering was not performed as part of this planning process. The first subsection, following the table, provides a very general picture of the various land uses in FEMA-designated flood zones in Gloucester County.

Background and Flood Vulnerability

Table 7.3.1-1 provides the estimated total acreage of Gloucester County's predominant asset classes in designated flood zones A through X (see flood zone descriptions below table). Note that the figure for total acreage shown below—just over 112,000—is less than the acreage of the entire county; this is because some of the less significant asset classes such as wetlands, forested lands, and military installations are not included in the total. In addition to some of the categories being excluded, the flood zone for a small portion of Gloucester County is undefined, and therefore not included in the total.

Table 7.3.1-1
Gloucester County: Land Area (Acres) of Predominant Asset Classes In Designated Flood Zones A Through X
(Source: NJDEP)

Land Use/Flood Zone	A	AE	X500	X	Total
Agriculture	870	1,530	1,396	52,689	56,485
Commercial	30	133	122	4,071	4,355
Industrial	18	376	512	2,560	3,466
Residential	431	913	886	35,632	37,863
Transportation/Communication/Utilities	94	260	233	2,638	3,226
Urban	75	577	524	5,495	6,671
Grand Total	**1,518**	**3,788**	**3,675**	**103,085**	**112,066**

The flood zone designations are defined as follows.

- Zone A. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
- Zone AE. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- X500. Areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.
- Zone X. Areas outside the 1% annual chance floodplain and 0.2% chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1', areas of 1% annual chance stream flooding where the contributing drainage area is less than one square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone.[1]

Table 7.3.1-2 shows areas and values for various land uses in Gloucester County in FEMA-designated flood zones A and AE. The values of the agriculture, commercial, industrial and residential assets and contents were estimated based on data extracted from the FEMA Hazards US (HAZUS) software in the fall of 2007. HAZUS was developed by FEMA, and is a risk assessment software program used to analyze potential losses from floods, hurricane winds, and earthquakes. The HAZUS program uses current scientific and engineering knowledge coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before or after a disaster occurs.[2] The figures should be considered estimates of values. The A and AE flood zone values were determined based on a percentage of the land use data. Note that the roadway value calculation is left out of the value columns because these cannot be identified through open-source methods, and because it is assumed they are not particularly susceptible to the effects of low-level floods. No specific building data was available for the transportation, communication, utilities, and urban categories, and therefore these categories are also not included in the value columns of the table.

[1] FEMA. Retrieved from http://www.fema.gov/
[2] FEMA-HAZUS. Retrieved from http://www.fema.gov/plan/prevent/hazus/

Table 7.3.1-2
Areas (In Acres) and Values for Various Gloucester County Asset Classes in the 100-Year Floodplain (Flood Zones A and AE)
(Sources: NJDEP, HAZUS Query–Fall 2007)

Land Use	Zones A and AE (Acres)	Asset Class Total (Acres)	% in A/AE Zone	HAZUS (Total Value)	Value in A/AE Zone
Agriculture	2,400	56,485	4.25%	$80,902,000	$3,437,183
Commercial	163	4,355	3.73%	$3,497,256,000	$130,426,258
Industrial	394	3,466	11.35%	$1,761,208,000	$199,876,038
Residential	1,344	37,863	3.55%	$18,857,500,000	$669,644,521
Transportation/ Communication/Utilities	354	3,226	11.00%	----------	----------
Urban	652	6,671	9.77%	----------	----------
Grand Total	**5,306**	**112,066**	**4.74%**	----------	----------

At the time this initial version of the Plan was developed (2008 – 2009), FEMA and the State of New Jersey were engaged in the Map Modernization Program, which will improve and digitize floodplain maps across the State. Gloucester County's maps are scheduled for completion and adoption in 2009. The improved maps will facilitate more accurate determination of acres in the floodplain, and will increase the accuracy of site-specific risk assessments, particularly when Flood Insurance Studies are also updated. A short description of the Map Modernization effort and a map showing the adoption schedule can be found at the following web site: http://www.nj.gov/dep/floodcontrol/about.htm.

Method 1
Risk Estimate based on Area of Asset Classes in Various Flood Zones

The first method used to estimate the flood risk in Gloucester County is to use the estimates of total acreage and value of structures that are in FEMA-identified flood zones, as shown above. As shown in Tables 7.3-1 and 7.3-2 above, the county has 5,306 acres of built space in FEMA A and AE flood zones, 3,675 acres in zone X500, and 103,085 acres in zone X. Zones A and AE are designated 100-year flood areas; i.e. they have at least a 1% annual chance of flooding. The X500-year column identifies the area between the 100-year and 500-year flood. The X designation indicates that a particular place is determined outside the 500-year floodplain. In order to estimate the risk to these assets, the total value of the asset classes in each flood zone is multiplied by the probability. For example,

$2,244,645 (residential/single-unit/low density) X 0.002 (500-year probability) = $4,489 (risk)

It is recognized that this method has some uncertainty because it does not consider the variability of damage within the various flood zones due to the specific location and type of structures. However, it does offer a good proxy calculation to show the overall relative flood risk. Table 7.3.1-3 shows the estimated annual flood risk to these various asset classes.

Table 7.3.1-3
Estimated Annual Flood Risk for Various Gloucester County Asset Classes In Flood Zones A and AE
(Sources: HAZUS, RS Means)

Land Use	Asset Values	Annual Risk	100-Year Risk
Agriculture	$3,437,183	$34,372	$490,486
Commercial	$130,426,258	$1,304,263	$18,611,827
Industrial	$199,876,038	$1,998,760	$28,522,311
Residential	$669,644,521	$6,696,445	$95,558,273
Total	**$1,003,384,002**	**$10,033,840**	**$143,182,897**

Method 2
Analysis of NFIP Repetitive Loss and Severe Repetitive Loss Data

The second risk assessment method is based on an analysis of National Flood Insurance Program (NFIP) data on repetitive flood loss (RL) and severe repetitive loss (SRL) properties. The NFIP defines repetitive loss properties as those that have submitted at least two insurance claims of more than $1,000 in a 10 year period. As of March 2008, Gloucester County had 16 such properties, based on a query of the FEMA BureauNet NFIP interface. Of these, 15 properties were residential and one non-residential. SRL properties are discussed in greater detail further in this section.

Residential Repetitive Loss Properties

Table 7.3.1-4 provides a summary of residential repetitive flood insurance claims for communities within Gloucester County. The table includes the number of repetitive loss properties in each municipality, building and contents damages, the total number of claims, and the average claim amounts. As mentioned above, these figures are from an NFIP query performed in March of 2008 and include the April, 2007 floods.

Table 7.3.1-4
Summary of Residential NFIP Repetitive Loss Statistics, Gloucester County, Ordered by Number of Repetitive Loss Properties in Each Municipality
(Source: FEMA NFIP Query March 2008)

Municipality Name	Properties	Building	Contents	# Claims	$ Claims	Average
West Deptford, Township of	8	$152,763	$38,101	21	$190,864	$9,089
Logan, Township of	2	$20,602	$0	6	$20,602	$3,434
Mantua, Township of	2	$120,516	$33,888	5	$154,403	$30,881
Deptford, Township of	1	$8,759	$5,154	3	$13,913	$4,638
National Park, Borough of	1	$2,695	$0	2	$2,695	$1,348
Washington, Township of	1	$2,326	$1,017	2	$3,343	$1,671
Total/Average	**15**	**$307,660**	**$78,160**	**39**	**$385,820**	**$9,893**

The data in Table 7.3-5 suggests that much of the flood risk in Gloucester County appears to be concentrated in the Township of West Deptford, although several others have at least some minor history of flood losses. In West Deptford, Logan, and Mantua there is a relatively large ratio between the amounts of the claims for building damages versus contents damages. To a degree this may be a result of the flood insurance policies, but it more likely suggests that in these areas basements are being flooded, and that over time the owners have limited the amount of contents stored below grade because they are aware of the flood risk.

Non-Residential Repetitive Loss Properties

As noted earlier, as of April 2008, Gloucester County had only one non-residential repetitive loss property in the NFIP database. This property has experienced two losses totaling $15,219, including both structure and contents damages.

The series of maps below display information about the residential and non-residential repetitive flood loss insurance claims in Gloucester County. The first map (Figure 7.3.1-1) highlights the numbers of insurance claims by property. The second map (Figure 7.3.1-2) shows the cumulative amounts of insurance claims for the same properties.

Figure 7.3.1-1
NFIP Repetitive Loss and SRL Flood Insurance Claims for Gloucester County
(Source: FEMA)

Note: Two of the 16 repetitive loss property addresses were unable to be mapped. The unmapped properties are located in the Townships of West Deptford and Mantua.

The following map highlights the total value per property of NFIP repetitive loss and SRL flood insurance claims in Gloucester County.

Figure 7.3.1-2
Value of NFIP Repetitive Loss and SRL Flood Insurance Claims for Gloucester County
(Source: FEMA)

Note: Two of the 16 repetitive loss property addresses were unable to be mapped. The unmapped properties are located in the Townships of West Deptford and Mantua.

The repetitive loss claims can be further broken down from listing by municipality to focusing on individual streets level data. Table 7.3.1-5 provides a summary of residential repetitive loss claims for individual streets within Gloucester County. Address data about individual sites is omitted for reasons of confidentiality.

The information displayed in the table summarizes the NFIP repetitive loss data for each of the individual streets in the county that includes a repetitive loss property. The data is combined for streets with multiple repetitive loss properties.

Table 7.3.1-5
Summary of Residential NFIP Repetitive Loss Statistics, Gloucester County, Ordered By Number of Repetitive Loss Properties on Each Street
(Source: FEMA NFIP Query March 2008)

Municipality Name	Properties	Building	Contents	Total	Claims	Average
Logan, Township of	2	$20,602	$0	$20,602	6	$3,424
West Deptford, Township of	1	$52,483	$22,858	$75,341	7	$10,763
West Deptford, Township of	1	$22,496	$10,000	$32,496	2	$16,248
West Deptford, Township of	1	$12,501	$0	$12,501	2	$6,250
West Deptford, Township of	1	$13,675	$5,243	$18,918	2	$9,459
West Deptford, Township of	1	$34,575	$0	$34,575	2	$17,287
West Deptford, Township of	1	$11,019	$0	$11,019	2	$5,510
West Deptford, Township of	1	$2,595	$0	$2,595	2	$1,298
West Deptford, Township of	1	$3,419	$0	$3,419	2	$1,709
Mantua, Township of	1	$100,130	$28,307	$128,437	3	$42,812
Mantua, Township of	1	$20,385	$5,581	$25,966	2	$12,983
National Park, Borough of	1	$2,695	$0	$2,695	2	$1,348
Washington, Township of	1	$2,326	$1,017	$3,343	2	$1,617
Total/Average	**14**	**$298,901**	**$73,006**	**$371,907**	**36**	**$10,331**

Figure 7.3.1-3 on the following page highlights the total value per property of NFIP residential repetitive loss flood insurance claims for the Township of West Deptford. A map is shown for this municipality based on the order of Table 7.3.1-4.

Figure 7.3.1-3
Value Of NFIP Repetitive Loss Flood Insurance Claims For The Township Of West Deptford, New Jersey
(Source: FEMA)

Note: One of the eight repetitive loss property addresses in West Deptford was unable to be mapped, and therefore excluded.

In the past few years the Borough of Westville intended to take action to mitigate flood damage to one repetitive loss properties in Gloucester County, however, the project was not completed, as shown in Table 7.3.1-6.

Table 7.3.1-6
Mitigated Repetitive Loss Properties in Gloucester County
(Source: FEMA NFIP Query March 2008)

Street Name	Municipality Name	Community Number	NFIP Paid Claims	Cumulative NFIP Claims Paid	Mitigation Type
Timber Avenue	Westville, Borough of	340215	2	$3,584	intended acquisition; redevelopment project (and mitigation) halted
Total	**----------**	**------**			**---------**

Flood Risk to Residential Properties

This subsection provides estimated future losses to repetitive flood loss properties in Gloucester County, based on a simple methodology that uses the FEMA default present-value coefficients from the benefit-cost analysis software modules. To perform this calculation, the repetitive loss data was reviewed to determine an approximate period over which the claims occurred. There is not an exact method of doing this, because there are numerous properties in the database, and insurance policies come into force at different times, and are cancelled and reinstated periodically; these variables are not part of the query output. With the exception of several flood claims in 1978, almost all of the claims in the most recent NFIP query occurred between the mid-1980s and the present, a period of about 23 years.

As shown in Table 7.3.1-7, there have been 36 claims in the 23-year period, for an average number of 1.57 claims per year. Based on a 100-year horizon and a present value coefficient of 14.27 (the coefficient for 100 years using the mandatory Office of Management and Budget (OMB) discount rate of 7.0%), the projected flood risk to these properties is shown at the bottom of the table. It must be understood that individuals can obtain and cancel flood insurance policies, and that flood hazard depends on many variables, including the weather, so this projection is simply an estimate of potential damages. Nevertheless, it offers a useful metric for assessing the potential cost effectiveness of mitigation actions.

Table 7.3.1-7
Projected 100-Year Flood Risk in Gloucester County
Repetitive Loss Areas
(Source: FEMA NFIP Query March 2008)

Data	Value
Period in years	23
Number of claims	36
Average claims per year	1.57
Total value of claims	$371,907
Average value of claims per year	$16,170
Projected risk, 100-year horizon	$230,744

The next table (7.3.1-8) shows risk projections for the three streets that appear to have the most risk, based on NFIP repetitive loss records. These projections are done in the same manner as the overall projection that is described above. Note that the projected 100-year risk per policy for all three streets is very similar. This risk figure is a good basis for determining the total amount that can be spent (either overall, or per typical property) on mitigation actions, although the ultimate cost effectiveness is also a function of the effectiveness and useful life of the project itself.

Table 7.3.1-8
Projected 100-Year Flood Risk, Select Streets in Gloucester County With Highest Number of Repetitive Flood Loss Claims In NFIP Database
(Source: FEMA NFIP Query March 2008)

Creek Road	
Total claims	7
Average claims per year	0.304
Total value of claims	$75,341
Average value of claims per year	$3,275
Projected risk, 100-year horizon	$46,744
Number of claimants	1
Projected risk per policy, 100-year horizon	$46,744
Island Road	
Total claims	6
Average claims per year	0.26
Total value of claims	$20,602
Average value of claims per year	$896
Projected risk, 100-year horizon	$12,782
Number of claimants	2
Projected risk per policy, 100-year horizon	$6,391

Flood Risk to Non-Residential Properties

As noted in the section above, there are insufficient flood insurance claims history for non-residential properties to allow a risk estimate based on this methodology. It may be useful to examine the flood risk for the single non-residential property in the data set, but as noted, the total flood insurance claims are only $15,219.

Severe Repetitive Loss Properties

In 2004 FEMA began to develop the SRL Grant Program in an effort to reduce or eliminate flood damages to residential properties that met certain minimum requirements. FEMA initiated the program early in 2008. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building

Gloucester County has only one property on the SRL list. It is located on Creek Drive in the Township of West Deptford. The following table provides loss estimates for this property. As part of their initiation into the SRL grant program, FEMA provided states with actuarial calculations of risk (maximum benefits of mitigation) for 30-year and 100-year planning horizons for SRL properties.
The data provided by FEMA includes more details about claims histories at the policy level, but that information is not included here because of data confidentiality limitations. The information can be obtained from Gloucester County on a need-to-know basis.

The columns labeled *30-year Risk* and *100-year Risk* show the expected future losses over those planning horizons. It should be noted that the FEMA methodology does not express a complete range of potential risk (and benefits if the data is used in a Benefit-Cost Analysis (BCA) for a mitigation project), so individual properties should not be dropped from consideration for mitigation based solely on this calculation. More extensive risk assessment and benefit-cost analysis would include additional loss calculations that would likely increase the apparent risk along with the concomitant benefits of reducing or eliminating it. Note that the Creek Drive property in Table 7.3-9 and the one in Table 7.3.1-9 are the same, the difference in estimated risk is a function of the type of analysis that was used for each analysis. A fuller site-specific analysis would yield additional risks (benefits if mitigation is undertaken for the property).

Table 7.3.1-9
FEMA NFIP Actuarial Calculation of Potential Maximum Benefits
For Mitigating an SRL Property
(Sources: FEMA/NFIP Query March 2008)

Municipality Name	Street Name	Paid Claims	Cumulative Claims	30-Year Risk	100-Year Risk
West Deptford, Township of	Creek Drive	7	$75,341	$74,308	$85,447
Total		**7**	**$75,341**	**$74,308**	**$85,447**

Flood Risk to Gloucester County Public Assets

Detailed engineering assessments are required to accurately calculate flood risk to public facilities. Without engineering study, the best source of vulnerability and risk data about public facilities is from insurance records or FEMA Public Assistance program Project Worksheets. After Presidentially-Declared Disasters, FEMA engineers visit communities to determine the nature and dollar amount of damages, so that federal funds can be provided to the community.

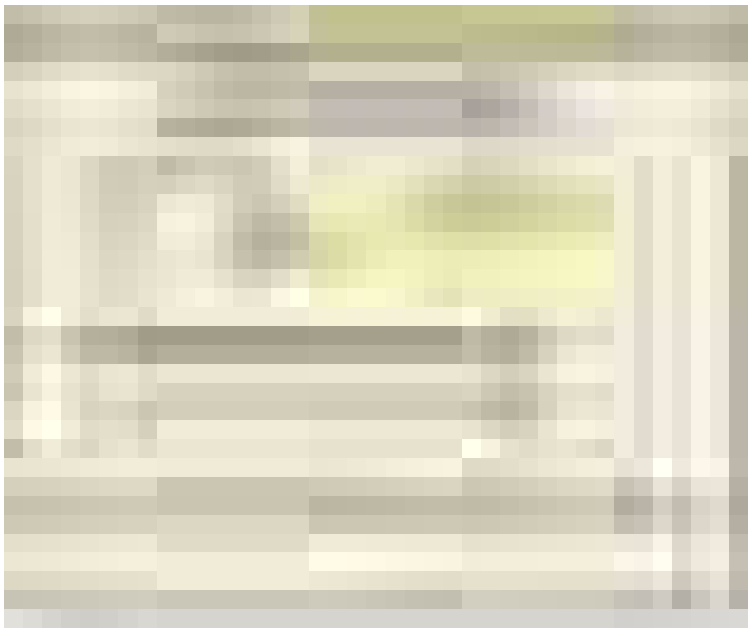
Research on damage to public facilities in Gloucester County showed that the county has experienced very few hazard-related impacts. As noted elsewhere in the plan, the county was part of two recent Presidential- Disaster Declarations (DR-1588-NJ, in 2005 and DR-1694, in 2007), but federal payments (outside of flood insurance) were limited to Individual Assistance. Since these disaster declarations did not include funding associated with the FEMA Public Assistance program, an analysis of public assets was not performed as part of the risk assessment.

7.3.2 Wind Risk in Gloucester County

This subsection describes the risk assessment for hurricane winds in Gloucester County. The calculations are done using the FEMA Full Data Hurricane Wind Benefit-Cost Analysis module. Data about various asset classes were extracted from the FEMA HAZUS database in the fall of 2007.

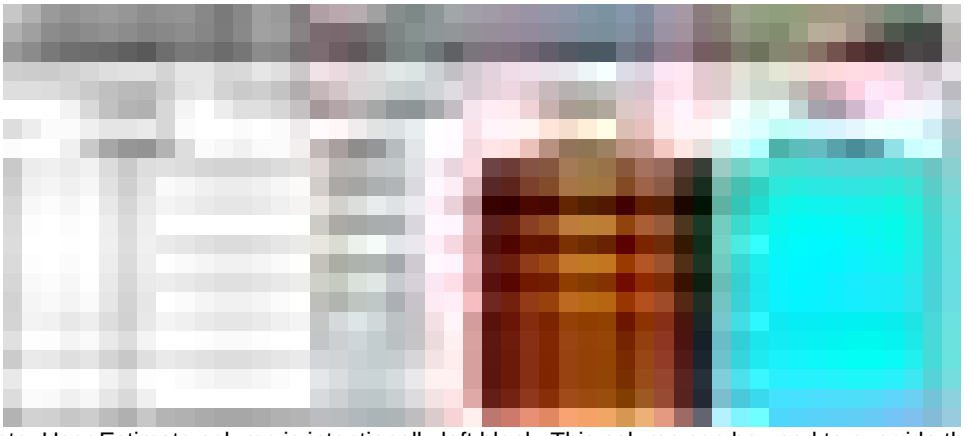
The first step in the risk assessment process is to determine wind profiles for the county, using the FEMA wind hazard and damage function database (BC Analysis Toolkit). Figure 7.3.2-1 shows the wind hazard profiles for Gloucester County at ZIP code 08028. This ZIP code (for Glassboro) was used because it is near the central geographic point of the county. There is very little wind speed differential across the county, so these figures can be considered reasonably accurate for all of Gloucester County.

Figure 7.3.2-1
Gloucester County Wind Hazard Profiles
(Source: FEMA Wind Hazard Database (BCA Toolkit))



The wind risk assessment for the county was conducted using the FEMA Hurricane Wind BCA software and the FEMA wind database on the BCA Toolkit Version 3.0. All figures are based on 100-year time horizon and a 7% discount rate to determine net present value of the risk. Table 7.3.2-1 shows the expected annual number of hurricane wind storms in Gloucester County by class.

Table 7.3.2-1
Expected Annual Number of Wind Storms by Class, Gloucester County
(Source: FEMA Full-Data Hurricane Wind BCA module)



Note: User Estimate column is intentionally left blank. This column can be used to override the default estimates calculated by the module.

Estimated Hurricane Wind Risk to Public and Private Assets

Damage functions for all structure types are verbatim from the FEMA software; the FEMA/HAZUS structure and roof types used in the analysis are noted in Table 7.3.2-2. Note that these assumptions are intended only to provide a general estimate of potential wind risk. Specific mitigation projects will require more detailed engineering assessments. The major roadways, transportation, communications, and utilities classes were not assessed as part of this plan because most of these are unique and require detailed engineering studies in order to be accurate.

Table 7.3.2-2
Abbreviations for HAZUS Structure Types
(Source: HAZUS)

HAZUS Structure Type	Roof Type	Abbreviation
Wood framed non-engineered gable	Gable	WMUH1 #1
Steel frame engineered commercial	Flat	SECBL #28
Masonry Industrial (Reinforced)	Flat	MLRI #25
Pre-engineered metal building	Flat	SPMBL #42
Masonry non-engineered reinforced gable	Gable	MERBL #13
Concrete engineered commercial	Flat	CECBL #35
Masonry non-engineering reinforced hip	Hip	MERBL #14

The FEMA HAZUS software was queried in fall 2007 to determine structure and content values for a range of land use categories in Gloucester County. The HAZUS query results include only the estimated dollar value for each category and not the total square footage. The results for Gloucester County are shown in Table 7.3.2-3. Values are in thousands of dollars. Following this table is a description of how the square footage estimates were calculated.

Table 7.3.2-3
Gloucester County: Square Footage and Value (In Thousands) For Predominant Asset Classes
(Source: HAZUS Version MR1 (v.1.1) Fall 2007)

Land Use Category	HAZUS Building Type	Total Square Footage	Structure Value (HAZUS)	Contents Value (HAZUS)
Residential	WMUH1 #1	100,553,880	$12,569,235,000	$6,288,265,000
Commercial	SECBL #28	11,598,407	$1,707,991,000	$1,789,265,000
Industrial	MLRI #25	6,721,259	$789,446,000	$971,762,000
Agriculture	SPMBL #42	455,151	$40,451,000	$40,451,000
Education	MERBL #13	669,059	$109,300,000	$126,682,000
Government	CECBL #35	165,516	$26,987,000	$29,186,000
Religious	MERBL #14	588,101	$116,305,000	$116,305,000
Total	**-------**	**120,751,373**	**$15,359,715,000**	**$9,361,916,000**

The online RS Means Quickcost Estimator was used to estimate the dollar per square foot cost for each land use category. The ZIP code 08028 (Glassboro) was again used because of its central location in the county. For each asset, estimates were made about the average building square footage and a typical facility type for each land use category. Table 7.3.2-4 summarizes the assumptions and results for each land use category, with the exception of residential which was estimated to be $125 per square foot (SF).

Table 7.3.2-4
Gloucester County: Predominant Asset Classes
Assumptions and Results of RS Means Quickcost Estimator

Land Use Category	Average Building SF	Building Type	$ Per SF Cost	Basis Construction Type	Construction Cost
Agriculture	25,000	Warehouse (Representing Barn/Storage)	$89	Tilt-up Concrete Panels/Steel Frame	$2,221,843
Commercial	35,000	Office Two-Four Story	$147	Face Brick with Concrete Block Back Up/Wood Joist	$5,154,129
Education	50,000	Junior High School	$163	Face Brick with Concrete Block Back Up/Steel Frame	$8,168,192
Government	30,000	Police Station	$163	Limestone with Concrete Block Backup	$4,891,426
Industrial	75,000	Factory (Three Story)	$117	Face Brick, Common Brick Backup/Steel Frame	$8,809,131
Religious	5,000	Church	$198	Decorative Concrete Block/Wood Arch	$988,818

The output from the Quickcost Estimator includes low, medium, and high construction cost ranges. The medium construction cost was used in the present analysis. Figure 7.3.2-2 provides a sample of the RS Means output for the education category, a two-three story Junior High School. Note that although the ZIP code for the Borough of Glassboro was entered as the project location, the estimating tool changed the location to Vineland, New Jersey. This is because Vineland is the closest city included in the Quickcost Estimator database.

Figure 7.3.2-2
RS Means Quickcost Estimator
Education Asset Class Results

Wind risk for Gloucester County assets is then calculated using the FEMA Full-Data Hurricane Wind BCA module and the wind damage functions in the FEMA wind hazard database (FEMA BCA Toolkit). The assessment uses a 100-year time horizon. Data parameters used in the Wind BCA Module as part of the risk assessment are described in Table 7.3.2-5.

Table 7.3.2-5
Data Parameters Entered Into BC Module for Each Asset Class

Data Field	Values per Category
Rental Cost of Temporary Building Space	▪ Government: $1 per SF/Month ▪ Agriculture: $1 per SF/Month ▪ Education: $1 per SF/Month ▪ Commercial: $1 per SF/Month ▪ Industrial: $2 per SF/Month ▪ Religious: $1 per SF/Month ▪ Residential: $1 per SF/Month
Other Costs of Displacement	▪ Government: $165,615 per month ▪ Agriculture: $455,151 per month ▪ Education: $669,059 per month ▪ Commercial: $11,598,407 per month ▪ Industrial: $13,442,518 per month ▪ Religious: $588,101 per month ▪ Residential: $100,553,800 per month
One Time Displacement cost	▪ Government: Equal to Building SF ▪ Agriculture: Equal to Building SF ▪ Education: Twice the building SF ▪ Commercial: Equal to Building SF ▪ Industrial: Twice the building SF ▪ Religious: Equal to Building SF ▪ Residential: Equal to Building SF
Annual Budget	▪ Education: $150 per SF ▪ Government: $200 per SF ▪ Remaining Categories: $0
Estimated Net Income of Commercial Business	▪ Commercial: $100 per SF ▪ Industrial: $200 per SF ▪ Agriculture: $25 per SF ▪ Remaining Categories: $0

The data parameters described above are then used in the FEMA Hurricane Wind BC Analysis module to calculate hurricane wind risk for Gloucester County. Tables 7.3.2-6 and 7.3.2-7 summarize the results of the analysis. The last column *100-year Wind Risk* indicates the estimated cumulative wind damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value.

In Table 7.3.2-6, the data is sorted by 100-year risk. This table shows the wind risk by building category and the total wind risk for Gloucester County assets from hurricanes. Although these figures seem relatively high, it should be noted that this hazard (hurricane wind) affects all the assets in Gloucester County about equally, whereas flooding generally affects only those assets or operations that are close to flood sources. The last column *100-year Wind Risk* indicates the cumulative expected wind damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value. Table 7.3.2-7 sorts the data by risk per square foot. When sorted by risk per square foot the government and commercial categories move to the top of the list.

Table 7.3.2-6
Estimated Hurricane Wind Risk to Gloucester County Assets, Ordered by 100-Year Risk
(Sources: HAZUS Query Fall 2007, FEMA Hurricane Wind BCA Module)

Land Use Category	HAZUS Structure Type	Total SF	Risk per SF	Annual Building Damages	Annual Content Damages	Annual Displacement Costs	Business Income Lost	Annual Public Services Lost	Total Annual Damages	100-Year Risk
Residential	WMUH1	100,553,880	$0.90	$3,604,413	$708,478	$1,969,840	$0	$47,529	$6,630,260	$90,328,069
Commercial	SECBL	11,598,407	$3.84	$1,312,647	$1,098,417	$548,372	$147,611	$15,008	$3,122,054	$44,549,377
Industrial	MLRI	6,721,259	$0.94	$570,993	$370,368	$607,838	$179,822	$7,291	$1,736,312	$6,314,473
Education	MERBL	455,151	$2.49	$30,548	$23,723	$19,327	$0	$5,779	$79,377	$1,132,653
Government	CECBL	669,059	$1.11	$21,575	$17,917	$8,070	$0	$4,543	$52,105	$743,503
Religious	MERBL	165,516	$4.12	$24,499	$13,275	$9,648	$0	$327	$47,749	$681,342
Agriculture	SPMBL	588,101	$1.51	$27,701	$19,850	$12,993	$1,401	$344	$62,289	$888,813
Total	**-----**	**120,751,373**	**$1.20**	**$5,592,376**	**$2,252,028**	**$3,176,088**	**$328,834**	**$80,821**	**$11,730,146**	**$144,638,230**

Table 7.3.2-7
Estimated Hurricane Wind Risk to Gloucester County Assets, Ordered by Risk per Square Foot
(Sources: HAZUS Query-Fall 2007, FEMA Hurricane Wind BCA Module)

Land Use Category	HAZUS Structure Type	Total SF	Risk per SF	Annual Building Damages	Annual Content Damages	Annual Displacement Costs	Business Income Lost	Annual Public Services Lost	Total Annual Damages	100-Year Risk
Religious	MERBL	165,516	$4.12	$24,499	$13,275	$9,648	$0	$327	$47,749	$681,342
Commercial	SECBL	11,598,407	$3.84	$1,312,647	$1,098,417	$548,372	$147,611	$15,008	$3,122,054	$44,549,377
Education	MERBL	455,151	$2.49	$30,548	$23,723	$19,327	$0	$5,779	$79,377	$1,132,653
Agriculture	SPMBL	588,101	$1.51	$27,701	$19,850	$12,993	$1,401	$344	$62,289	$888,813
Government	CECBL	669,059	$1.11	$21,575	$17,917	$8,070	$0	$4,543	$52,105	$743,503
Industrial	MLRI	6,721,259	$0.94	$570,993	$370,368	$607,838	$179,822	$7,291	$1,736,312	$6,314,473
Residential	WMUH1	100,553,880	$0.90	$3,604,413	$708,478	$1,969,840	$0	$47,529	$6,630,260	$90,328,069
Total	**-----**	**120,751,373**	**$1.20**	**$5,592,376**	**$2,252,028**	**$3,176,088**	**$328,834**	**$80,821**	**$11,730,146**	**$144,638,230**

Figure 7.3.2-3 is a sample of the results for the agriculture category from the Hurricane Wind Module. The summary of expected annual damages and benefits for each category was used to populate Tables 7.3.2-6 and 7.3.2-7 above.

Figure 7.3.2-3
Hurricane Wind Benefit Cost Module
Agriculture Asset Class: Summary of Expected Annual Damages and Benefits
(Source: FEMA Hurricane Wind BCA Module)

Table 7.3.2-8 summarizes hurricane wind risk for the 23 municipalities within Gloucester County. The municipal-level calculation is done proportionally, using the value of local structural exposure compared to the county level values. This proportion is then multiplied by the same values that are shown in Table 7.3.2-6 to estimate the local risk. It should be noted that these techniques produce risk figures that are very general, and should only be used for the purpose of planning and prioritizing where additional study should be conducted.

Table 7.3.2-8
Estimated Hurricane Wind Risk for Assets in the 23 Gloucester County Municipalities, Ordered by Total 100-Year Risk
(Sources: HAZUS Query Fall 2007, FEMA Hurricane Wind BCA Module)

Municipality Name	Residential	Commercial	Industrial	Agricultural	Education	Government	Religious	Total 100-Year Risk
Washington	$16,768,871	$8,227,150	$207,980	$133,198	$91,731	$51,271	$93,978	$25,574,179
Deptford	$9,826,036	$6,335,904	$119,683	$42,825	$208,323	$124,528	$60,674	$16,717,972
Monroe	$9,755,781	$3,350,246	$425,478	$75,498	$78,571	$67,774	$80,475	$13,833,822
West Deptford	$6,972,156	$4,048,929	$473,366	$49,790	$25,161	$45,265	$40,674	$11,655,340
Glassboro	$6,584,124	$3,286,577	$133,193	$48,823	$329,589	$89,814	$97,622	$10,569,742
Woodbury	$3,584,762	$4,426,479	$125,898	$7,822	$23,430	$187,949	$68,717	$8,425,058
Pitman	$3,423,527	$1,137,580	$2,877,285	$11,250	$5,627	$0	$22,267	$7,477,536
Franklin	$5,175,237	$1,622,357	$105,590	$81,123	$61,182	$0	$29,637	$7,075,125
Mantua	$5,013,707	$1,592,779	$78,042	$66,291	$8,694	$0	$27,850	$6,787,364
Logan	$2,317,196	$2,419,138	$540,762	$2,109	$143,162	$0	$13,708	$5,436,076
Harrison	$3,205,692	$682,903	$42,049	$87,407	$47,835	$17,274	$36,016	$4,119,175
Clayton	$2,409,161	$1,026,258	$322,184	$6,438	$11,047	$63,641	$23,661	$3,862,391
East Greenwich	$2,130,119	$740,390	$59,918	$115,993	$18,560	$20,828	$26,216	$3,112,023
Paulsboro	$2,056,939	$687,259	$28,787	$2,549	$16,114	$27,440	$19,531	$2,838,619
Westville and W.Deptford	$1,569,044	$899,600	$278,136	$21,357	$0	$0	$2,209	$2,770,346
Greenwich	$1,799,650	$811,778	$13,814	$2,109	$0	$0	$0	$2,627,352
Woolwich	$1,241,839	$1,042,795	$87,793	$69,895	$36,259	$12,343	$15,624	$2,506,547
Woodbury Heights	$1,098,275	$628,885	$14,437	$0	$16,446	$0	$0	$1,758,043
South Harrison	$973,073	$502,070	$11,830	$23,071	$0	$0	$5,600	$1,515,644
Elk	$1,107,855	$164,974	$1,312	$5,405	$0	$17,550	$0	$1,297,096
National Park	$1,012,792	$182,241	$0	$5,779	$1,586	$17,825	$10,685	$1,230,908
Swedesboro	$726,053	$398,677	$88,257	$3,120	$6,684	$0	$6,198	$1,228,989
Wenonah	$1,022,659	$101,593	$2,512	$13,667	$2,653	$0	$0	$1,143,084
Newfield	$553,521	$232,816	$276,168	$13,293	$0	$0	$0	$1,075,799
Total	**$90,328,069**	**$44,549,377**	**$6,314,473**	**$888,813**	**$1,132,653**	**$743,503**	**$681,342**	**$144,638,230**

7.3.3 Severe Storm−Winter Weather Risk in Gloucester County

The Nation Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) database lists 94 winter storm/snow/ice events from 1995 to 2007 for Gloucester County. The website does not indicate why the data does not extend back to 1950 as it does for most other hazards. However, the amount of data that is presently on the site is sufficient for a basic risk assessment for Gloucester County. Table 7.3.3-1 shows the basic data required for the assessment; all information is from open sources.

Table 7.3.3-1
Data Parameters for Gloucester Winter Storm Risk Assessment;
Data from the NOAA/NCDC Database, 1995-2007
(Source: NOAA/NCDC)

Data	Value
Winter storm events	94
Average annual number of winter storm events	7.23
Total reported damages	$27,000,000
Annual damages	$2,076,923
Reported deaths	0
Annual deaths	0.0
Value of single death (value in approximate 2008 $)	$3,000,000
Estimated annual cost of deaths from winter storms	$0
Reported injuries	10
Annual injuries	0.77
Value of single injury (FEMA, approximately 1998 value)	$20,000
Estimated annual cost of injuries from winter storms	$15,400

After determining the annual figures for damages, deaths and injuries for the county, the risk assessment comprises a simple projection of future expected damages based on a standard present value coefficient of 14.27. This represents a 100-year time horizon and a 7% discount rate (the latter required by OMB).

Table 7.3.3-2
Estimate of Risk to Gloucester County from Winter Storms

Data	Value
Annual damages to Gloucester County	$2,076,923
Projected risk from direct winter storm damages	$29,637,691
Estimated Annual cost of deaths	$0
Projected risk from winter storm-related deaths	$0
Estimated annual cost of injuries	$15,400
Projected risk from winter storm-related injuries	$219,758
Estimated total risk from winter storms (100-year horizon)	**$29,857,449**

The winter weather risk for Gloucester County can be analyzed in greater detail by focusing on individual municipalities. Specific municipality level winter weather data was not available for Gloucester County from the NCDC database or other sources.

In the absence of this data, the winter weather damages for each municipality were calculated as a proportion of the Gloucester County population. In the year 2000, the US Census Bureau reported that the total population in Gloucester County was 251,641.

For each municipality, the percentage of the county population was calculated. The total winter weather damages for each municipality were then calculated by multiplying the percentage of the county population by $27,000,000, the total winter weather damages for the county for the NCDC period of record, plus the value of injuries ($20,000 per injury X 10 = $200,000).

Table 7.3.3-3 provides a summary of the winter weather risk for each of the 23 municipalities within Gloucester County. For each municipality, the annual damages were calculated by dividing the total damages by 13, the number of years reported in the NCDC database. The last column, *100-year Winter Weather Risk,* indicates the estimated cumulative winter weather damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value. The table shows that the Townships of Washington, Monroe, and Deptford have the highest 100-year winter weather risk. Note that the discrepancy between the total estimated winter storm risk in Table 7.3.3-2 and Table 7.3.3-3 is due to the rounding calculation for percent of county population in the latter table.

Table 7.3.3-3
Estimate of Risk to the 23 Gloucester County Municipalities from Winter Storms, Ordered by 100-Year Risk
(Sources: NOAA/NCDC, US Census Bureau)

Municipality Name	Population	% of County Population	Total Damages	Annual Damages	100-Year Risk
Washington Township	47,114	18.72%	$5,091,840	$391,680	$5,589,274
Monroe Township	28,967	11.51%	$3,130,720	$240,825	$3,436,567
Deptford Township	26,763	10.64%	$2,894,080	$222,622	$3,176,809
West Deptford Township	19,368	7.70%	$2,094,400	$161,108	$2,299,007
Glassboro Borough	19,068	7.58%	$2,061,760	$158,597	$2,263,178
Franklin Township	15,466	6.15%	$1,672,800	$128,677	$1,836,220
Mantua Township	14,217	5.65%	$1,536,800	$118,215	$1,686,934
Woodbury City	10,307	4.10%	$1,115,200	$85,785	$1,224,146
Pitman Borough	9,331	3.71%	$1,009,120	$77,625	$1,107,703
Harrison Township	8,788	3.49%	$949,280	$73,022	$1,042,017
Clayton Borough	7,139	2.84%	$772,480	$59,422	$847,945
Paulsboro Borough	6,160	2.45%	$666,400	$51,262	$731,502
Logan Township	6,032	2.40%	$652,800	$50,215	$716,574
East Greenwich Township	5,430	2.16%	$587,520	$45,194	$644,916
Greenwich Township	4,879	1.94%	$527,680	$40,591	$579,230
Westville Borough	4,500	1.79%	$486,880	$37,452	$534,444
Elk Township	3,514	1.40%	$380,800	$29,292	$418,001
National Park Borough	3,205	1.27%	$345,440	$26,572	$379,187
Woodbury Heights Borough	2,988	1.19%	$323,680	$24,898	$355,301
South Harrison Township	2,417	0.96%	$261,120	$20,086	$286,629
Wenonah Borough	2,317	0.92%	$250,240	$19,249	$274,687

Municipality Name	Population	% of County Population	Total Damages	Annual Damages	100-Year Risk
Swedesboro Borough	2,055	0.82%	$223,040	$17,157	$244,829
Newfield Borough	1,616	0.64%	$174,080	$13,391	$191,086
Total	**251,641**	**100.00%**	$27,208,160	$2,092,935	$29,866,188

7.3.4 Earthquake Risk in Southern Delaware Valley Region Counties

As noted in the Hazard Identification and Profiling section, earthquake risk in New Jersey is concentrated in the northern part of the state, with southern counties also having some risk due to the built environment and population density. The subsections below describe a simplified methodology that uses the FEMA Earthquake Benefit-Cost Analysis software, as well as series of general derived values to estimate earthquake risk in the Southern Delaware Valley Region (SDVR) counties of Camden, Salem, Cumberland, and Gloucester. In addition to the FEMA Earthquake software, earthquake loss estimates for Gloucester County are summarized from the *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States*. As noted, these estimates should be considered valid for planning purposes only. Particular facilities in these counties may have more or less significant risk from earthquakes, depending on structural type, occupancy, and level of criticality.

Probabilistic Earthquake Risk Estimates

In addition to the deterministic earthquake risk assessments described above, which do not incorporate the probabilities of occurrence for the various scenarios, this section also includes probability-based risk estimates that were performed using the FEMA Full-Data Earthquake Benefit-Cost Analysis Module. Calculations were performed for two general asset classes: residential and non-residential. The non-residential class includes industrial, commercial, government, education, and religious assets. As was the case with the hurricane wind risk calculations in a previous section, data regarding the square footage of these various assets was obtained through the HAZUS software. Note that the non-residential asset class of agriculture was not included in these calculations because of the assumed relatively low occupancy of such assets, and the difficulty of assigning a specific structural type to buildings.

Methodology

The FEMA Earthquake BCA software includes default shake data based on ZIP code. ZIP code 08083 was used for this analysis, as it was with the wind calculations, because of its fairly central location in the area. Table 7.3.4-1 shows the default annual probabilities for various levels of ground shaking, expressed as percent ground acceleration (PGA, a percentage of G [gravity]).

Table 7.3.4-1
Earthquake Shake Probabilities for Central Point in the Southern Delaware Valley Region of New Jersey
(Source: FEMA Full Data Earthquake BCA Software Default)

Risk to Residential Assets and People

The shake data is used in combination with information about the value, occupancy, and seismic performance of the asset, to calculate annual and long-term risk. Specific residential building and occupancy parameters are summarized in Table 7.3.4-2 below.

Table 7.3.4-2
Select Data Parameters for Gloucester County Earthquake Risk Estimate-Residential Assets
(Sources: FEMA Full Data Earthquake BCA Software, HAZUS)

Data Type	Value	Note
Residential building type	Wood, light frame	FEMA BCA default W1
Residential structure replacement value	$125/SF	Estimated
Residential contents replacement value	$41.66/SF	FEMA default %
Displacement monthly rental cost	$1.00/SF	FEMA default
One time displacement cost	$1.00/SF	Estimated
Occupancy load	2.5 per 1,000 SF	Derived from US Census/HAZUS

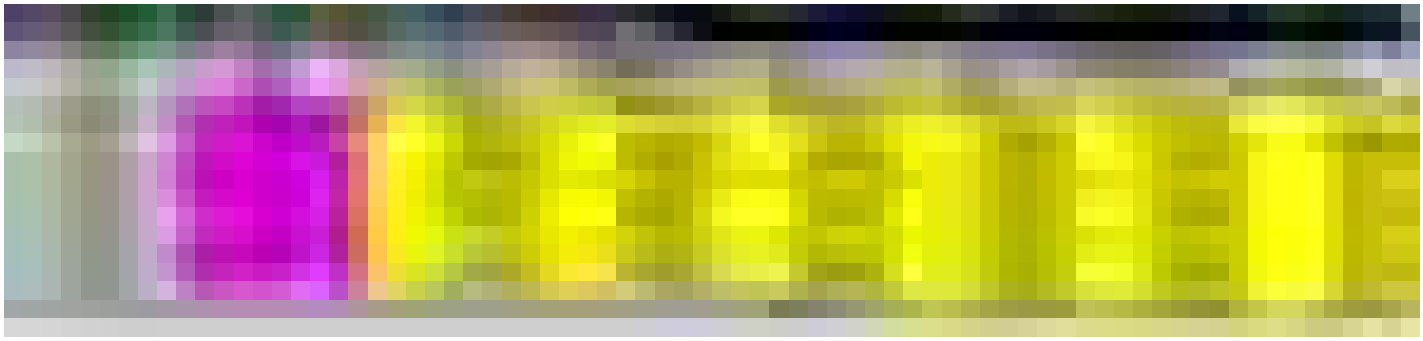
These data are used in the FEMA BCA software module to calculate risk for residential assets. The following two figures show scenario damages to buildings and contents, and displacement costs, by level of shaking. The level of shaking is expressed in percent ground acceleration. The figures do not yet incorporate probabilities.

Table 7.3.4-3
Scenario Building and Contents Damages, and Displacement Costs, by Level of Shaking (PGA), Residential Assets
(Source: FEMA Full Data Earthquake BCA Software)

Note: Figures are per 100,000 square feet of building area.

Table 7.3.4-4 shows similar data related to casualties by level of shaking. The group of columns labeled *Scenario* shows the numbers of expected casualties by magnitude, as related to level of shaking (pga). The group of columns labeled *Expected Annual* shows the annual numbers of expected casualties by magnitude, as related to level of shaking (pga).

Table 7.3.4-4
Scenario Injuries and Deaths by Level of Shaking (PGA)-Residential Assets
(Source: FEMA Full Data Earthquake BCA Software)



Note: Figures are per 100,000 square feet of building area.

Risk to Non-Residential Assets, Operations, and People

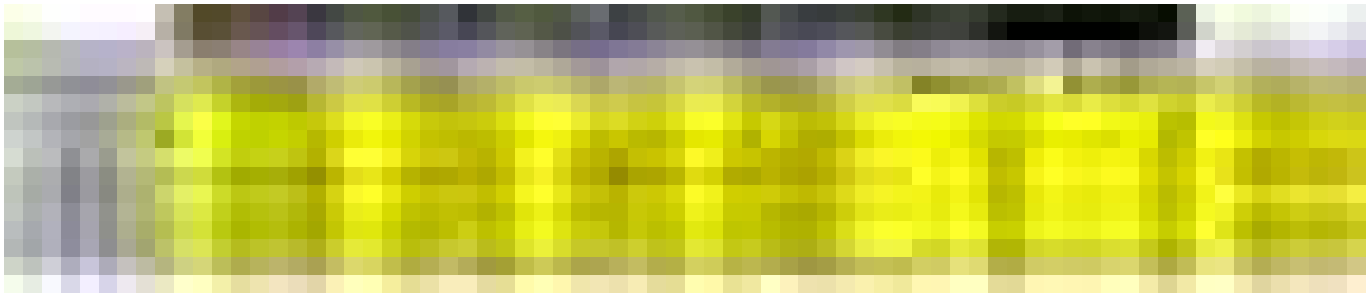
This subsection addresses estimated earthquake risk to non-residential assets, operations, and people. As noted earlier, non-residential assets were combined into a single category in order to simplify the analysis. Basic data parameters are provided in the table below.

Table 7.3.4-5
Select Data Parameters for the SDVR Counties
Earthquake Risk Estimate-Non-Residential Assets
(Sources: FEMA Full Data Earthquake BCA Software, HAZUS)

Data Type	Value	Note
Non-residential building type	Steel frame/unreinforced masonry	Average of types
Non-residential structure replacement value	$140/SF	Estimated
Non-residential contents replacement value	$140/SF	Estimated
Displacement monthly rental cost	$1.00/SF	FEMA default
One time displacement cost	$1.00/SF	Estimated
Occupancy load	10 per 1,000/SF	Derived from census/HAZUS

These data are used in the FEMA BCA software module to calculate risk for non-residential assets. The following two figures show scenario damages to buildings and contents, displacement costs, and operational business losses, by level of shaking. The level of shaking is expressed in percent ground acceleration (pga). The figures do not yet incorporate probabilities. Note that in order to streamline the analysis, public, and non-profit losses were not separately calculated; when facility-specific calculations are required, the FEMA BCA software requires inputs for annual budgets of public and non-profit operations, which must be determined on an individual basis.

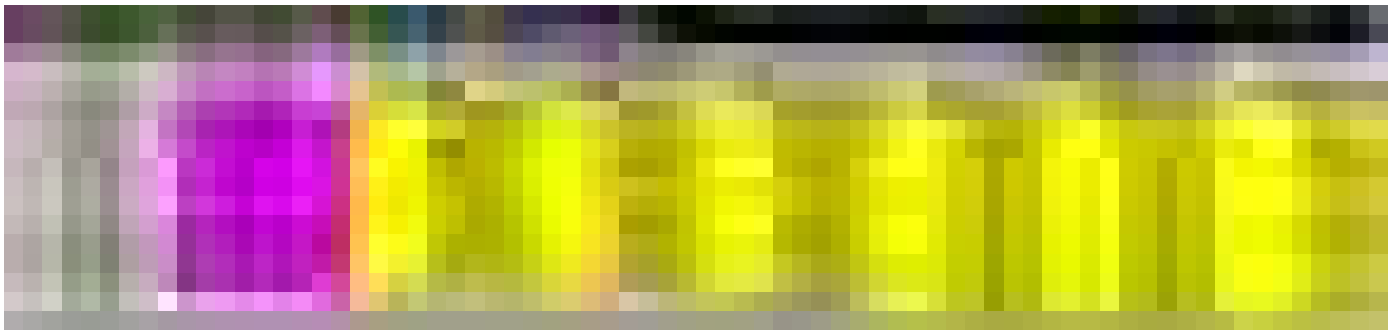
Table 7.3.4-6
Scenario Building and Contents Damages, and Displacement Costs, by Level of Shaking (PGA), Non-Residential Assets
(Source: FEMA Full Data Earthquake BCA Software)



Note: Figures are per 100,000 square feet of building area.

Table 7.3.4-7 shows similar data related to casualties by level of shaking. The group of columns labeled *Scenario* shows the numbers of expected casualties by magnitude, as related to level of shaking (pga). The group of columns labeled *Expected Annual* shows the annual numbers of expected casualties by magnitude, as related to level of shaking (pga).

Table 7.3.4-7
Scenario Injuries and Deaths by Level of Shaking (PGA)-Non-Residential Assets
(Source: FEMA Full Data Earthquake BCA Software)



Note: Figures are per 100,000 square feet of building area.

Earthquake Risk Estimates to Residential and Non-Residential Assets

Tables 7.3.4-8 through 7.3.4-10 summarize earthquake risk to SDVR assets, operations and people. It must be noted that these calculations are based on broad estimates of building types, occupancies and soil characteristics. Northern New Jersey has a moderate degree of known earthquake risk that is related to both the presence of faults and the amount of built environment and people. In many cases, particularly where critical facilities are involved, jurisdictions should initiate limited studies of these facilities in order to identify on a site-specific basis where there are significant risks from earthquakes. The information in this section should be used for planning purposes only, i.e. as the basis for additional steps in risk assessment, and eventually (where warranted) targeted mitigation actions to reduce the risk.

Table 7.3.4-8
Summary of Estimated Earthquake Risk to
Southern Delaware Valley Region County Residential Assets, by County
(Source: FEMA Full Data Earthquake BCA software)

County	Building	Contents	Displacement	Business Loss	Total
Camden	$2,740,087	$0	$197,447	$0	$2,937,535
Salem	$338,806	$0	$24,414	$0	$363,220
Cumberland	$569,286	$0	$41,022	$0	$610,308
Gloucester	$1,367,533	$0	$98,543	$0	$1,466,076
Total	**$5,015,712**	**$0**	**$361,426**	**$0**	**$5,377,138**

Table 7.3.4-9
Summary of Estimated Earthquake Risk to Southern Delaware Valley Region Plan County
Non-Residential Assets and Operations
(Source: FEMA Full Data Earthquake BCA Software)

County	Building	Contents	Displacement	Business Loss	Total
Camden	$7,240,861	$6,765,954	$1,035,595	$21,447,947	$36,490,357
Salem	$936,687	$875,252	$33,897	$2,774,533	$4,620,369
Cumberland	$2,538,203	$2,371,730	$7,077,756	$7,518,339	$19,506,028
Gloucester	$724,086	$4,132,862	$591,086	$12,241,831	$17,689,865
Total	**$11,439,837**	**$14,145,798**	**$8,738,334**	**$43,982,650**	**$78,306,619**

Table 7.3.4-10
Estimated Casualty-Related Earthquake Risk in Southern Delaware Valley Region Counties
(Source: FEMA Full Data Earthquake BCA Software)

Asset Type	Residential			Non-Residential		
Magnitude	**Minor**	**Major**	**Death**	**Minor**	**Major**	**Death**
Rate per 100K s.f.	0.0164	0.0093	0.00441	0.0982	0.0685	0.0331
County						
Camden	$396,507	$374,747	$26,655,407	$407,597	$473,869	$34,346,877
Salem	$49,027	$46,337	$3,295,882	$52,727	$61,300	$4,443,155
Cumberland	$82,379	$77,858	$5,537,981	$142,879	$166,110	$12,039,914
Gloucester	$197,890	$187,030	$13,303,278	$232,644	$270,470	$19,604,146
Total	**$725,803**	**$685,972**	**$48,792,548**	**$835,846**	**$971,749**	**$70,434,092**

Note that the figures in the three tables above are risk projections over a 100-year planning horizon. Annualized risk in the three loss categories can be derived by dividing the 100-year figure by the appropriate present value coefficient of 14.27 (representing the required 7% discount rate and the 100-year horizon). The estimated annualized loss to residential assets is thus $102,738; to non-residential assets $1,239,654; and annual losses from deaths and injuries are estimated at $1,373,801. There are significant differences in the results of this analysis versus the estimates in the following subsection, which describes estimates using the FEMA HAZUS software. These differences are presumably based partly on the expected regional economic losses, which HAZUS incorporates, but the above

methodology does not. In both cases, the results of the studies should be used primarily for the purpose of determining what additional risk assessment or mitigation actions may be indicated by patterns in the data.

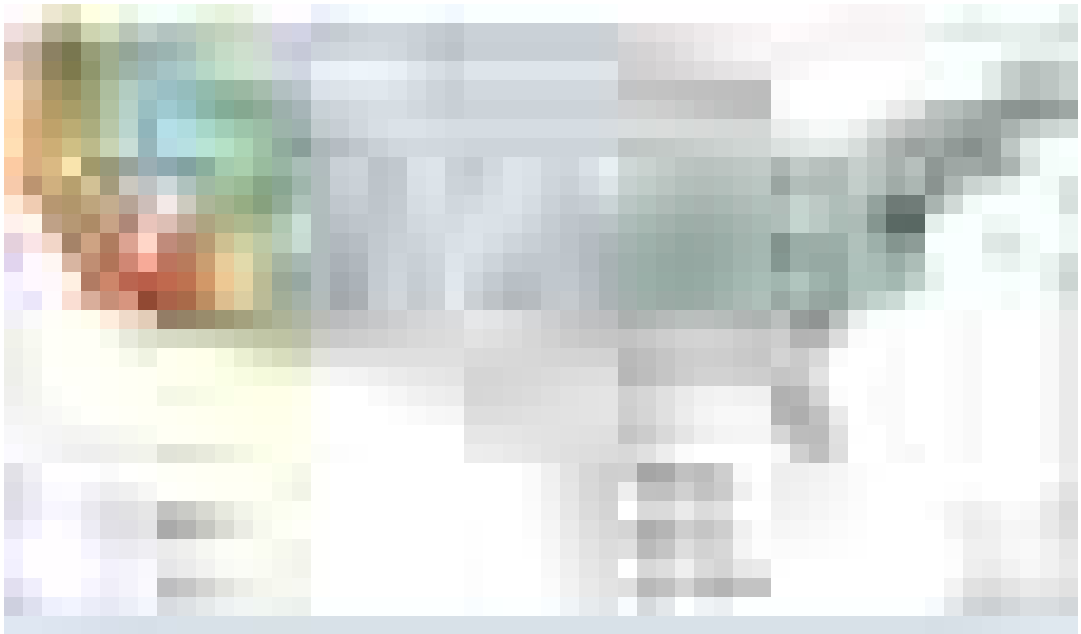
Earthquake Loss Estimates in Gloucester County

In addition to the above risk estimates, which were formulated using the FEMA Earthquake software, the April 2008 FEMA document titled, *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States provides* annualized earthquake loss estimates at the national, regional, State, and County levels. The study is based on loss estimates generated by HAZUS-MH, a geographic information system (GIS)-based earthquake loss estimation tool developed by FEMA in cooperation with the National Institute of Building Sciences (NIBS). The HAZUS tool provides a method for quantifying future earthquake losses[3].

The software incorporates various default data, including building values, shake probabilities, soil types, and damage and mortality/injury functions, as the basis of the probabilistic risk estimates. The study estimated a total countywide building inventory replacement value of between $10 and $50 billion for most counties in New Jersey, including Gloucester.

The study results shows that New Jersey ranks 14th nationally in estimated annual earthquake losses with $39.7 million in annual losses. As shown in Figure 7.3.4-1, the annual estimated earthquake losses for counties in southern New Jersey, including Gloucester County, were estimated between $100,000 and $500,000 (shown as 0.1 to 0.5 million in the legend).

Figure 7.3.4-1
Annual Earthquake Losses (AEL)
(Source: HAZUS Multi-Hazard (MH)
Estimated Annualized Earthquake Losses for the United States, April, 2008*)*



[3] FEMA *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States*

7.3.5 Dam Failure Risk in Gloucester County

This subsection of the Plan discusses the dam failure risk in Gloucester County. As described in Section 6, Hazard Identification and Profiling, the New Jersey Department of Environmental Protection (NJDEP)-Bureau of Dam Safety and Flood Control indentifies 62 dams in Gloucester County. In Section 6, Table 6.3.1-2 lists these dams, including the NJDEP hazard classification, which ranks the potential for loss of life and infrastructure and property damages downstream if a dam failure were to occur. NJDEP has established three hazard classifications: high (H), significant (S), and low (L). See Table 6.3.1-2 in Section 6 for a list of the dams and hazard classifications. The descriptions of the hazard classifications at the bottom of the table are repeated below

- H = High Hazard: Loss of life likely (if failure were to occur)
- S = Significant Hazard: Loss of life not likely but the potential for significant property damage
- L = Low Hazard: Loss of life not likely and minimal infrastructure or property damage other than the structure itself

The Gloucester County Hazard Mitigation Working Group (HMWG) determined that dams that are classified by NJDEP as high hazard would be selected for further analysis as part of the dam failure risk assessment. In Gloucester County there are four high hazard dams. The four dams are summarized below in Table 7.3.5-1.

Table 7.3.5-1
Gloucester County High Hazard Dams
(Source: NJDEP-Bureau of Dam Safety and Flood Control)

Municipality Name	Dam Name	River/Stream	Height (ft)	Length (ft)	Last Date Inspected
Elk Township	Lake Gilman Dam	Raccoon Creek	14	350	4/12/2007
Franklin Township	Franklinville Lake Dam	Little Ease Run Branch	8	800	3/22/2007
Glassboro Borough	Wadsworth Lake Dam	Mantua Creek	19.5	350	2/1/2002
Washington Township	Sterling Lake Dam	Duffield Run	14.5	150	10/21/1997

The HMWG and its consulting engineers determined that to estimate downstream dam failure vulnerabilities, a geographic information system would be used to establish a 500-foot-wide stream buffer extending 1.5 miles downstream of each high hazard dam. This area is then used in combination with population, housing and land use data to determine the degree of exposure downstream. The downstream buffer is shown only to identify the population and development downstream of the dam. *It is important to note that the buffer zone is intended for general planning purposes only, and does not indicate the downstream inundation area if a dam failure were to occur. Inundation areas and zones of potential high- velocity flow are highly site-specific and require detailed engineering study to accurately characterize risk.*

Figures 7.3.5-1 through 7.3.5-4 show commercial, industrial, and residential land use types for each census block intersecting the 500-foot buffer downstream of each high hazard dam. Each map is followed by two tables (Tables 7.3.5-1–7.3.5-8) that identify the population, housing units and the number of acres for each land use category displayed on the map.

Figure 7.3.5-1
Lake Gilman Dam
Land Use/Land Cover for Census Blocks Intersecting a 500-Foot-Wide Buffer
(Source: NJDEP)

Table 7.3.5-1 identifies the population and residential housing units for each of the six census blocks numbers included on the Lake Gilman Dam map (Figure 7.3.5-1).

Table 7.3.5-2
Population and Housing Units for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Lake Gilman Dam
(Source: US Census Bureau-2000 Population)

Municipality Name	Map ID	Block Number	Population	Housing Units
Harrison Township/Elk Township	1	4033	99	34
Harrison Township	2	4997	0	0
Harrison Township/Elk Township	3	4996	0	0
Harrison Township/Elk Township	4	3998	0	0
Elk Township	5	3040	17	8
Harrison Township/Elk Township	6	3008	52	19
Total	**----**	**----**	**168**	**61**

Table 7.3.5-2 identifies the number of acres within each of the six census blocks numbers for the four land use categories identified on the Lake Gilman Dam map (Figure 7.3.5-1). The table shows that the *other* land use category has the highest acreage within the selected census blocks. The *other* category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked after the *other* category in total number of acres and includes a total population of 168 residents and 61 housing units.

Table 7.3.5-3
Land Use/Land Cover (In Acres) for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Lake Gilman Dam
(Source: NJDEP-Dam Safety and Flood Control)

Municipality Name	Map ID	Block Number	Commercial (Acres)	Industrial (Acres)	Other (Acres)	Residential (Acres)	Grand Total
Harrison Township/ Elk Township	1	4033	0.07	0	91.49	43.62	135.18
Harrison Township	2	4997	0	0	0.76	0	0.76
Harrison Township/ Elk Township	3	4996	0	0	6.88	0.71	7.59
Harrison Township/ Elk Township	4	3998	0	0	10.48	0.04	10.52
Elk Township	5	3040	0	1.01	27.14	25.48	53.64
Harrison Township/ Elk Township	6	3008	0	0	73.85	33.65	107.49
Total	**----**	**----**	**0.07**	**1.01**	**210.60**	**103.50**	**315.18**

Figure 7.3.5-2 is a map of Franklinville Lake Dam located along Little Ease Run Branch in Franklinville Township. The map identifies the land use/land cover for the census blocks intersecting a 500-foot-wide stream buffer.

Figure 7.3.5-2
Franklinville Lake Dam
Land Use/Land Cover for Census Blocks Intersecting a 500-Foot-Wide Buffer
(Source: NJDEP)

Table 7.3.5-3 identifies the population and residential housing units for each of the 13 census blocks included on the Franklinville Lake Dam map (Figure 7.3.5-2) in Franklin Township.

Table 7.3.5-4
Population and Housing Units for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Franklinville Lake Dam
(Source: US Census Bureau-2000 Population)

Map ID	Block Number	Population	Housing Units
1	1029	8	2
2	1030	22	6
3	1026	2	1
4	1024	0	0
5	1025	0	0
6	1023	43	12
7	2003	63	27
8	2002	46	14
9	2018	67	24
10	2020	0	0
11	2019	0	0
12	2030	29	9
13	2021	2	1
Total	**-----**	**282**	**96**

Table 7.3.5-4 identifies the number of acres within each of the 13 census blocks for the four land use categories identified on the Franklinville Lake Dam map (Figure 7.3.5-2). The table shows that the *other* land use category has the highest acreage within the selected census blocks. The *other* category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked after the *other* category in total number of acres and includes a total population of 282 residents and 96 housing units.

Table 7.3.5-5
Land Use/Land Cover (In Ares) for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Franklinville Lake Dam
(Source: NJDEP-Dam Safety and Flood Control)

Map ID	Block Number	Commercial (Acres)	Industrial (Acres)	Other (Acres)	Residential (Acres)	Grand Total
1	1029	1.61	0	0.15	1.62	3.38
2	1030	2.65	0	4.96	3.21	10.82
3	1026	0.42	0	0.88	0.67	1.98
4	1024	1.20	0	1.66	0.01	2.87
5	1025	0.22	0	1.33	0.00	1.55
6	1023	1.44	0	0.04	5.85	7.33
7	2003	0	0	28.06	22.76	50.82
8	2002	0	5.94	42.61	10.75	59.31
9	2018	0	0	16.10	16.35	32.45
10	2020	0	0	1.07	0	1.07
11	2019	0	0	1.09	0	1.09
12	2030	0.01	0	8.46	6.58	15.05
13	2021	0	0	11.26	1.43	12.69
Total	**-----**	**7.55**	**5.94**	**117.67**	**69.24**	**200.41**

Figure 7.3.5-3 is a map of Wadsworth Lake Dam located along Mantua Creek. The map identifies the land use/land cover for the census blocks intersecting a 500-foot-wide stream buffer.

Figure 7.3.5-3
Wadsworth Lake Dam
Land Use/Land Cover for Census Blocks Intersecting a 500 Foot-Wide Buffer
(Source: NJDEP)

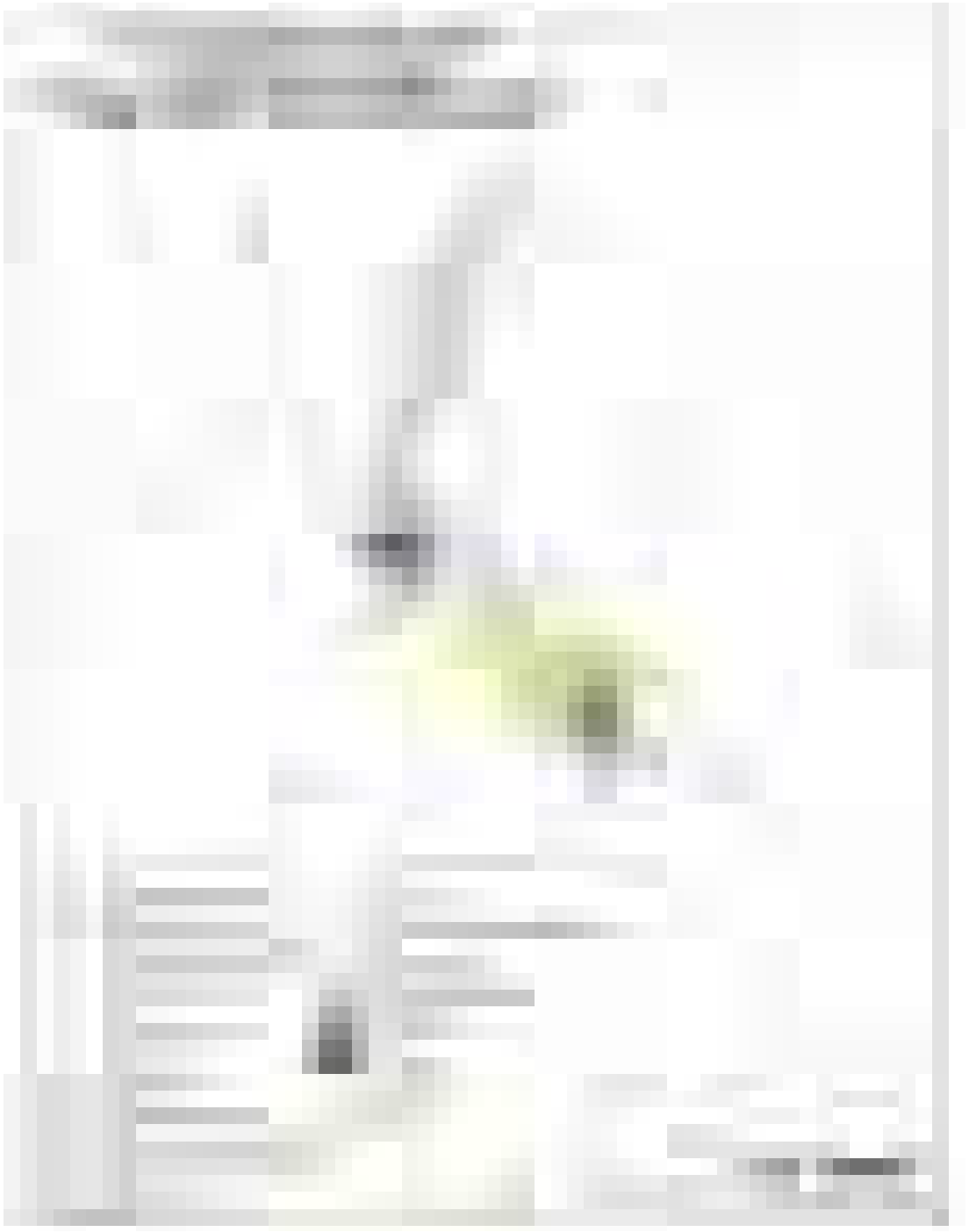


Table 7.3.5-5 identifies the population and residential housing units for each of the nine census blocks included on the Wadsworth Lake Dam map (Figure 7.3.5-3).

Table 7.3.5-6
Population and Housing Units for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Wadsworth Lake Dam
(Source: US Census Bureau-2000 Population)

Municipality Name	Map ID	Block Number	Population	Housing Units
Glassboro Township	1	1999	0	0
Washington Township	2	2998	0	0
Washington Township	3	2019	2	2
Glassboro Borough/Pitman Borough/ Washington Township	4	1001	73	21
Pitman Borough/Washington Township	5	1000	0	0
Washington Township	6	2014	27	14
Pitman Borough	7	1002	117	70
Mantua Township/Pitman Borough/ Washington Township	8	1003	47	19
Mantua Township/Washington Township	9	3037	15	6
Total	**-----**	**-----**	**281**	**132**

Table 7.3.5-6 identifies the number of acres within each of the nine census blocks for the four land use categories identified on the Wadsworth Lake Dam map (Figure 7.3.5-3). The table shows that the *other* land use category has the highest acreage within the selected census blocks. The *other* category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked after the *other* category in total number of acres and includes a total population of 281 residents and 132 housing units.

Table 7.3.5-7
Land Use/Land Cover (In Acres) for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Wadsworth Lake Dam
(Source: NJDEP-Dam Safety and Flood Control)

Municipality Name	Map ID	Block Number	Commercial (acres)	Industrial (acres)	Other (acres)	Residential (acres)	Grand Total
Glassboro Township	1	1999	0.02	0	2.68	0	2.70
Washington Township	2	2998	0	0	5.24	0.62	5.86
Washington Township	3	2019	0	0	1.06	1.86	2.92
Glassboro Borough/Pitman Borough/Washington Township	4	1001	0	0	4.16	11.64	15.80
Pitman Borough/ Washington Township	5	1000	0.40	0	2.13	0	2.53
Washington Township	6	2014	2.37	0	6.41	8.93	17.71
Pitman Borough	7	1002	0	0	3.26	9.40	12.66
Mantua Township/Pitman Borough/Washington Township	8	1003	1.14	8.83	30.18	13.39	53.54
Mantua Township/ Washington Township	9	3037	0	0	47.13	11.79	58.92
Total	**----**	**---**	**3.93**	**8.83**	**102.25**	**57.63**	**172.64**

Figure 7.3.5-4 is a map of Sterling Lake Dam located along Duffield Run River in Washington Township. The map identifies the land use/land cover for the census blocks intersecting a 500-foot-wide stream buffer.

Figure 7.3.5-4
Sterling Lake Dam
Land Use/Land Cover for Census Blocks Intersecting a 500 Foot-Wide Buffer
(Source: NJDEP)

Table 7.3.5-7 identifies the population and housing units for each of the 12 census blocks included on the Sterling Lake Dam map (Figure 7.3.5-4).

Table 7.3.5-8
Population and Housing Units for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Sterling Lake Dam
(Source: US Census Bureau-2000 Population)

Municipality Name	Map ID	Block Number	Population	Housing Units
Washington Township	1	2018	0	0
Washington Township	2	2021	0	0
Glassboro Borough	3	1999	0	0
Washington Township	4	2998	0	0
Washington Township	5	2020	0	0
Washington Township	6	2019	2	2
Washington Township	7	2014	27	14
Pitman Borough/ Washington Township	8	1000	0	0
Glassboro Borough/Pitman Borough/Washington Township	9	1001	73	21
Pitman Borough	10	1002	117	70
Mantua Township/Pitman Borough/Washington Township	11	1003	47	19
Mantua Township/ Washington Township	12	3037	15	6
Total	**----**	**-----**	**281**	**132**

Table 7.3.5-8 identifies the number of acres within each of the 12 census block for the four land use categories identified on the Sterling Lake Dam map (Figure 7.3.5-4). The table shows that the *other* land use category has the highest acreage within the selected census blocks. The *other* category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked after the *other* category in total number of acres and includes a total population of 281 residents and 132 housing units.

Table 7.3.5-9
Land Use/Land Cover (In Acres) for Selected Census Blocks Intersecting the 500-Foot-Wide Stream Buffer Downstream of Sterling Lake Dam
(Source: NJDEP-Dam Safety and Flood Control)

Municipality Name	Map ID	Block Number	Commercial (Acres)	Industrial (Acres)	Other (Acres)	Residential (Acres)	Grand Total
Washington Township	1	2018	0	0	3.96	0.46	4.43
Washington Township	2	2021	0	0	4.47	1.04	5.51
Glassboro Borough	3	1999	0.02	0	2.68	0	2.70
Washington Township	4	2998	0	0	5.24	0.62	5.86
Washington Township	5	2020	0	0	2.66	0.64	3.30
Washington Township	6	2019	0	0	1.06	1.86	2.92
Washington Township	7	2014	2.37	0	6.41	8.93	17.71
Pitman Borough/ Washington Township	8	1000	0.40	0	2.13	0	2.53
Glassboro Borough/ Pitman Borough/ Washington Township	9	1001	0	0	4.16	11.64	15.80
Pitman Borough	10	1002	0	0	3.26	9.40	12.66
Mantua Township/ Pitman Borough/ Washington Township	11	1003	1.14	8.83	30.18	13.39	53.54
Mantua Township/ Washington Township	12	3037	0	0	47.13	11.79	58.92
Total	**----**	**-----**	**3.93**	**8.83**	**113.34**	**59.78**	**185.88**

7.3.6 Levee Failure Risk in Gloucester County

The potential for levee failure was identified by the County as a risk that should be included in the present section of the hazard mitigation plan. Based on research of State and federal agencies as well as databases, there is little or no publicly-accessible information regarding levees in the State of New Jersey. The New Jersey Department of Environmental Protection (NJDEP) maintains what appears to be a very informal inventory of levees, but it is not comprehensive and includes little or no data that would be useful in a risk assessment (age, condition, area protected, history of breaches, etc.). Some or all of this information would be required for a detailed risk assessment. Several strategies and actions are included in Section 8 of this hazard mitigation plan, in the event that the County or any of its constituent municipalities wish to pursue detailed assessments. These strategies and actions first focus on developing a reliable inventory of levees, followed by engineering studies to evaluate the structures, then assessing vulnerability and risk, and finally on mitigation actions (which can be identified only after the vulnerabilities and risks are characterized). There is no well-documented history of significant levee failures in Gloucester County, but this is not necessarily a good predictor of risk in the future.

7.3.7 Wildfire Risk in Gloucester County

This sub-section details the risk assessment completed for the wildfire hazard in Gloucester County. The wildfire hazard was also profiled and ranked in Section 6. The Gloucester County HMWG discussed the wildfire risk with each of the municipality representatives within the county and determined that two municipalities would be included in the risk assessment. The HMWG determined the vulnerability was significant enough within the townships of Franklin and Monroe, to warrant a more detailed risk assessment.

Figure 7.3.7-1
Wildfire Hazard Assessment for New Jersey
(Source: New Jersey Forest Fire Service)

Wildfire Risk in New Jersey and Gloucester County

Figure 7.3.7-1 shows the wildfire hazard assessment for New Jersey. The map was produced by the New Jersey Forest Fire Service in 2004. The map reveals that the majority of the extreme wildfire hazard in New Jersey is concentrated near eastern Burlington and Ocean Counties. In Gloucester County the greatest fire risk is located in the southeastern part of the county within Franklin and Monroe Townships. Both Townships include areas of *high* and *extreme* wildfire hazard categories, as shown in Figure 7.3.7-1. It should be understood that wildfire hazard can change from year to year, depending on meteorological and antecedent conditions, and the risk related to wildfires may change depending on the level of exposure, e.g., numbers of structures near hazardous areas, etc. The map below represents the most recent available data.

As described in Section 6, Hazard Identification, Profiling, and Ranking (Section 6.3.21, Wildfire), the NCDC database indicates there were four wildfires in Gloucester County between 2002 and 2007. The four events occurred in the Township of West Deptford and the Boroughs of National Park and Paulsboro. Information about past wildfire events was unavailable for the Townships of Franklin and Monroe. Section 6.3.21 also includes historical wildfire incidents from the New Jersey Forest Fire Service including tables and maps showing the number of fire incidents in New Jersey per year and the number of acres burned, for the period from 1996 to 2006.

Wildfire Risk for Selected Gloucester County Municipalities

The Gloucester County HMWG requested specific wildfire data from past events for each of the selected municipalities in advance of preparing the risk assessment. Neither municipality was able to provide the historical wildfire data needed to complete the risk assessment. If specific local risk assessments are required at some point in the future (i.e. as part of the cyclical hazard mitigation plan updates) the following paragraphs characterize the data and actions that may be used for this purpose. It is important to recognize that wildfire risk (like most natural hazards) is a function of both the hazard itself, as well as the potential for people, operations and the built environment to be damaged by the hazard. Also, as is the case with many hazards, the potential for wildfires is partly the result of natural events such as the weather, so there is usually considerable uncertainly in regard to estimating the probabilities of events occurring. With wildfires, however, there are several other important factors that influence risk, such as:

- Fire detection and suppression capabilities
- Amount and type of fuel load (mainly vegetation) in the subject area
- Topography
- Antecedent conditions (such as dryness)
- Proximity of built assets and people to risky areas
- Nature of the built environment
- Prevailing wind

For the purpose of mitigation planning, risk is defined as expected future damages resulting from the effects of natural hazards. As shown in Table 6.3.21-3, Gloucester County regularly experiences wildfires or forest fires, averaging 111 acres burned per year between 1996 and 2006. However, there are presently no public records that indicate any significant damages related to wildfires, such as structures burned or casualties. Even if this data were present, it would not be an especially reliable predictor of future events.

The bullets below indicate some of the data that will be required to perform a detailed risk assessment for wildfires and/or urban interface fires, should the county chose to do so at a later date.

- Specific history of wildfire events (date, number of acres burned, location, maps, etc.)
- Descriptions of damages to structures
- Descriptions of lost function
- Descriptions of injuries or deaths
- Description of any suppression activities by local communities

In many cases, this information will still not be sufficient to perform a risk assessment because areas will experience very few fires. A more rigorous risk assessment is possible if additional information is collected, although the lack of reliable, site-specific probability data, renders such studies closer to vulnerability assessments. However, the results can still be used in a mitigation plan as the basis for determining appropriate actions to reduce risk. The following information can be gathered to support detailed risk/vulnerability assessments in specific locations. Some of these data change over time, and it is important to ensure that the most current information is being used when assessing risk or identifying mitigation actions.

- Type and amount of fuel load
- Antecedent conditions
- Proximity of people and built environment to potential burn areas
- Characteristics of structures/infrastructure that may be exposed to fire
- Existing detection and suppression capabilities

The information described above is also found in the Mitigation Strategies section of this HMP. That section includes more specific actions that may be undertaken by the county to accurately assess wildfire risk.

7.4 Gloucester County's Critical Facilities Risk Assessment

Although not a specific requirement for mitigation plans, risk assessments for critical facilities are an important element in developing and prioritizing mitigation actions. At the time this Plan was drafted and approved by the State of New Jersey and FEMA, there was only a limited amount of information available to complete risk assessments for critical facilities in Gloucester County. This subsection describes the information required to complete risk assessments.

FEMA does not prescribe a definition of critical facilities. Generally speaking, critical facilities are those assets and operations that are essential to a jurisdiction maintaining functionality, especially during and after emergencies or significant natural hazard events. There is a range of facilities that can be categorized as critical, including

- Police and fire facilities
- Emergency operations centers
- Water and wastewater treatment plants
- Shelters
- Hospitals (in particular, trauma centers)
- Communications facilities and infrastructure
- Key infrastructure, such as bridges and roads
- Lifelines, in particular utility lines (water, electricity, gas)

Risk assessments typically contemplate three general categories of potential losses: (1) direct damage to structure and contents; (2) loss of function; and, (3) injuries and deaths. There are well-established procedures for calculating these types of risks as they relate to critical facilities. All of these procedures require information about the facilities to facilitate a vulnerability calculation, and then a risk assessment that quantifies potential future losses. Although it is not necessary to have all of the data points listed below, it is highly recommended that jurisdictions attempt to secure as much of the information as possible so that the risk assessment will fully capture all potential risks. Note that all of this information is used in conjunction with data about natural hazards (probability and severity) to calculate risk; this subsection deals only with information related to the facilities. This is a general list of information that should be gathered – note that not all of these data points apply to all critical facilities. For example, it is not necessary to gather the square footage of a bridge or water line.

- Use of the facility
- Location, in particular with respect to natural hazards, and preferably with latitude/longitude
- Size of the facility (for buildings, in square feet)
- Replacement value of the asset (can usually be obtained through open sources)
- Description and replacement value of contents (can usually be obtained through open sources)
- Structure type (for buildings, preferably in conformance with FEMA HAZUS descriptors)
- Elevation (above mean sea level)
- Occupancy (i.e. number of people, preferably by time of day)
- Annual budget of the operation
- Cost of securing similar alternative facilities (not critical information)
- Volume of service provided (applies to lifelines and transportation infrastructure)
- Number in community served by the facility or operation
- Any history of losses related to natural hazards (direct damages, loss of function)
- Any existing engineering or vulnerability studies
- Photographs of the facilities and surrounding area

The present subsection is not intended to provide an explanation of how to complete a vulnerability or risk assessment. The information listed here is the basic data required to complete a risk assessment. FEMA has an extensive suite of software and guidance that can be used for this purpose, including the 386-series of mitigation planning guides, in particular publication 386-2 *Understanding Your Risks: Identifying Hazards and Estimating Losses* (fema.gov/library, then use search engine). All of the benefit-cost analysis software and technical manuals are also available through FEMA.

The risk assessment is an essential first step in the process of identifying sites where additional study may be warranted and/or where efforts should be focused on developing mitigation actions. After developing a risk profile for a critical facility (i.e., a calculation of expected future losses from various hazards), potential losses can be readily compared to provide a picture of which combinations of vulnerability and hazards appear to be the most significant. Once this is known, there are several potential next steps:

- No action: If risks are relatively small in an absolute sense, or in comparison to other facilities, the results of the assessment can be used as a way to assign low priority to any mitigation actions, including additional study and specific projects.
- Further study: The risk assessment will show the source of potential future damages and losses, although in some cases not in enough detail to identify specific vulnerabilities. The risk calculation will inform decisions about the need for additional study, which will in turn lead to the development of mitigation actions. Such studies are nearly always completed by engineers or architects, with experience and technical knowledge related to the performance of building and infrastructure components. It is also important to understand the expected performance of any mitigation projects in reducing risk–this should be a part of any vulnerability study. It is also important to understand the costs of any mitigation projects that may be indicated, so that (if a particular project is part of a grant application) its costs can be compared to the risks (and effectiveness–as above) to determine if it merits funding.
- Develop mitigation alternatives: In cases in which vulnerabilities are obvious based on the risk assessment and other empirical knowledge of an asset or site (including existing local knowledge or engineering studies), it may be possible for a jurisdiction to bypass any additional vulnerability studies, and proceed to the process of developing mitigation alternatives for high-priority sites. These can partially be identified through the risk assessment process, which quantifies potential damages and allows comparisons. In cases where specific vulnerabilities are well understood, it is possible to develop basic specifications for mitigation projects, then to compare their effectiveness and costs to the results of the risk assessment. This is the most important use of the risk assessment data, outside the process of selecting sites for study.

It is not possible in the context of a hazard mitigation plan to discuss all potential mitigation projects, because there is a very large number of them, and because they have widely varying effectiveness and costs. The risk assessment process is an essential first step in identifying sites that merit additional study, and in making valid comparisons of cost savings among different assets and mitigation projects.

It is important to note that the participating municipalities in Gloucester County have made substantial progress in identifying and gathering information about their critical facilities. Appendix E contains an excerpt of the information that has already been gathered as part of the development of this Plan. This information was important in helping some of the participating municipalities identify candidate mitigation projects in this Plan and it is expected that improving the quality and quantity of data regarding these facilities will result in the identification of additional viable projects as part of subsequent plan updates.

7.5 Gloucester County's Future Development Trends

This subsection of the Gloucester County HMP identifies areas in the county that may have potential for development, particularly in floodplains. Areas shown as being targeted for development in state land use and development plans–known as *Smart Growth Areas*–were identified, and then a GIS process was used to remove from the Smart Growth Areas any lands that are either already developed, or are unlikely to be developed because of environmental or other regulatory restrictions. What remained was assumed to be lands both available and targeted for future development. This remainder was then compared to known hazard areas in order to assess future risk.

The main sources of data for this process were the New Jersey State Development and Redevelopment Plan (NJDRP), the New Jersey Department of Environmental Protection, and the New Jersey Department of Community Affairs-Office of Smart Growth. State plans and spatial data were determined appropriate for this purpose by the consultant team and the HMSC because there is presently no consistent GIS or database that includes zoning, comprehensive planning, or permitting data information across all municipalities in the county. State, county, and municipal land use and development planning have an indirect relationship, informing each other regarding land use planning trends. (As stated in the Municipal Land Use Law, each municipality has the authority to designate its own development practices.) However, designation of Smart Growth Areas occurs during the Cross Acceptance process, during which negotiations result in a mutually agreed upon area. As a result, Smart Growth Areas are considered for the purposes of this analysis to be consistent with local planning priorities.

The Smart Growth Areas in New Jersey are based on a typology of five Planning Areas, which are established in the NJDRP and are used to apply statewide policies to both natural and built resources. The lands designated in each of the five Planning Areas share a common set of conditions such as population density, infrastructure systems, level of development or natural systems.

- Metropolitan Planning Area (Planning Area 1) Provides for much of the state's future redevelopment. Revitalize cities and towns; promote growth in compact forms; stabilize older suburbs; redesign areas of sprawl; and protect the character of existing stable communities.
- Suburban Planning Area (Planning Area 2) Provides for much of the state's future development. Promote growth in centers and other compact forms; protect the character of existing stable communities; protect natural resources; redesign areas of sprawl; reverse the current trend toward further sprawl; and revitalize cities and towns.
- Fringe Planning Area (Planning Area 3) Accommodate growth in centers; protect the environs primarily as open lands; revitalize cities and towns; protect the character of existing stable communities; protect natural resources; provide a buffer between more developed Metropolitan and Suburban Planning Areas and less developed Rural and Environmentally Sensitive Planning Areas; and confine programmed sewers and public water services to centers.
- Rural Planning Area and Rural/Environmentally Sensitive Planning Area (Planning Area 4) Maintain the environs as large contiguous areas of farmland and other lands; revitalize cities and towns; accommodate growth in centers; promote a viable agricultural industry; protect the character of existing stable communities; and confine programmed sewers and public water services to centers.
- Environmentally Sensitive Planning Area and Environmentally Sensitive/Barrier Islands Planning Area (Planning Area 5) Protect environmental resources through the protection of large contiguous areas of land; accommodate growth in centers; protect the character of existing stable communities; confine programmed sewers and public water services to centers; and revitalize cities and towns.[4]

[4] 2001 State Development and Redevelopment Plan.

The NJDRP indicates that Planning Area designations 1 and 2 (Metropolitan and Suburban) are most appropriate for development, although in some limited circumstances the other areas may also be considered appropriate. This section of the county hazard mitigation plan does not include a detailed discussion of the criteria used in the NJDRP, but planners and local officials can review the latter plan on the web at http://www.state.nj.us/dca/osg/plan/.

The NJDRP is supported by the identification of Smart Growth areas. Smart Growth is the term used to describe well-planned, well-managed growth that adds new homes and creates new jobs, while preserving open space, farmland, and environmental resources. Smart Growth supports livable neighborhoods with a variety of housing types, price ranges, and multi-modal forms of transportation. The Smart Growth Areas were created to help implement the goals of the New Jersey State Plan.[5]

The boundaries of the smart growth areas in New Jersey were developed by the Office Smart Growth. The Smart Growth areas supporting the NJDRP are predominately located within Planning Area designations 1 and 2 (Metropolitan and Suburban), but also include land within the growth areas of the New Jersey Pinelands Management Areas as well as some areas of the Meadowlands.

Figure 7.6-1 highlights in tan the remaining buildable land within the Smart Growth areas for Gloucester County. Also identified on the map are the FEMA designated 100-year and 500-year floodplains. The five Planning Areas from the NJDRP and the Smart Growth areas described above were used to isolate the buildable lands. To identify the remaining buildable lands in Gloucester County, the areas designated as non-Smart Growth and the Planning Areas not suitable for development were eliminated as buildable land. In addition, areas already considered urban were also eliminated. The area remaining is considered the buildable land area identified on the Gloucester County Future Growth Map.

[5] New Jersey Department of Community Affairs-Office of Smart Growth.

Figure 7.5-1
Gloucester County Future Growth Locations
(Sources: 2001 New Jersey State Development and Redevelopment Plan, FEMA, NJDEP)

Table 7.5-1 identifies the acres of remaining buildable land areas in Gloucester County that are displayed above on the Future Growth Locations map. The data is ranked by the total number of buildable acres in each municipality and is broken out by FEMA flood zones (100-year and 500-year floodplain). The table reveals the majority of buildable land area in Gloucester County is located outside of the 100-year and 500-year floodplains. Within Gloucester County, the largest area of buildable land is located in Monroe Township.

Table 7.5-1
Gloucester County Buildable Land (In Acres) By Flood Zone, Ranked by Municipality
(Sources: 2001 New Jersey State Development and Redevelopment Plan, FEMA)

Municipality Name	Acres within 100-year Floodplain	Acres within 500-year Floodplain	Acres Outside 500-year Floodplain	Grand Total
Monroe	773	50	13,270	14,093
Franklin	20	21	8,398	8,440
Deptford	135	34	3,226	3,395
Washington	103	22	3,129	3,255
West Deptford	783	238	1,467	2,488
Logan	1,279	161	860	2,300
Mantua	71	2	1,653	1,726
East Greenwich	88	9	1,542	1,640
Woolwich	0	0	1,177	1,177
Glassboro	19	7	967	993
Elk	5	0	779	785
Clayton	1	0	640	641
Harrison	0	0	476	476
Greenwich	340	82	42	464
Pitman	11	0	170	181
National Park	124	27	28	179
Woodbury Heights	1	0	134	135
Westville	78	2	24	105
Swedesboro	1	0	88	90
Woodbury City	12	0	43	55
Paulsboro	20	5	11	37
Wenonah	1	0	18	19
Total	**3,865**	**662**	**38,144**	**42,672**

The *2008 Comprehensive Economic Development Strategy (CEDS) for Gloucester County* was also reviewed to determine which areas of the County are most likely to experience future development. The study found that many of the trends evident in the 1990- 2000 Census period appear to be continuing. For example, three of the five municipalities that had the largest increases in population between 1990 and 2000 also had the largest increases over the past five years. These municipalities included Washington, Deptford, and Harrison Townships. The other two municipalities in the top five for 2005 include Monroe Township and Woolwich Township. Between 2000 and 2005 it is estimated that Woolwich added 4,531 persons, an increase of 149.4%[6].

[6] 2008 *Comprehensive Economic Development Strategy (CEDS) for Gloucester County, April 2008*

As shown in Table 7.5-1, with the exception of Monroe Township (823 acres, or six % of buildable land in the floodplain), these municipalities have very little or no buildable lands in the floodplain.

The 2008 CEDS indicated that while the largest 1990 to 2000 population increases seemed to be concentrated in municipalities along the Route 55 corridor, the current trends point to significant growth in the U.S. 322 corridor. This residential development has led to population growth in many communities that have the most open space, while the older towns on the western and northern ends of the County continue to stagnate or decline[7]. While these population figures do not correlate exactly to the numbers and types of new buildings that may be constructed in these areas, the extent of new development is likely to parallel these trends.

The CEDS report also identified several long-range priority commercial projects for Gloucester County. One of the County CEDS priority projects is the proposed development of the Paulsboro waterfront site into a 190-acre high-tech Port-Distribution-Logistics Center, at an estimated cost of $250 million. Another high priority project for the County is the development of the South Jersey Technology Park. This project will result in over 1.5 million square feet of technology based development in conjunction with Rowan University, Drexel University, and other leading institutions in the region[8].

[7] 2008 *Comprehensive Economic Development Strategy (CEDS) for Gloucester County, April 2008*
[8] 2008 *Comprehensive Economic Development Strategy (CEDS) for Gloucester County, April 2008*

7.6 Summary of Risk Assessment

Mitigation planning is intended to provide a rational method for communities to decide what actions to take to reduce their risks from natural hazards. Aside from actually determining and implementing specific actions, perhaps the most important part of a mitigation plan is the risk assessment, which establishes an objective basis for prioritizing mitigation efforts. The risk assessment in this plan has been used to identify the most significant risks are in Gloucester County: to identify the natural hazards that present the most potential damage to the county, municipalities and their assets: to ascertain where additional study may be warranted: and to begin identification and prioritization of mitigation actions.

Table 7.6-1 summarizes the risk (future loss) estimates for identified countywide hazards: floods, high winds, winter storms, earthquakes, dam failure, and levee failure. Note that for dam and levee failure, no monetary estimates are provided due to limitations of the data. The figures are based on calculations of direct damages, losses of functions and casualties. Gloucester County shows a fairly typical pattern for New Jersey: flood is by far the most significant threat when analyzed on a site-specific basis (see right-hand columns of Table 7.6-1), although the data shows lower total risk from floods than from the other hazards when considered across the entire county and over a long planning horizon. The reason for this is that the flood hazard is relatively concentrated in a geographic sense, while the entire county is uniformly exposed to the effects of wind, winter storms, and earthquakes (although there are some variations from place to place, based on topography, soils, etc., which are discussed in the present section, as well as in Section 6 of this plan).

Table 7.6-1
Summary of Gloucester County Natural Hazard Risks
by Asset and Hazard Type (100-Year Horizon)
(Sources: 2000 US Census, HAZUS)

Hazard	Asset	Risk (100-Year Horizon)	Risk Per SF (1)	Risk Per Capita (2)
Flood	Repetitive loss properties (residential)	$230,744	$7.69	$6,153
Flood	Severe repetitive loss properties	$85,447	$42.72	$34,179
Flood	Deaths and injuries	Not Determined	NA	NA
High Wind–Straight-Line Wind	All assets	$144,638,230	$1.20	$568
High Wind–Straight-Line Wind	Deaths and injuries	Not Determined	NA	NA
Severe Storm–Winter Weather	All assets, direct damages (3)	$29,637,691	NA	$118
Severe Storm–Winter Weather	Deaths (monetized) (4)	$0	NA	NA
Severe Storm–Winter Weather	Injuries (monetized)	$251,641	NA	NA
Earthquake/Geological	All assets	$19,155,941	$0.16	$75
Earthquake/Geological	Deaths (monetized)	$32,907,424	NA	NA
Earthquake/Geological	Injuries (monetized)	$888,034	NA	NA
Dam Failure	All assets, direct damages	See Section 7.3.5	NA	NA
Levee Failure	Injuries	See Section 7.3.6	NA	NA

Notes: (1) Risk per square foot (SF) estimate for the flood hazard based on average building size of 2,000 SF. Risk per SF for the high wind - straight-line wind and earthquake/geological hazards based on HAZUS estimate of total square footage for the county (See Table 7.3.2-6). (2) Risk Per Capita column based on Gloucester County 2000 population from the US Census Bureau.
Flood risk per capita based on household occupancy of 2.5 people per dwelling. (3) Winter storm risks are assumed to be primarily related to damages to public assets and infrastructure, to interrupted services, or to response requirements. (4) Standard FEMA practice is to express deaths and injuries in terms of dollars (monetized) in order

that the risks can be compared to other categories that are not related to life safety. For further information see FEMA Guidance titled *What is a Benefit*? (included on BCA Toolkit version 3.0).

As noted earlier, the purpose of risk assessment is to identify and quantify future losses from natural hazards, with the goal of using this information to determine what actions should be taken to reduce damages. Although Gloucester County as a whole has more risk from wind, winter storms, and earthquakes than it does from floods, there are several factors that must be considered and understood in order to put this into context. First, as noted, wind, winter storm, and earthquake hazards are far less site-specific than floods and most other natural hazards, so the risk is by definition greater because the whole county is exposed. Second, there are no large-scale mitigation measures that would reduce risks to all properties simultaneously, so site-specific risks are a more significant consideration than countywide ones in most cases. It is necessary to calculate risks on a site-specific basis as a first step in developing meaningful mitigation actions. The paragraphs below describe initial steps that the County and municipalities can take to begin a more detailed risk assessment process that will inform the process of developing mitigation actions.

Flood

There is a range of specific information in this section related to the flood hazard in Gloucester County, and this has been used to identify sites to study in more detail. Tables 7.3.1-4 and 7.3.1-5 provide key flood risk metrics that have been used to prioritize these areas. For example, Table 7.3.1-4 shows the various municipalities in the county with repetitive flood insurance claims. This table shows that the Township of Mantua by far has the highest average amount of claims, over three times more than the Township of West Deptford, the municipality with the second highest average. This suggests that there is significant flood risk in this area.

Although this is not definitive, it does offer some insight to planners and engineers as to where they should focus efforts to more fully determine flood risk. Similarly, Table 7.3.1-5 shows individual streets in the various municipalities, with numbers of claims and average amounts of claims. The data can be used in the same manner as described above. For example, in this table Melody Lane in the Township of Mantua has a relatively high number of claims, and a high claims average. This information should be used to prioritize sites for further review. It is also important to recognize in some cases (particularly for flood mitigation) it may be possible to develop mitigation measures t address risks to multiple properties. Therefore, it is important to understand the proximity of floodprone structures to each other, and of local topography and hydrologic conditions that may influence risk.

High Wind—Straight-line Wind

Straight-line wind risk is addressed in detail in Subsection 7.3.2. As noted, wind risk can be considered to be fairly uniform across Gloucester County, although topography and vegetation can influence the effects of the hazard to some degree. Subsection 7.3.2 addresses a range of building types, based on best available asset inventory information from open sources. While this is a reasonable approach to large-scale assessments such as this, there are many characteristics of individual buildings that must be considered in a site-specific risk assessment. These include the amount of exterior glazing (and structural characteristics of the glazing), roof configuration, ground-to-roof structural characteristics (load path), and the strength and configuration of doors. Although some site characteristics can influence the severity of the wind hazard (by increasing or reducing velocity, or by the presence of potential windborne missiles), most wind risk is related to the structural characteristics of built assets.

This plan recommends that Gloucester County undertake more detailed wind risk assessments based on identifying the most critical facilities and compiling specific structural data about them. In 2006 FEMA, developed a wind hazard database that is used in conjunction with its benefit-cost analysis software. The database includes a list of several dozen structural types, and associated wind damage functions. This list of structure types can be used as the basis

for field work to collect information about critical facilities and other buildings. It should be noted that most of New Jersey (including Gloucester County), has a relatively low level of wind hazard, so the county should probably start with a fairly small list of its most critical facilities and operations, and estimate the risks for those, before continuing with any additional work on assets that are less important.

Earthquake/Geological

As described in Subsection 7.3.4, there is a moderate degree of earthquake risk in all the SDVR counties, including Gloucester, although the risk does not appear to be as significant as it is in the more densely populated counties in the northern part of New Jersey. However, the risk study done in support of this plan is not highly detailed, particularly as regards site-specific elements such as soil characteristics and building structural types. As described in Section 9 (Mitigation Action Plan), it will be desirable for Gloucester County to identify and prioritize specific areas or facilities where there is a high density of built assets and populations. In these areas (and potentially others), this plan also recommends that the county undertake a more detailed examination of proximity to faults and soil characteristics, to further identify areas that may be at higher risk because of the hazard (as opposed to the nature of the built environment or presence of populations). The purpose of these exercises is to identify combinations of hazard, population and building characteristics that suggest elevated risk. Some building types–specifically unreinforced masonry, a common type in New Jersey–are particularly prone to damage and collapse when subjected to shaking forces, and should be studied from an engineering perspective when they are in areas subject to soil liquefaction, particularly when the facilities house critical operations or have large occupancies.

Other Countywide Hazards

With regard to the other hazards shown in the table above (severe storm–winter weather, dam failure, and levee failure), there is presently not enough open-source information to support specific conclusions about risks, or to make meaningful comparisons to other hazards.

In the case of severe storms–winter weather, the risk is presumably widespread, and related to vulnerabilities in buildings (and infrastructure) as well as to deaths and injuries, and the costs of snow and ice treatment and removal. There are several specific actions that the county or individual jurisdictions can undertake to better understand winter weather risks. A typical approach is to identify and prioritize critical facilities, then undertake engineering studies of the facilities in order to identify any hazard-specific vulnerabilities such as weak structural systems, or exterior infrastructure (such as electrical feeds or antennae) that may be subject to damage from snow/ice loads or high winds.

In reference to dams, in the State of New Jersey, NJDEP maintains an inventory of dams, including hazard rankings, as discussed in detail in the subsection above. Although the rankings offer a good initial indication of which dams may create risks (particularly in conjunction with the downstream buffer methodology used in this section), there are numerous risk variables that should be studied if a comprehensive, engineering-based assessment is needed. As noted, these variables include the condition of the dam(s), the amount of water impounded behind them, local topography, and downstream populations and infrastructure. As is the case with other hazards discussed here, if a more detailed risk assessment is needed, the county could prioritize the dams based on the variables noted above, then identify a means to complete an engineering study, perhaps in cooperation with NJDEP.

In reference to levee failure, as noted in an earlier subsection, New Jersey is home to a moderate number of levees statewide. As is the case with dams, the NJDEP is the agency responsible for maintaining an inventory of levees. The Delaware Estuary Levee Organization provided some limited data about levees as a part of this planning exercise, but the information was insufficient to allow even a cursory vulnerability or risk assessment due to the lack

of location or hazard data. A more comprehensive inventory of levees is planned. In some cases it may be worthwhile for county or local officials, in coordination with this inventory effort, to determine if there is a need for additional data collection as a precursor to risk assessments. The first step in this process would be to work with NJDEP engineers, planners or other State or federal authorities to compile and analyze any additional information on New Jersey levees.

Depending on the nature of this information (or lack thereof), officials could then determine if additional study or site visits are indicated. Even further resolving the locations of levees could support GIS procedures such as determining the numbers of populations adjacent to them, and potentially allow a basic prioritization of sites that may warrant more thorough investigation.

Relative Risks in the Municipalities

Table 7.6-2 provides a general comparison of hazard vulnerabilities among Gloucester County jurisdictions. All hazards included in the present risk assessment section of the plan are included in the matrix, although only four of the seven hazards include rankings in the matrix below because there was no jurisdiction-level risk or vulnerability data available at the time this Plan was completed. For the flood, high wind, winter storm and dam failure hazards, the risk in each jurisdiction is ranked high, medium or low. These relative rankings are based on a composite review of the risk data presented earlier in this section, and are intended *only* as a relative indication of potential risks. It should be understood that even where overall risks are ranked medium or low, in many cases specific sites, populations and operations in communities may still be at elevated risk from certain hazards. The matrix is intended only as a general indication of where County of local planners may wish to focus their initial attention in further understanding risks and the potential for mitigation actions if resources are limited.

The flood rankings were generally based on (1) the numbers of National Flood Insurance Program claims in the various communities (and the amounts of the claims, and (2) the percentage of the jurisdiction in the floodplain. The high wind and winter storm rankings are based on the potential dollar losses described in Subsections 7.3.2 and 7.3.3, respectively.

Table 7.6-2
Gloucester County Municipality-Level Risk Matrix

Municipality Name	Flood	High Wind	Winter Storm	Earthquake/ Geological	Dam Failure	Levee Failure	Wildfire
Clayton Borough	L	M	L	Note 1	L	Note 2	Note 3
Deptford Township	M	H	H	Note 1	L	Note 2	Note 3
Elk Township	L	L	L	Note 1	M	Note 2	Note 3
Franklin Township	L	M	M	Note 1	M	Note 2	Note 3
Glassboro Borough	L	H	M	Note 1	M	Note 2	Note 3
Gloucester County	L	L	L	Note 1	L	Note 2	Note 3
Greenwich Township	M	L	L	Note 1	L	Note 2	Note 3
Harrison Township	L	M	M	Note 1	L	Note 2	Note 3
Logan Township	M	M	L	Note 1	L	Note 2	Note 3
Mantua Township	M	M	M	Note 1	L	Note 2	Note 3
Monroe Township	M	H	M	Note 1	L	Note 2	Note 3
National Park Borough	M	L	L	Note 1	L	Note 2	Note 3
Paulsboro Borough	L	L	L	Note 1	L	Note 2	Note 3
Pitman Borough	L	M	M	Note 1	L	Note 2	Note 3
Rowan University	L	L	L	Note 1	L	Note 2	Note 3
South Harrison Township	L	L	L	Note 1	L	Note 2	Note 3
Swedesboro Borough	L	L	L	Note 1	L	Note 2	Note 3
Washington Township	M	H	H	Note 1	L	Note 2	Note 3
Wenonah Borough	L	L	L	Note 1	M	Note 2	Note 3
West Deptford Township	H	H	M	Note 1	L	Note 2	Note 3
Woodbury City	L	M	M	Note 1	L	Note 2	Note 3
Woodbury Heights Borough	L	L	L	Note 1	L	Note 2	Note 3
Woolwich Westville Borough	L	L	L	Note 1	L	Note 2	Note 3

Note 1 – In some cases there may be moderate earthquake or landslide risk in certain jurisdictions, but the availability of technical data does not support such determinations on a local level at this time. As noted earlier in Subsection 7.3.4, earthquake risk in particular is a function of both the seismic hazard and the nature of the built environment (specifically, the tendency of structures to fail under shaking loads). Earthquake (and landslide) risk assessments must be conducted on a highly site-specific basis.

Note 2 – As noted earlier in the risk assessment subsection, there is presently very little information available about the potential for levee failures, even on a County level, and as such the risk cannot be ranked.

Note 3 – Wildfire records in New Jersey are compiled on a County level, and therefore it is not possible to rank the risk at the jurisdiction.

Recommendations to Enhance the Risk Assessment

Section 9 of this Plan outlines a series of general recommendations that can be implemented on a countywide basis as well as a wide range of specific, prioritized actions that individual municipalities are committing to as part of the planning process. The Gloucester County HMWG used the present risk assessment section as the basis for these actions and priorities. However, it has been generally acknowledged that additional information would be helpful in refining and updating this Plan in the years to come. Section 9 also includes actions to aid in this process that include the following general steps:

- Continue to identify and prioritize critical facilities, facilities with high occupancies, or operations with high value
- Study hazard vulnerabilities based on specific conditions and hazards at sites for the highest priority sites and facilities
- Undertake detailed risk assessments for critical facilities in hazard areas, and with known vulnerabilities
- Develop appropriate, cost-effective mitigation measures for the facilities

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Section 8
Capability Assessment

Contents of this Section

8.1 Overview and Purpose of Capability Assessment

Although not required by Disaster Mitigation Act of 2000 or the Interim Final Rule (IFR), a capability assessment adds context to a mitigation plan by providing an inventory of a jurisdiction's programs and policies, and an analysis of its capacity to carry them out. These are essential for developing mitigation strategies and actions.

The capability assessment is a review of Gloucester County resources in order to identify, review, and analyze what the county is currently doing to reduce losses, and to identify the framework that is in place for the implementation of new mitigation activities. This section of the Plan also facilitates efforts with the New Jersey State Office of Emergency Management (NJOEM) and with federal agencies and resources. In addition, this assessment will be useful in gauging whether the current local organizational structures and inter-jurisdictional or county coordination mechanisms for hazard mitigation could be improved, and how.

This local capability is extremely important, because the municipal officials know their own landscape best. Additionally, many of the most critical and effective hazard mitigation strategies and programs, including enforcement of floodplain management, building codes, and land-use planning, require a strong local role to achieve effective implementation.

New Jersey follows a strong *Home Rule* legal philosophy. That philosophy dictates that all land in the state not directly belonging to a government entity is incorporated into a municipality, and that each municipality must assign an individual to be responsible for its local emergency management duties; that person is responsible for coordinating municipal emergency response with county, state, and federal officials.

8.2 Methodology

This capability assessment results from research, interviews, and surveys. Relevant documents were reviewed related to hazard mitigation, including especially the 2008 New Jersey State Hazard Mitigation Plan Update (SHMPU), as well as state and federal sources related to funding, planning, and regulatory capability. Extensive summary information from these sources can be found in Appendix F.1-F.3.

For the county capability assessment, a series of in-depth one-on-one interviews provided key insights and information. In Gloucester County, these interviews were conducted during the period of May 2008 until June 2008 with the following individuals:

- Len Clark, Deputy Emergency Management Coordinator, County Office of Emergency Management
- George Strachan, Administrator, County Improvement Authority
- Debbie Costello, Deputy Clerk, County Clerk of the Board Office
- Lisa Cerny, Director, County Office of Human Services
- Rick Westergard, Acting Assistant Director, County Department of Public Works−Planning Division
- Ken Atkinson, Director, County Land Preservation Department
- Lisa Morina, Director, County Department of Economic Development

For the municipal capability assessment, a web-based survey tool was designed and administered. The questions were vetted by the Gloucester County Office of Emergency Management (GCOEM), and the survey was live from April 8, 2008 until June 9, 2008. The survey was targeted to the primary municipal contacts for this planning process. For the most part, these are municipal Office of Emergency Management (OEM) coordinators. Other municipal staff with relevant expertise–including those in the departments of planning, public works, and buildings–were encouraged to take the survey as well.

The survey generally covered the following topics:

- Staff, personnel, and technical capability
- Knowledge of Federal Emergency Management Agency (FEMA) mitigation programs
- Current/ongoing mitigation efforts
- Intra- and inter-governmental coordination
- Land use and regulation
- Floodplain management
- Building code inspection
- Capital improvement
- Land conservation programs

The text of this survey, as well as tabular results can be found in Appendix F.4.

Additionally, a separate survey was created to assess the knowledge of the general public in matters related to hazard mitigation. This is a key capability issue, as many of the most crucial mitigation decisions are made by members of the public. The questions were vetted by the Hazard Mitigation Steering Committee, and the survey went live on May 23, 2008. To date, the survey has not yet generated sufficient responses to draw meaningful results, but in the future such an analysis can be performed. The text of this survey can be found in Appendix F.5.

8.3 Federal and State Regulations, Plans, and Funding Sources

8.3.1 Inventory of Regulations, Plans and Funding Sources

This section, including Table 8.3.1-1, provides summary information regarding selected federal and state regulations, plans, and sources of funding that are relevant to mitigation projects and activities. For additional information regarding funding availability and eligibility, and other details about and evaluations of these regulations, plans, and funding sources, see Appendix F.1-F.3.

Also, see Table 8.5.1-1 for further discussion and evaluation of key regulations and minimum standards that are implemented at the municipal level.

Table 8.3.1-1
Summary of Selected State and Federal Regulations, Plans, and Funding Sources Relevant to Natural Hazard Mitigation

Title	Program Type	Administered By	Eligible Recipient	
			County	Municipality
Farm Bill Cons. Program/Farm and Ranch Lands Protection Program	Funding (Federal)	New Jersey Department of Agriculture (NJDOA)/Division of Agriculture and Natural Resources	X	X
FEMA Public Assistance (PA) Grant Program	Funding (Federal)	NJOEM	X	X
FEMA Hazard Mitigation Grant Program (HMGP)	Funding (Federal)	NJOEM	X	X
FEMA Pre-Disaster Mitigation (PDM) Grant Program	Funding (Federal)	NJOEM	X	X
FEMA/National Flood Insurance Program (NFIP) Repetitive Flood Claims (RFC) grants	Funding (Federal)	NJOEM	X	X
FEMA/NFIP Severe Repetitive Loss (SRL) Grant Program	Funding (Federal)	NJOEM	X	X
FEMA/NFIP Flood Mitigation Assistance (FMA) grants	Funding (Federal)	NJOEM	X	X

Title	Program Type	Administered By	Eligible Recipient	
			County	Municipality
National Dam Safety Program/ Water Resources Development Act (WRDA)	Funding (Federal)	New Jersey Department Environmental Protection (NJDEP)/Dam Safety Section		(specific waterways explicitly identified in WRDA)
Housing and Urban Development Community Development Block Grants (CDBG)	Funding (Federal)	New Jersey Department of Community Affairs (NJDCA)/Division of Community Resources	X	X
Land and Water Conservation Fund	Funding (Federal)	NJDEP/Green Acres Program	X	X
United States Department of Agriculture Forest Legacy Program	Funding (Federal)	NJDEP/Green Acres Program		(available to private landowners)
New Jersey Open Space Program	Funding (Local)	NJDEP/Green Acres Program	X	X
Community Wildfire Hazard Mitigation Assistance Program	Funding (New Jersey)	NJDEP/New Jersey Forest Fire Service	X	X
Shore Protection Program	Funding (New Jersey)	NJDEP/Office. of Engineering and Construction	X	X
Green Acres	Funding (New Jersey)	NJDEP/Green Acres Program	X	X
Coastal Blue Acres	Funding (New Jersey)	NJDEP	X	X
Farmland Preservation Program	Funding (New Jersey)	NJDOA/State Agriculture Development Committee	X	X
Freshwater Wetland Protection Act/ Wetland Mitigation Fund	Funding (New Jersey)	NJDEP	X	
Dam Restoration and Inland Water Projects Loan Program	Funding (New Jersey)	NJDEP	X	X
Sewerage Infrastructure Improvement Act Grants	Funding (New Jersey)	NJDEP	X	X
New Jersey Small Communities CDBG	Funding (New Jersey)	NJDCA/ Division of Community Resources	X	X
Environmental Infrastructure Financing Program	Funding (New Jersey)	NJDEP		(any public, private, or non-profit owned water system)

Title	Program Type	Administered By	Eligible Recipient	
			County	Municipality
Transportation Trust Fund Municipal Aid	Funding (New Jersey)	New Jersey Department of Transportation (NJDOT)/Division of Local Aid	X	X
Transportation Trust Fund	Funding (New Jersey)	NJDOT	X	
New Jersey Conservation Foundation	Funding (Private)			(private program)
New Jersey Development and Redevelopment Plan	Plan	NJDCA/Office of Smart Growth	X	X
Watershed Permitting	Regulation	NJDEP/Municipal Stormwater Regulation Water Quality Division		X
New Jersey Flood Hazard Area Control Act	Regulation	NJDEP/Flood Control Section		X
Uniform Construction Code	Regulation	NJDCA/Division of Codes		X
Uniform Fire Code	Regulation	NJDCA/Fire Safety Division		X
Flood Hazard Area Control Act	Regulation	NJDEP	X	X
Safe Dam Act	Regulation	NJDEP	X	X
Waterfront Development Statute and Coastal Permit Program	Regulation	NJDEP/Division of Land Use Regulation (DLUR)		X
Coastal Area Facility Review Act	Regulation	NJDEP/DLUR		X
Wetlands Act/ Coastal Zone Management	Regulation	NJDEP/DLUR		X
Stormwater Mgt. Rules	Regulation	NJDEP		X
Tidelands Act	Regulation	NJDEP		X
Municipal Land Use Law	Regulation	NJDEP/Bureau of Land Use Compliance	X	

For many federal grants, the non-federal share can be borne by the state as *grantee*, the recipient community as *subgrantee* or in some cases, the property owner who benefits from the project. In the case of property acquisitions intended to remove properties that experience repetitive flood losses, the non-federal share is typically covered by the property owner, who accepts the federal share of 75% and documents the lost equity as the non-federal share. This can serve as a disincentive to participation.

It is also important to note in this discussion of federal plans that on March 19, 2009, during the development of this Plan, FEMA approved a multi-year initiative called "Risk Mapping, Assessment and Planning" or "Risk MAP". The plan implementation spans FY10-FY14 and builds on the success of FEMA's Map Modernization program that will soon be concluding the work to provide reliable digital flood mapping for the majority of the Nation's population.

Per FEMA's website[1], the "vision for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property". One objective of the initiative is to "[r]educe losses of life and property through continuous improvement of mitigation plans", which is consistent with the goals and specific action items in this Plan. The Mitigation Action Plan for Gloucester County (see Section 9) includes an action item that specifically includes ensuring that Gloucester County takes full advantage of any opportunities that the Risk MAP program will provide.

8.3.2 Implications of NJOEM Capabilities on Local Hazard Mitigation Efforts

State capabilities for hazard mitigation have an impact on the efficacy of local planning and implementation. In accordance with the State Hazard Mitigation Plan Update (SHMPU), the focus of New Jersey's statewide hazard mitigation effort is centered in the New Jersey Office of Emergency Management (NJOEM), located in the Division of State Police.

NJOEM is represented on the State Hazard Mitigation Team (SHMT), which is chaired by a representative of the Governor's Office. Other state agencies represented on the SHMT and actively involved in hazard mitigation include the NJDEP, the NJDCA, the NJDOT, and the Department of Banking and Insurance.

The SHMT has responsibility for the following, at a minimum:

- Identifying hazards, monitoring changes in hazard vulnerability, and implementing measures for reducing potential damage by providing a mechanism for follow-up activities crucial to the successful implementation of team recommendations
- Developing and maintaining a comprehensive state hazard mitigation plan for the reduction of natural hazards
- Promoting public awareness of risks associated with known hazards and preparedness among residents of the state
- Serving as an advisory group to the Governor's Advisory Council on Emergency Services (GACES) and preparing post-disaster hazard mitigation recommendations for all applications for assistance.
- Investigating and recommending cost-effective hazard mitigation opportunities to the NJOEM and the GACES as part of any disaster recovery effort

Historically, NJOEM has had limited staffing to address the hazard mitigation needs of the state. Additional staff is needed to expand the ability of the state to support local and county mitigation planning needs. NJOEM needs to employ adequate staffing with the necessary expertise for the timely development of hazard mitigation plans and to facilitate the implementation of risk reduction projects statewide.

In the past, NJOEM has employed planning professionals and program administrators who conducted community outreach, mitigation workshops, and training opportunities to promote development of hazard mitigation plans, assist with developing alternative funding sources, and promote a statewide risk reduction strategy.

[1] http://www.fema.gov/plan/ffmm.shtm

Recent staffing loss and the inability to hire has left the State Hazard Mitigation program understaffed to meet the needs of county and local emergency management programs. As stated in the SHMPU, the state would benefit from hiring professional staff for the State Mitigation Unit to fulfill its responsibilities and manage its increased workload resulting from recent disasters, the addition of several FEMA funded mitigation programs, and commitments in the SHMPU. Increased NJOEM staffing is needed in the areas of planning, engineering, and project management.

In addition to the employment of professional staff, there is a need to develop a cadre to supplement disaster recovery operations and mitigation staff to assist NJOEM with education of affected communities, project assessment, and development of mitigation projects that have been recommended but not initiated. Such a cadre could be used to supplement state staffing during disaster recovery operations.

8.4 Capability Assessment for Gloucester County

In accordance with New Jersey's home rule structure, authority over the three key tools for proactive hazard mitigation–land use planning, floodplain management, and building code enforcement–reside at the municipal level. For more on this, see Section 8.5. Counties play a coordinating role in these matters.

8.4.1 Relevant Ordinances and Policies

This section, as illustrated in Table 8.4.1-1, provides a list of Gloucester County ordinances and policies that have the potential to affect and/or promote mitigation within the county. Understanding which ordinances and policies affect mitigation in the county is a helpful component to mitigation activities. Many of the ordinances and policies that most directly affect development in relation to hazards reside at the municipal level. These include zoning, floodplain management, and building code enforcement.

Table 8.4.1-1: Gloucester County Ordinances and Policies Relevant To Hazard Mitigation
(Source: County Interviews)

Ordinance/ Policy	Description	Enforcement
Municipal Land Use Law	Encourages appropriate development in municipalities that promotes public health, safety, morals, and general welfare.	Planning Department
Cross-Acceptance Report	Encourages consistency between municipal, county, regional, and state plans for development and redevelopment.	Planning
Master Plan	The county's Master Plan is out of date, but due to home rule, municipal Master Plans (and the Cross-Acceptance Report) are more relevant	Planning
County Open Space and Recreation Plan	Controls the process of land preservation	Planning
Emergency Operations Plan	The county is required by state statute to update its Emergency Operations Plan every four years. The current plan used was adopted in 2007.	Office of Emergency Management

Ordinance/ Policy	Description	Enforcement
Gloucester County Comprehensive Economic Development Strategy	The county has a Comprehensive Economic Development Strategy that was adopted in 2008.	Department of Economic Development

8.4.2 Fiscal Capacity

This section, as illustrated in Table 8.4.2-1, provides a list of local funding sources within Gloucester County and determines if that funding source can be used to affect or promote mitigation within the county. Understanding where potential funding sources are available to the county is a helpful component to mitigation activities.

Table 8.4.2-1
Gloucester County Funding/Financing Sources Relevant To Hazard Mitigation
(Source: County Interviews)

Financial Resources	Accessible or Eligible to Use
General Fund	Yes
Development Fees	No
CDBG	Yes
Capital Improvements Project Funding	Yes
Authority to Levy taxes for Specific Purposes	Yes (1)
Fees for Water, Sewer, Gas, or Electric Service	Yes
County Open Space and Recreation Plan	Yes
Green Acres Fund	Yes
Impact Fees for Homebuyers or Developers for New Developments/Homes	No
County Match Fund	Yes
Federal Hazard Mitigation Grants	Yes (once the plan is approved by FEMA and adopted, participating jurisdictions will be eligible for HMGP, PDM, and other federal grants)

(1) Limited local authority, only as allowed by state statutes.

Gloucester County retains a county grants coordinator who manages all grants needing freeholder approval. Grants awarded to county departments can tap a funding source know as *cash match funds* which are actual county dollars to pay for any local match to the grant.

In the case of other grants, including distribution of some federal program funds, while municipalities can benefit from county projects such funds cannot be passed through to the municipalities, depending on the scope of the grant and the work to be performed.

The Gloucester County Improvement Authority has the power to acquire, build, and finance most public facilities including municipal buildings, fire stations, schools, sewers, roads, bridges, parks, affordable housing, and community complexes. Natural hazards are taken into account whenever possible during the planning and project implementation. For example, the Gloucester County Improvement Authority recently funded the Repaupo Creek Floodgate project which involved renovation and restoration to the existing flood control device.

The Gloucester County Improvement Authority will work with municipalities to arrange refinancing and can provide a means for joint financing of projects. They can structure debt service repayment to fit the specific needs of a local government entity and/or the unique characteristics of a project.

Generally, the following conditions must be met in order for a project to be considered for county funding: the project must cross municipal boundaries and must have a benefit to the public. Additionally, counties may participate in projects that affect county infrastructure, including roads and drainage infrastructure.

8.4.3 Technical, Administrative, and Regulatory Capacity

This section provides a review of the administrative and technical resources within the county's departments to determine if all of the necessary resources are available to Gloucester County to engage in mitigation planning processes. Table 8.4.3-1 indicates potential resource needs, and indicates whether the county currently has staff with that expertise or available outside contractors.

Table 8.4.3-1: Gloucester County Administrative and Technical Capacity
(Source: County Interviews)

Staff/Personnel Resources	On Staff	Department/Agency
Planner(s) or engineer with knowledge of land development and land management practices	Yes	Planning
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Yes	Engineering
Planners or engineer(s) with an understanding of natural and/or human-caused hazards	Yes	Planning
Floodplain Manager	No	--
Surveyors	No	--
Staff with education or expertise to assess the municipality's vulnerability to hazards	Yes	Office of Emergency Management
Personnel skilled in Geographic Information System (GIS) and/or Hazards US (HAZUS)	Yes	Planning
Scientists familiar with the hazards of the community	No	--
Emergency Manager	Yes	Office of Emergency Management

Additionally, although most land-use related regulatory powers in New Jersey reside at the municipal level, counties have the ability to influence and guide development in important ways. These are discussed below.

Intra- and Inter-Jurisdictional Coordination

Although not all, several Gloucester County agencies mentioned that they employ staff that serve as board members and are part of other working groups that cross agency boundaries and create better sense of other issues, concerns, and/or efforts. County staff reported working with state partners on implementing state funded programs such as the Green Acres Program however did not note significant contact with NJOEM. The main point of interaction for the county with NJOEM has been applying and receiving the award of the planning grant used to develop this hazard mitigation plan. FEMA was also generally described as having very little presence in Gloucester County. They were noted as a funding source but only through the state which served as the *grantee* (with the county being the *sub-grantee*) for the award of this planning grant.

Regionalization

Municipalities in New Jersey are currently being encouraged to consolidate (*regionalize*) services and functions. These may include police, fire, EMS, limited emergency operations functions, and other items. In some cases, regionalization is taking place between two or more municipalities. In others, this effort is being coordinated and led by the county−in some cases with the county providing the service.

With the exception of EMS service, there are currently no county based regionalized services in Gloucester County. However, there have been recent conversations about the regionalization of basic services such as garbage removal. Discussion of regionalizing the school districts within Gloucester County has also occurred, but no action has been taken. Hazard mitigation, if regionalized, could become a function of the county, but would probably not be possible with current staffing levels.

As noted above, 12 of the 24 municipalities use regionalized EMS service in Gloucester County.

Land Use Planning and Regulation

The Gloucester County Planning Department has the authority to approve or reject all land development projects and site plans at the municipal level under the New Jersey Municipal Land Use Law. This gives the county some control and provides a mechanism for coordinated development. The Gloucester County Planning Department also manages drainage issues/projects along county roads and holds formal monthly meetings in which the municipalities are encouraged to participate and bring forth issues.

Floodplain Management

Floodplain management in Gloucester County is a function strictly handled at the municipal level of government. The county is not responsible for either adopting or enforcing a minimum floodplain ordinance. At the municipal level, 22 of the 24 municipalities have adopted some type of ordinance that restricts or controls development or construction in floodprone areas. For more information on floodplain management and NFIP participation at the municipal level, see Section 8.5 and Appendix F.1-F.2 and F.4.

The county is required to follow all applicable national and state restrictions pertaining to floodplains and wetlands when acquiring land for parks and recreation through programs such as Green Acres or Farmland Preservation. Such lands are then owned by the county.

Building Code Enforcement

Building code enforcement in Gloucester County takes place at the municipal level of government. All municipalities are required by New Jersey law to enforce the New Jersey Uniform Construction Code. Building codes are either enforced by local inspectors or third party contractors. Gloucester County manages the County Construction Board of Appeals, which provides a mechanism to solve disputes over construction practices at the municipal level. For more on building code enforcement at the municipal level, see Section 8.5 and Appendix F.1-F.2 and F.4

Economic Development Planning

The Gloucester County Department of Economic Development promotes public and private partnerships to create sustainable growth by attracting businesses, developing a trained and educated workforce, and enhancing tourism and open spaces. The overarching concept is to provide a sustainable living environment while expanding economic opportunities for the citizens of Gloucester County. Economic development is a partnership between the county and each municipality. As such, the Department of Economic Development approves all plans involving development adjacent to county roads. Applicable federal and state wetland restrictions are followed during this approval process. The Gloucester County Office of Emergency Management can, and does, provide assistance on a case-by-case basis when an area of particular concern arises. For example, an area that is considered for development which may be in a risk area, such as a floodplain, is often discussed with the OEM to ascertain any ramifications or problems that may arise in the future from developing that parcel of land. The Gloucester County Department of Economic Development retains staff that has participated in Continuity of Operations and Continuity of Government Planning with the Office of Emergency Management which has furthered fostered the relationship between the two departments.

Capital Improvements Planning

The Gloucester County Treasurer's Office develops and monitors a six-year County Capital Improvement Plan. Drainage projects and improvements to roads, bridges, and dams receive annual appropriations in the budget which are important projects in terms of hazard mitigation.

Land Conservation

The Gloucester County Land Preservation Department maintains an active land conservation program through two specific programs, the Farmland Preservation Program and the Open Space Preservation Program. Approximately 14,500 acres of farmland and open space have been preserved in 18 municipalities through these two programs. Funding for the Open Space Preservation Program comes partially through the state's Green Acres program and also from a county open space tax. As such, the county is bound to all Green Acres regulations during the appraisal process of acquiring land which includes surveying, soil studies, etc. Once acquired, the land is typically designated as park or recreation land and is then maintained by the county. These efforts are guided by the County Open Space and Recreation Plan.

While hazard mitigation may not formally be the expressed objective of this process, much of the acquired land has been adjacent to bodies of water or part of existing county parklands and therefore reducing exposure to flooding damage.

8.5 Capability Assessment for Municipalities within Gloucester County

8.5.1 Overview of Relevant Statewide Mandatory Minimum Standards Related to Local Ordinances and Policies

New Jersey follows a home rule philosophy under which each municipality is directly responsible for local enforcement of building codes, floodplain management, emergency management, and zoning ordinances.

In order to ensure a minimum set of standards, the state has passed laws and regulations mandating each municipality adopt local ordinances with the same basic criteria, so that jurisdictions may add additional requirements, but cannot have fewer/weaker requirements than the state standard. Having each municipality with a core set of policies, programs, and capabilities at its disposal, allows for more effective mitigation against hazards, regardless of a municipality's relative size, population, or wealth.

New Jersey mandates compliance with the Municipal Land Use Law, Uniform Construction Codes, Floodplain Management, and Growth Management, and strongly encourages land and water preservation through incentive programs. These mandates translate into local ordinances, policies, or programs that regulate and enforce how zoning, building and open space are managed by the municipalities. Table 8.5.1-1 highlights the state laws that drive the state's policies to support local jurisdictions' ability to impact hazard mitigation.

Table 8.5.1-1: New Jersey Policies That Impact Municipal Hazard Mitigation Efforts
(Source: New Jersey State Hazard Mitigation Plan Update, 2008)

Policy	**Land Use Planning**
Description	State of New Jersey Municipal Land Use Law (MLUL) L.1975, c. 291, s. 1, effective August 1, 1976, is the legislative foundation of the land use process, including decisions by Planning Boards and Zoning Boards of Adjustment, in the State of New Jersey. It defines the powers and responsibilities of boards and is essential to their functions and decisions. It also provides the required components of a municipal Master Plan.
Applicability	Every municipal agency shall adopt and may amend reasonable rules and regulations, not inconsistent with this act or with any applicable ordinance, for the administration of its functions, powers, and duties.
Effectiveness	The MLUL requires that each municipality prepare a comprehensive plan and update that plan every six years. These plans help jurisdictions review their land use plans and policies with public participation.
Policy	**Floodplain Management**
Description	New Jersey State Law Flood Hazard Area Control Act (NJSA 58:16A-52). The National Flood Insurance Act of 1968 is a federal program establishing the National Flood Insurance Program (NFIP), which enables property owners in participating communities to purchase insurance as protection against flood losses, in exchange for state and community floodplain management regulations that reduce future flood damages. As further incentive for communities to surpass the NFIP basic requirements, the CRS recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

Applicability	The act and regulations attempts to minimize damage to life and property from flooding caused by development within fluvial and tidal flood hazard areas, to preserve the quality of surface waters, and to protect the wildlife and vegetation that exist within and depend upon such areas for sustenance and habitat. While it does not require local adoption, as it is enforced by the NJDEP. The floodplain ordinances of each municipality need to be reviewed to be in compliance with revised regulations (2007).
Effectiveness	Flood Hazard Control Act: Regulations for the Flood Hazard Control Act were adopted in November 2007 so it is difficult to quantify the effectiveness at this time. See below for discussion of floodplain management activity at the county and municipal levels in Gloucester County. The New Jersey Dam Safety program, new state storm water management requirements, and the development of all hazard mitigation plans, are among of the efforts that can provide CRS credits for New Jersey municipalities.
Policy	**Building Codes**
Description	Uniform Construction Code (UCC) (Uniform Construction Code Act of 1975) requires all jurisdictions to have current land use master plans (reexamined every six years), zoning, and other land development ordinances. The UCC contains subcodes for residential and other buildings, as well as requirements that address construction in both A and V flood zones. All new construction is required to comply with the UCC for flood zone construction. In the affected areas, older at-grade structures have been routinely razed and replaced with new and often larger structures, all now conforming to the NFIP's requirements for A-zone and V-zone construction. Thus, through the building boom of the 1990's and 2000's, there have been thousands of structures modified to FEMA's more stringent requirements, especially with respect to homes built on piling at or above the Base Flood Evaluation for that zone. This in itself is a form of mitigation. However, there are still thousands of older homes still at grade that remain vulnerable to flood from storm surge and other sources.
Applicability	New Jersey State Law requires that all municipalities adopt ordinances that follow the UCC.
Effectiveness	Considered among the most effective elements in a mitigation program, because building codes mandate best practices and technology, much of which is designed to reduce or prevent damage from occurring when structures are under stress.
Policy	**Growth Management**
Description	The State Plan was prepared and adopted by the State Planning Commission according to the requirements of the State Planning Act of 1985 as amended (NJSA 52:18A-196 et seq.) to serve as an instrument of state policy to guide state agencies and local government in the exercise of governmental powers regarding planning, infrastructure investment and other public actions and initiatives that affect and support economic growth and development in the state.
Applicability	Through the Green Acres Program, Open Space Tax Program, State Development and Redevelopment Plan, and the State Planning Act, New Jersey has enhanced the traditionally limited role of county land-use planning and control. The state also provides tools for municipalities when preparing their master plans and better opportunity for a comprehensive approach to planning so not to harm or be in conflict with neighboring municipalities' plans.
Effectiveness	See below for discussion of land use planning and regulation as it applies to hazard mitigation in Gloucester County.
Policy	**Critical Area Protection**
Description	Green Acres Program; Blue Acres Program; Historical Preservation Program; Farmland Preservation
Applicability	These programs provide the funding necessary for municipalities and counties to purchase land for open space preservation and recreation.

Effectiveness	The state has made $3.3 billion for public investment in open space preservation and recreation since 1961. New Jersey residents have consistently voted for open space and recreation referendums at the state and local levels. In 2007, all 21 counties and 231 municipalities assessed a special tax for land preservation and recreation purposes. See below for further discussion of land conservation as it relates to hazard mitigation in Gloucester County.

8.5.2 Technical, Administrative, and Regulatory Capacity

As described above, capability at the municipal level was assessed through the use of an online survey, augmented by research into other state sources and interviews with county officials. The survey was targeted to the primary contacts for this Hazard Mitigation Plan in each municipality (those who comprise the Hazard Mitigation Work Group). Typically, these were municipal OEM coordinators. Others with relevant knowledge were solicited to participate as well, including those in the departments of planning, public works, and buildings. In Gloucester County, 22 out of 24 primary contacts participated (a response rate of 92%).

The full text of the survey questions as well as full data reporting for Gloucester County, are contained in Appendix F.4.

Staffing and Personnel Capability for Hazard Mitigation

Municipal primary emergency management contacts in Gloucester County typically have significant experience and training relevant to emergency response, but often not to hazard mitigation. Most respondents to the survey (59%) reported having been in their current position between five and 15 years. None were newer than one year. More than half of respondents (57%) reported a background in fire, police, or EMT, and more than half (52%) reported a college education as being relevant to their work. More than 40% reported taking FEMA/Incident Command System courses.

However, municipal staffing levels were often thin. The majority of respondents (55%) reported having zero staff, although a small number of municipalities reported having upwards of 20 or 30 staff to manage municipal operations. Most respondents (73%) also reported having no staff that works in a hazard mitigation capacity, although a few offices reported having as many as 10 staff that had some mitigation component to their jobs. Only one municipal office reported using contractors.

Only a few offices reported having staff trained in grant writing (five) or grant administration (six), and a large majority (86%) stated that their staff could spend a total of zero-to-five hours per week on mitigation related management duties. However, most (72%) of respondents said no other office would be a preferable location for hazard mitigation grant and project oversight.

Respondents reported moderate use of GIS–only 36% reported using the technology, and none reported using it for hazard mitigation related analysis.

Familiarity with FEMA mitigation programs was mixed. As shown in Figure 8.5.2-1, respondents had some familiarity with older FEMA mitigation grant programs such as PA, HMGP, PDM, and FMA. In each case, at least 70% of respondents reported a moderate or higher familiarity with these programs. Respondents were far less familiar with newer programs such as SRL and RFC. As Figure 8.5.2-2 shows, however, participation in FEMA grant programs has been very low in Gloucester County.

Figure 8.5.2-1: Respondent Familiarity with FEMA Mitigation Funding Sources
Answering 14 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

Figure 8.5.2-2: Municipal Participation in FEMA Mitigation Programs
Answering 14 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

Very few respondents provided any insight into the effectiveness of mitigation programs in their municipalities. Challenges attributed to executing mitigation projects included limited funding and planning reviews. Qualities reported in successful mitigation programs included sufficient funding. The need for adequate financing was also noted as a lesson-learned for future mitigation programs. Only one respondent proposed additional mitigation programs that would be useful in their municipality; they recommended drainage projects.

As Figure 8.5.2-3 shows, few respondents reported that their municipalities maintain any public information programs related to hazard mitigation.

Figure 8.5.2-3: Existence of Municipal Public Education Programs Related To Hazard Mitigation
Answering 22 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

Intra- and Inter-Jurisdictional Coordination

Many municipal primary contacts coordinate their mitigation activities with other agencies, both within the same municipality and beyond. Almost half (46%) of respondents reported that other municipal offices also carry out mitigation-related work, typically in the Department of Public Works (90%), the Planning Department (30%), the Building Department (30%), and the OEM (40%). Staffing, in these other offices, ranges from a handful to more than 30. Eighty percent of respondents reported regular interaction with these other offices, either via email, phone, or face-to-face; 64% reported active partnering on mitigation efforts.

Most (63%) of respondents reported working with neighboring municipalities on mitigation efforts. All reported working with the county, while 23% reported working with a regional planning entity, 85% reported working with state agencies, and 31% reported working with federal partners. Of all of these, the county OEM was rated the most valuable partner by 85% of respondents.

Land Use Planning and Regulation

Primary contacts who responded to the survey were mixed on their familiarity with land-use planning and regulation tools as they related to hazard mitigation, but those who were familiar with them tended to also be familiar with the ways in which these tools assist mitigation.

The majority of respondents were not familiar with the content of their municipality's Comprehensive (Master) Plan. Those who were familiar rated their plans high for prioritizing mitigation, as shown in Figure 8.5.2-4. Comprehensive Plans were generally understood to call for limiting development in hazard-prone areas and establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc.

Figure 8.5.2-4: Hazard Mitigation Addressed In Municipal Comprehensive Plans
Answering 8 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

A large majority of respondents were familiar with their municipality's zoning, and most rated their zoning codes high for prioritizing mitigation, as shown in Figure 8.5.2-5. Zoning codes were generally understood to call for limiting development in hazard-prone areas and establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc. Codes were also understood to allow for creative site-design solutions that can help mitigate hazards.

Figure 8.5.2-5: Hazard Mitigation Addressed In Municipal Zoning
Answering 19 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

Half of respondents were familiar with their municipality's subdivision ordinance, and most rated their subdivision ordinance very highly for prioritizing mitigation, as shown in Figure 8.5.2-6. Subdivision ordinances were generally understood to call for limiting development in hazard-prone areas and establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc. Ordinances were also understood to allow for creative site-design solutions that can help reduce or eliminate hazards.

Figure 8.5.2-6: Hazard Mitigation Addressed In Subdivision Ordinance
Answering 11 of 22
(Source: New Jersey Southern Delaware Valley Region Municipal Capability Assessment Survey, 2008)

Floodplain Management

Very few respondents reported a familiarity with administration of freshwater wetland rules or floodplain management in their jurisdictions. However, as Table 8.5.2-1 shows, 22 of 24 municipalities in Gloucester County participate in the NFIP, meaning that they are required under state and federal law to have adopted a model floodplain management ordinance and have a designated floodplain manager. However, the degree of on-the-ground effectiveness of floodplain managers varies widely. Only a few are estimated to be actively engaged in mitigating risk. In some cases, the individual who is formally tasked with the responsibility for floodplain management may not be aware of the assignment.[2]

Of NFIP-participating municipalities in Gloucester County, only one (Greenwich) has taken any additional steps to enhance risk management and decrease flood insurance premiums through participation in the CRS.

[2] In the past, municipal building code enforcement/inspectors were often automatically assigned the duties of a floodplain manager. This practice is now being discouraged by the state Division of Codes and Standards (DCA), which is part of the Office of Community Affairs. This agency supervises building inspection programs in New Jersey.

Table 8.5.2-1
NFIP and CRS Participation in Gloucester County
(Source: FEMA)

Municipality	Participating in the National Flood Program as of 6/30/08	CRS Rating
Clayton Borough	X	10
Deptford Township	X	10
East Greenwich Township	X	10
Elk Township	X	10
Franklin Township	X	10
Glassboro Borough	X	10
Greenwich Township	X	9
Harrison Township	X	10
Logan Township	X	10
Mantua Township	X	10
Monroe Township	X	10
National Park Borough	X	10
Newfield Borough	--	--
Paulsboro Borough	X	10
Pitman Borough	X	10
South Harrison Township	--	--
Swedesboro Borough	X	10
Washington Township	X	10
Wenonah Borough	X	10
West Deptford Township	X	10
Westville Borough	X	10
Woodbury City	X	10
Woodbury Heights Borough	X	10
Woolwich Township	X	10

Building Code Enforcement

Respondents reported that building code enforcement is most often (64%) the responsibility of a Building Department. Sixty percent of code enforcement offices have three of fewer people; none have more than 10. All inspectors were reported to be state certified.

Capital Improvement Planning

Most respondents (77%) reported that the executive leadership of their municipality oversees the capital improvement program. Very few (14%) reported that hazard mitigation projects are generally considered as part of the capital improvements program, and fewer still (5%) reported that capital improvement projects themselves are assessed for hazard or hazard mitigation implications.

Land Conservation

Most respondents (64%) stated that their municipalities participate in land conservation programs such as Green Acres and Blue Acres. Administration of these programs was spread through the departments of planning, public works, and others. No respondents stated that such funds are used for any hazard mitigation purposes.

8.6 Current and Completed Hazard Mitigation Programs and Projects

This section provides a review of the completed hazard mitigation projects or programs and provides a description of potential or in-process projects or programs and the agency or agencies that the county worked with or is working with to complete the projects.

Table 8.6-1: Current and Completed Hazard Mitigation Programs and Projects
(Source: County Interviews)

Program or Project	Description	Agency
Hazard Mitigation Plan	The county and its municipalities are currently in the process of developing a Multi-hazard, Multi-jurisdictional Hazard Mitigation Plan.	Gloucester OEM
Sluice Gates/Levee Replacement	Through the Gloucester County Improvement Authority (GCIA) the county is currently replacing deteriorating sluice gates and levees.	GCIA
Storm Water Management Plan	Through the GCIA the County developed a SWMP to encourage a countywide standard for storm water management and regional coordination.	GCIA

8.7 Summary and Conclusions

In conclusion, there are several areas which may be investigated further to determine the relevance of developing hazard mitigation strategies to fill gaps or shortcomings. Particularly these areas include: staffing, resources, and coordination.

As noted, there is often little to no staffing available at the local level to devote to hazard mitigation related activities. This includes project identification and data gathering; grant writing and application development; and the subsequent project management that follows an award of a grant. A regionalized approach, outside assistance or an augmented staff with knowledge in hazard mitigation project management would be beneficial in bolstering Gloucester County's efforts in reducing future risk. It would also assist in preparing better project applications that may be selected based on a competitive selection process. Additional staff also creates the ability to improve coordination at all levels of government.

Section 9
Mitigation Action Plan

Contents of this Section

9.1 Interim Final Rule Requirement for the Mitigation Action Plan

Requirement §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, an its ability to expand on and improve these existing tools.

Requirement §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Requirement §201.6(c)(3)(ii): [The mitigation strategy ***shall*** *include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Requirement: §201.6(c)(3)(iii): [The mitigation strategy section ***shall*** *include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization* ***shall*** *include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Requirement §201.6(c)(3)(iv): For multi-jurisdictional plans, there ***must*** *be identifiable action items specific to the jurisdiction requesting Federal Emergency Management Agency (FEMA) approval or credit of the plan.*

9.2 Hazard Mitigation Goals

This section contains goals, objectives and action items for the Gloucester County, New Jersey Multi-Jurisdictional Hazard Mitigation Plan. For the purposes of this Plan, the following definitions are proposed:

- Goals are general guidelines that explain what the county and participating municipalities want to achieve. Goals are expressed as broad policy statements representing desired long-term results.

- Objectives (or strategies) describe strategies to attain an identified goal. Objectives are more specific statements than goals; objectives are also usually measurable and can have a defined completion date.
- Mitigation Actions are the specific steps (projects, policies, and programs) that advance a given objective. They are highly focused, specific, and measurable.

The hazard identification and risk assessment in Sections 6 and 7 consisted of identifying the hazards that affect Gloucester County and the potential for damage to community assets that are vulnerable to the hazards. Section 8 identified the strengths and weaknesses of state and local capabilities. The goals and objectives described below, in Table 9.2-1 and following, were established by the Southern Delaware Valley Hazard Mitigation Steering Committee (HMSC) and validated by the Gloucester County Hazard Mitigation Working Group (HMWG) members in response to these assessment results. Many of the actions described below apply to the county and all participating municipalities.

The broad goals of the Gloucester County Hazard Mitigation Plan are as follows:

- Goal 1: Improve EDUCATION AND OUTREACH efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact.
- Goal 2: Improve DATA COLLECTION, USE, AND SHARING to reduce the impact of hazards
- Goal 3: Improve CAPABILITIES, COORDINATION, AND OPPORTUNITIES at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities
- Goal 4: Pursue OPPORTUNITIES TO MITIGATE repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Specific objectives and actions to support these goals are described below in Table 9.3.2-1. Additionally, actions related to enhanced data collection (flood and critical facilities excepted) are described in Table 9.3.2-2 and municipality-specific actions are described in Table 9.3.3-1.

For additional information related to state and federal programs and funding sources to support the below actions, please refer to Appendix F.1-F.3; in particular, for detail regarding limitations related to FEMA mitigation grant programs, see Appendix F-3, Table F.3-2.

9.3 Identification and Analysis of Mitigation Actions

9.3.1 Potential Mitigation Actions

Gloucester County has identified several hazard mitigation actions that would benefit the county. These were identified in the HMSC and HMWG meetings, which included input from representatives of governmental organizations, local businesses, and private citizens. This was based in part on consideration of the range of potential mitigation actions for hazards faced by Gloucester County and its constituent municipalities which are described below.

Public Awareness

Insurance industry and emergency management research has demonstrated that awareness of hazards is not enough. People must know how to prepare for, respond to, and take preventive measures against threats from natural hazards. This research has also shown that a properly run local information program is more effective than national advertising or public campaigns.

Although concerted local, county, and statewide efforts to inform the public exist, lives, and property continue to be threatened when segments of the population remain uninformed or chose to ignore the information available. Public education serves to assist the communities with problems experienced from floods, high wind, severe storms, earthquakes, dam failure, levee failure, and wildfires as well as other lower priority hazards. Educating the public of these life and property saving techniques must remain a high priority item at the local, state, and federal level and is consistent with Goal 1.

Projects identified by the HMSC and HMWG are as follows:

- Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness
- Initiate a public awareness program on local TV for hazard safety
- Conduct evacuation exercises with and for local Office of Emergency Management (OEM) personnel and private citizens
- Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below)
- Educate the public through New Jersey Office of Emergency Management (NJOEM) and New Jersey Forest Fire outreach programs and hazard mitigation workshops

National Flood Insurance Program, Floodplain Management, and Building Codes

Improved floodplain management, including land use planning, zoning, and enforcement at the local level can reduce flood related damages for both existing buildings and new development and are consistent with Goal 3. The use of the National Flood Insurance Program (NFIP) is critical to the reduction of future flood damage costs to the taxpayer.

About 16.4% of Gloucester County is located in a floodplain. All developments, regardless of the location, require a permit to include buildings, fill, and any other type development. Under New Jersey's *home rule* system, different offices in the various municipalities have authority over the necessary permits.

The NFIP requires that when the cost of reconstruction, rehabilitation, addition, or other improvements to a building equals or exceeds 50% of the fair market value, then the building must meet the same construction requirements as a new building. Substantially damaged buildings must be brought up to new construction standards. A residence or building damaged so that the cost of repairs equals or exceeds 50% of the structure's fair market value must also be elevated above the Base Flood Elevation (BFE) in flood zones where BFE's are available.

See Table 9.3.1-1 for the dates on which the communities of Gloucester County joined the NFIP. Each municipality within Gloucester County is expected to appoint a Floodplain Manager to enforce municipal floodplain ordinances. These ordinances are intended to addresses methods and practices to minimize flood damage to new and substantial home improvement projects, as well as addressing zoning and sub-division ordinances and state regulations as enforced through the New Jersey Department of Environmental Protection (NJDEP).

Table 9.3.1-1
National Flood Insurance Program

Name of Community	Date Joined NFIP
Clayton Borough	March 11, 1983
Deptford Township	November 17, 1982
East Greenwich Township	December 1, 1982
Elk Township	October 21, 1983
Franklin Township	February 3, 1982
Glassboro Borough	August 16, 1982
Greenwich Township	September 16, 1982
Harrison Township	April 1, 1983
Logan Township	January 6, 1983
Mantua Township	November 3, 1982
Monroe Township	January 20, 1982
National Park Borough	September 2, 1982
Newfield Borough	--
Paulsboro Borough	September 2, 1982
Pitman Borough	April 1, 1983
South Harrison Township	--
Swedesboro Borough	July 5, 1982
Washington Township	November 17, 1982
Wenonah Borough	May 11, 1979
West Deptford Township	June 1, 1982
Westville Borough	May 1, 1980
Woodbury City	May 11, 1979
Woodbury Heights Borough	May 18, 1979
Woolwich Township	September 2, 1982

Within floodplain management as a whole, the education process must play an important role. As noted above, an effective education program should be implemented to show citizens the importance of building codes and ordinances and how cost effective they could be in reducing future damages.

Established through the NFIP, the Community Rating System (CRS) is a program that counties and municipalities can elect to join. Once a county has joined, participants receive a discount on their flood insurance premiums. As a result of being part of the CRS, the county would have to actively pursue public outreach programs. One of the requirements of CRS is an annual outreach project, such as a Repetitive Loss Outreach Program. This program would focus on repetitive loss areas within the county and consists of three main components. The first is to advise the homeowners that they live in a repetitive loss area and could be subject to flooding. The second is to give the homeowner appropriate property protection measure guidelines. The third is to make the homeowner aware of the basic facts about Flood Insurance.

The New Jersey Unified Construction Code is the mandated construction code for all New Jersey municipalities. The State of New Jersey Department of Community Affairs issues licenses to all construction code and cub-code officials that enforce the State's Uniform Construction Code.

However, the state's Department of Environmental Protection is the lead state agency for the administration of the state's Floodplain Management Program. Each community that participates in the NFIP must adopt and enforce municipal floodplain management regulations that meet or exceed the minimum requirements of the NFIP as directed by the state's Floodplain Management Program. This requirement is in addition to the enforcement of the State Uniform Construction Code.

Each community in Gloucester County that is a participating community in the NFIP Program is required to have both a well trained municipal floodplain manager and construction code official. To ensure adequate enforcement of both codes, each community in Gloucester County should encourage additional training opportunities for all code enforcement personnel, to include its municipal floodplain manager.

Floodplain management and building codes serve to assist the communities with problems experienced from floods, hurricanes, tornadoes, and thunderstorms/lightning/high winds as well as other lower priority hazards.

Floodplain management and building codes serve to assist the communities with problems experienced from floods, high winds, severe storms, and earthquakes as well as other lower priority hazards.

Flood Mitigation Actions

Retrofitting structures prone to periodic flooding is an effective mitigation technique to reduce the flood loss of property and is consistent with Goal 4. Techniques include the elevation of structures, acquisition, mitigation reconstruction, dry floodproofing, wet floodproofing, drainage improvements and installation of generators.

Elevation: involves raising a structure on a new foundation so that the lowest floor is above the Base Flood Elevation (BFE). Almost any type and size of structure can be elevated.

Acquisition of structures: or *buyout* option is the most effective mitigation technique to reduce the loss of property due to flooding. The owners of repetitive flood loss structures sell their structure to the community on a cost share basis for the fair market value of the structure prior to the last flood event. The structure is removed/demolished and a deed restriction is placed on the property for perpetuity, thus eliminating the structure from future flood damage. This approach is most effective when flood prone structures located within the same vicinity are grouped together and acquired. The remaining property can be converted into usable recreational space with minor structure restrictions.

Mitigation Reconstruction: is a component of the Severe Repetitive Loss (SRL) grant program that allows demolition and reconstruction of structures when traditional elevation cannot be implemented. This activity can be used for structures that were substantially damaged or destroyed. Currently this is a pilot program utilized mainly on the gulf coast but can be considered a potential approach to mitigation activities.

Dry floodproofing: techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and special backflow valves for water and sewer lines. Wet floodproofing includes low cost mitigation measures such as raising air conditioners, heat pumps, and hot water heaters on platforms above the BFE.

Wet floodproofing: includes measures applied to a structure that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls. Application of wet floodproofing as a flood protection technique under the NFIP is limited to enclosures below elevated residential and non-residential structures and to accessory and agricultural structures that have been issued variances by the community.

Drainage: Improving the drainage capacity around roads and low lying areas is a time tested technique to mitigate flood damage. Maintenance of drainage canals and laterals is essential to maximize their efficiency and continued long term effectiveness. Actions in general to reduce the effects of flooding are widening and deepening the earthen canals, cleaning of existing ditches, and replacing existing culverts, upgrading pumps, installing check valves, and inverts in certain culverts. Maintaining and improving drainage serves to assist the communities with problems experienced from floods, high wind, and severe storms.

Generators: Another cost effective retrofitting technique includes the installation of generators. By providing power with generators during and after severe storms many critical facilities may continue to provide necessary services to the community. The installation of generators serves to assist the communities with problems experienced from floods, high wind, severe storms, and earthquakes.

Wind Retrofitting Mitigation Actions

Structures can be retrofitted to withstand high winds by installing hurricane shutters, roof tie-downs and other storm protection features. The exterior integrity is maintained by protecting the interior of the structure and providing stability against wind hazards associated with hurricanes. These types of measures can be relatively inexpensive and simple to put in place.

Another retrofitting technique is to bury electric power lines to avoid tree limbs falling on them or from wind damage resulting in a break in service to the consumer. Burying electric power lines serves to assist the communities with problems experienced from floods, high wind, and severe storms.

Early Warning Systems

With sufficient warning of a flood, a municipality and its residents can take protective measures such as moving personal property, cars, and people out of harm's way. When a flood threat recognition system is combined with an emergency response plan that addresses the municipality's flood problems, considerable flood damage can be prevented. This system must be coupled to warning the general public, carrying out appropriate tasks, and coordinating the flood response plan with operators of critical facilities. A comprehensive education and outreach program is critical to the success of early warning systems so that the general public, operators of critical facilities, and emergency response personnel will know what actions to take when warning is disseminated.

Early warning systems serve to assist the communities with problems experienced from floods, high wind, severe storms, dam failure, and levee failure.

Earthquakes

Significant seismic events, while not common to the region, do pose a potentially significant threat to Gloucester County and the surrounding area. The most practical preventative action to be considered, concerns appropriate building code enforcement. While this is not necessarily practical for existing structures except for renovations or reconstruction, there are activities that can be taken to mitigate further exposure to risk.

Building Retrofit: the use of reinforced concrete materials in combination with cross ties is a proven technique to provide current structures with additional stabilization. The addition of seismic stabilizer platforms for important of critical mechanicals within buildings will significantly reduce adverse impacts.

Dam and Levee Failure

Mitigation for dam and levee failure is often similar to that which can be done for flooding; however, dam and levee failure has the potential to cause catastrophic damage for which the majority of flood mitigation measures would be ineffective.

Educational Outreach: develop and conduct educational outreach programs on the associated risks that close proximity to dams and levees presents.

Building Codes: adopt building codes using a flood protection elevation which is based on dam or levee failure water levels.

Warning Systems: install warning systems to prevent loss of life in the event of a dam or levee failure.

Land Use: avoid construction in areas located within a dam or levee high velocity inundation zone.

Inundation Studies: conduct detailed studies to identify the inundation areas including potential water velocity and height.

Wildfire

The following mitigation measures can be applied to those areas of the County which are designated as wildfire risk zones.

Educational Outreach: develop and conduct educational outreach programs on wildfire prevention including training on fire safe building for contractors and homeowners.

Retrofitting: existing buildings can be retrofitted to reduce their vulnerability to wildfires. Potential measures include covering roof vents with wire mesh to prevent entry of embers or flaming debris, and replacing flammable roof materials such as wood or certain types of shingles. Fire resistant roofing materials include various tiles, fiberglass shingles and single ply membranes.

Safety Zones: safety zones can be created around structures by reducing or eliminating brush, trees and vegetations around a home or facility. FEMA recommends using a 30 foot safety zone, including keeping grass below 2 inches tall and clearing all fallen leaves and branches promptly.

Fire Breaks: roads and trails can be planned so as to serve a dual function as firebreaks. Firebreaks are areas of inflammable materials which create a fuel break and do not allow fires to spread.

9.3.2 Countywide Mitigation Actions

The HMSC and HMWG developed the following program of mitigation actions in response to the risk and capability assessments (see Sections 7 and 8) that will be implemented on a countywide basis. These general actions are presented in Table 9.3.2-1.

Table 9.3.2-1
Gloucester County Hazard Mitigation Goals, Objectives, And General Actions

GOAL 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 1.A: Increase awareness of risks and understanding of the advantages of mitigation by the general public and local government officials (see also municipal actions in Table 9.3.2-1).	1.A.1: Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness.	High	Gloucester County and municipal OEMs	One year	Gloucester County and municipal OEM personnel	Better informed populace creates a greater willingness and expectation to participate in mitigation actions.
	1.A.2: Initiate a public awareness program on local TV channel for hazard safety.	Medium	Gloucester County and municipal OEMs	Six months to one year	Gloucester County and municipal OEM personnel, local public TV	A better informed and involved population reduces risk and loss.
	1.A.3: Conduct evacuation exercises with and for local Office of Emergency Management (OEM) personnel and private citizens.	Medium	Gloucester County Office of Emergency Management (GCOEM)	One year	Gloucester County and municipal OEM personnel, local business groups, citizen groups	Public participation leads to more active emergency and preparedness response.
	1.A.4: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below).	High	GCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Makes local officials and the public aware of federal grants increases participation.

GOAL 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 1.A cont.:	1.A.5: Educate the public through NJOEM and New Jersey Forest Fire Service outreach programs and hazard mitigation workshops.	High	NJOEM, New Jersey Forest Fire Service	Ongoing	Existing state resources	Encourages the development of PDM plans and participation in mitigation grant programs.
Objective 1.B: Increase local government official awareness regarding funding opportunities for mitigation.	1.B.1: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC (coordinated with Action 1.A.4, above).	High	GCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Makes local officials aware of federal grants increases participation.
Objective 1.C: Increase local government official awareness regarding opportunities for participation in and contributing to future Plan updates.	1.C.1: Reach out to municipal Floodplain Administrators, depts. of planning, public works, engineering, etc. regarding the importance of hazard mitigation planning and provision of municipal plans and data for planning purposes.	High	GCOEM, municipal coordinators	Ongoing	Existing county and municipal resources	Makes local officials aware of benefits of plan participation.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A: Improve availability to the county and participating municipalities of data related to all relevant hazards for use in future planning efforts.	2.A.1: Develop and maintain relationships with organizations that can provide technical information and/or assistance in the areas of hazard identification and risk assessment, e.g., incorporate information re: implementation of Risk MAP initiative as source of improved information re: flood risk in participating municipalities.	Medium	GCOEM, Rutgers University, New Jersey Geologic Survey (NJSG), National Oceanic and Atmospheric Administration (NOAA), and United States Army Corps of Engineers (USACE),	Ongoing	Existing county staff, FEMA, NJOEM, Rutgers University, NJGS, other federal agencies including NOAA and USACE	Provides the basis for making decisions about where to focus mitigation activities, including further study, and eventually mitigation projects.
	2.A.2: Undertake site-specific studies to better characterize flood risks to areas with extensive flood loss histories (see also municipal actions in Table 9.3.3-1 for additional detail).	High	GCOEM	Starting within six months, then ongoing	Gloucester County OEM staff, municipal staff	This is an essential step in developing flood mitigation actions.
	2.A.3: Coordinate with state efforts to undertake detailed vulnerability assessments and develop mitigation options for critical facilities in V and VE zones.	High	Gloucester County and municipal OEMs	To be determined based on funding.	Existing staff	Step in process of securing grant funds to mitigate risks to these sites.
	2.A.4: Use best possible flood data, including DFIRM and Map Mod data, if available, in next plan update. Track implementation of Risk MAP initiative to ensure Gloucester County and municipalities gain full advantage of opportunities under this program.	High	Gloucester County and municipal OEMs	3 years	Existing staff	This is essential data for establishing flood risk.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.5: Continuously update and verify status of repetitive loss and severe repetitive loss lists from the NFIP.	High	Gloucester County and municipal OEMs	Ongoing	Existing staff	Essential to continuing the county's efforts to reduce flood losses. Enables the county to appropriately prioritize its actions to mitigate repetitive loss and severe repetitive loss properties, in accordance with FEMA requirements (and contributes to qualifying the county and local jurisdictions for the 90:10 federal-local match under the SRL program).
	2.A.6: Inventory critical facilities to identify those in geographic areas that may be prone to high ground motion during earthquakes (due to proximity to faults or to soil characteristics), and those with structures that may be at risk during an earthquake.	Medium	GCOEM and municipal OEMs, with support from NJGS.	1 year	FEMA grants, existing staff and resources	Allows risk-based decisions regarding protection of critical facilities.
	2.A.7: Coordinate with state efforts to prioritize critical facilities and conduct more detailed earthquake risk assessments, taking into account the relative importance of the facility and the level of seismic hazard.	High	GCOEM, Municipal OEMs, FEMA, NJGS	1 year	FEMA grants, existing staff and resources	Serves as first step in a long term plan to reduce risks to the most critical county facilities.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.8: Work with NJGS to determine soil and shake characteristics at specific sites that the county has identified as priority critical facilities with potential vulnerabilities to earthquake forces, and then work with engineers to develop appropriate projects.	High	GCOEM	1 year	TBD, potential collaboration with ongoing NJGS HAZUS-based earthquake studies	This is an essential step in developing appropriate mitigation actions for priority facilities.
	2.A.9: Coordinate with NJGS and other county, state, and federal agencies to better identify specific sites in the county that may be exposed to the effects of geo-hazards such as landslides, sinkholes and subsidence.	Medium	GCOEM, New Jersey Department of Environmental Protection (NJDEP), NJGS	2 years	Existing resources and staff	Although risk does not appear to be particularly high from these hazards, there remains a need to better understand the hazards on a site-specific basis. Studies will be used as the basis for developing additional actions and strategies to mitigate risk, particularly when critical facilities are at risk.
	2.A.10: Using a prioritized list of state, county, and local facilities, coordinate with state effort to survey wind vulnerabilities, based on criteria such as age of the facility, value of operations, proximity to the coast, etc.	High	GCOEM, municipal OEMs, NJOEM, with cooperation of other agencies that own and/or operate the facilities; New Jersey State Climatologist	1 year	Existing resources and staff	Although wind is not as significant a risk to the county as some other hazards, there are likely some critical facilities that are quite vulnerable to wind hazards, and where these vulnerabilities may be relatively inexpensive to mitigate.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.11: Conduct wind risk assessments on a limited number of high-priority facilities that appear to be vulnerable to high winds. Assessments will use standard FEMA guidelines, procedures and software, including the wind hazard database.	High	GCOEM, municipal OEMs	1 year	Existing resources and staff	Quantifies risk to most important facilities.
	2.A.12: Coordinate with state efforts to inventory or survey of prioritized areas to determine if there is a need for additional study or data collection related to wildfire and/or urban-interface fires. Focus of inventory/study will be on identifying areas where there exist vulnerable populations or built environment and/or areas where fuel loads and other conditions suggest potential for wildfire risk.	High	GCOEM, municipal OEMs, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing resources and staff	Establishes basis for additional studies and eventually mitigation actions, if they are indicated.
	2.A.13: Coordinate with state efforts to maintain current information about fuel loads and conditions that may affect potential for fires.	High	GCOEM, municipal OEMs, New Jersey Forest Fire Service	Ongoing	Existing resources and staff	Provides a basis for risk assessment.
	2.A.14: For areas with significant risk from wildfires or urban interface fires, perform detailed studies to objectively determine (a) the potential for wildfires, including likely magnitude, and (b) vulnerabilities of surrounding populations, built environment and functions.	Medium	GCOEM, municipal OEMs, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing resources and staff	Provides a basis for risk assessment.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.15: Coordinate with state efforts to conduct wildfire risk assessments for areas and assets that are determined to have the most hazard (fuel load, etc.) potential, and the most vulnerable structures, populations or operations.	Medium	GCOEM, New Jersey Forest Fire Service, outside engineering consultants	Ongoing	TBD, potential FEMA grants to conduct studies as indicated.	Quantifies which facilities are at most risk, and forms basis for determining where mitigation actions should be contemplated.
	2.A.16: Maintain effective coordination and information sharing related to hazardous material sites with NJOEM and the Right to Know (RTK) Network.	Medium	GCOEM, RTK Network, NJOEM	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.
	2.A.17: Complete data collection for Geographic Information System (GIS) analysis and mapping of potential areas of impact related to hazardous material sites.	High	GCOEM, county agencies	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.
	2.A.18: Integrate data about hazardous materials with most current available information about other risk factors, e.g. population, climate, other site-specific characteristics.	High	GCOEM, county agencies, RTK Network, NJDEP, US Environmental Protection Agency (EPA)	Ongoing	Existing resources and staff	Potentially allows integration of hazardous materials information with data related to natural hazards.
	2.A.19: Complete a detailed analysis of past losses related to winter storms to determine if additional study is indicated.	Medium	Gloucester County and local agencies with critical facilities	2 years	Existing resources and staff	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.20: Undertake a survey of critical facilities to identify and prioritize those that may have structural characteristics that make them vulnerable to excessive snow and ice loads.	Medium	Gloucester County and local agencies with critical facilities	2 years	TBD	Provides a basis for prioritizing actions, including mitigation.
	2.A.21: Complete a detailed analysis of past losses related to nor'easters and other coastal storms to determine if additional study is indicated. Work with state and federal agencies to develop a detailed characterization of erosion history and risks in particular.	Low to Medium	Gloucester County and local agencies with critical facilities; New Jersey State Climatologist	3 years	TBD	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.
	2.A.22: Work with appropriate agencies to identify specific areas that are vulnerable to storm effects, then inventory assets and populations in these areas as the basis for a risk calculation.	Medium	GCOEM, NOAA, USACE, local officials, NJDEP	3 years	TBD	Provides a basis for determining if any further risk assessment action is warranted.
	2.A.23: Work with NJDEP to more fully understand the dam hazard rankings and methodology behind them, particular regarding high-hazard sites.	Medium	GCOEM, NJDEP	3 years	NJDEP, USGS, NRCS	Provides a basis for further development and prioritization any future actions or strategies.
	2.A.24: Undertake more detailed engineering studies of dams that may pose risks to the county, based on additional data collected from state or federal agencies.	High	GCOEM, NJDEP, NJOEM	Ongoing	NJDEP, USGS, NRCS	Provides a basis for any additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.25: Conduct detailed risk assessments for dams that appear to have vulnerabilities, and where there is potential for significant damage or loss of life.	High	GCOEM NJDEP, USACE, engineering consultants	Ongoing	NJDEP, USGS, NRCS, USACE	Quantifies potential losses from dam failures where vulnerabilities have been identified.
	2.A.26: Conduct detailed risk assessments for levees which appear to have vulnerabilities, and where there is potential for significant damage or loss of life.	High	CGOEM, NJDEP, engineering consultants	Ongoing	NJDEP, USGS, NRCS, USACE	Quantifies potential losses from levee failure where vulnerabilities have been identified.
	2.A.27: Work with NJDEP and other agencies to compile better information about levees in the State, including inventories, engineering data and any other studies (in particular those that may discuss or catalog past levee failures).	Medium	GCOEM, NJDEP	Ongoing	NJDEP, USGS, NRCS	Although levees do not appear to pose a high risk to the County, information available at present is so limited that it is not possible to make even a preliminary determination regarding the need for further studies or actions. This action will allow officials to begin this process.
	2.A.28: Undertake more detailed engineering studies of levees that may pose risks to the county, based on additional data collected from local, State or federal agencies.	High	GCOEM, NJDEP, NJOEM	5 years	NJDEP, USGS, NRCS	Basis for any additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.29: Consolidate and incorporate relevant local data related to hazards, extent, probability, exposure, risk, history, etc.	High	Municipal OEMs	Ongoing	Existing resources	Basis for hazard identification, risk assessment, and mitigation strategies
Objective 2.B: Provide government officials and local practitioners with educational opportunities and information regarding best practices for hazard mitigation planning, project identification and implementation.	2.B.1: Participate in the Emergency Preparedness Conference and workshops.	High	Gloucester County and municipal OEMs, NJOEM, New Jersey Forest Fire Service	Ongoing	Existing state resources	The Emergency Preparedness Conference is an important venue to promote and increase participation in hazard mitigation programs and reaches a wide variety of people and interests.
Objective 2.C: Acquire and maintain detailed data regarding critical facilities such that these sites can be prioritized and risk-assessed for possible mitigation actions.	2.C.1: Develop a database inventory of critical facilities countywide (county-, local-, and privately-owned), including fire and police stations, medical facilities, major public buildings important for emergency response and recovery, and critical lifeline transportation and utility nodes such as bridges, water treatment plants, wastewater treatment plants, high voltage electric substations, and hazardous materials facilities.	High	GCOEM, municipal OEMs	Ongoing	Existing staff, possibly consultants depending on funding availability.	Developing basic information such as this will allow the state to meet federal requirements for prioritizing mitigation grant funds that will be directed to reducing losses to critical facilities.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.C, cont.:	2.C.2: Prioritize critical facilities and complete Phase 1 site surveys to identify vulnerabilities.	High	GCOEM, municipal OEMs	Commencing immediately, then ongoing.	Existing staff, possibly consultants depending on funding availability.	This is an essential first step in understanding risks and developing mitigation actions.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 3.A: Continue support of hazard mitigation planning, project identification and implementation at the municipal and county level.	3.A.1: Continue working with the State, as well as local jurisdictions, to encourage local cooperation in making Repetitive Loss (RL) (and SRL) property mitigation a high priority, and to offer municipalities technical support in carrying out the requirements of FEMA mitigation programs as well as current information related to RL and SRL properties.	High	GCOEM	Ongoing	Existing staff	This represents a basic requirement to initiate and sustain program momentum for RL and SRL mitigation.
	3.A.2: Provide grants information, planning tools, training and technical assistance to increase the number of public and private sector hazard mitigation projects.	High	GCOEM, NJOEM, FEMA Region II	Ongoing	Existing Resources, Mitigation Grant	Expanding the number of hazard mitigation projects will improve the county's resistance to hazards and reduce the impact of hazard events on its municipalities.
	3.A.3: Conduct direct outreach and education to municipal OEMs and other potential participants in Plan maintenance and future Plan updates	High	GCOEM	Ongoing	Existing resources	Increases efficacy and participation in hazard mitigation planning
	3.A.4: Work with NJOEM and FEMA to incorporate "recommended revisions" per NJOEM and FEMA Region II review of this Plan into future Plan updates.	High	GCOEM	Ongoing	Existing resources	Builds on successful completion of initial Plan and incorporates NJOEM and FEMA input.
Objective 3.B: Support increased NFIP/CRS participation.	3.B.1: Conduct community outreach, workshops and training to increase NFIP participation (coordinate with outreach actions listed under Objectives 1.A & 1.B).	High	GCOEM, NJOEM	Ongoing	Existing resources	This action encourages participation in the program, so that flood losses will be insured and covered, and it allows eligibility in the FMA program.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	3.B.2: Encourage municipalities to participate in the CRS program, including potentially setting up CRS site visits and/or workshops for interested jurisdictions.	High	GCOEM, NJOEM	2 years	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved
	3.B.3: Encourage municipalities to include identification and prioritization of actions related to future participation in and compliance with the NFIP	High	CGOEM. Municipal OEMs	Ongoing	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved
Objective 3.C: Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/ county zoning and subdivision regulation, and comprehensive planning.	3.C.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, and other land use tools at the municipal level.	High	GCOEM, NJDEP, municipal officials	Ongoing	Existing Resources and Federal grant funds (FEMA CAP-SSSE)	Guides communities in a more effective control and use of floodplains.
	3.C.2: Coordinate with state efforts to encourage the New Jersey League of Municipalities to become more involved in mitigation activities, and in particular to support the activities described in Action 3.C.1 and 3.D.1.	Medium	NJOEM, New Jersey League of Municipalities	Ongoing	Existing staff	Advances all goals in the plan by increasing preparedness and knowledge of citizens, and law and policymakers.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs, and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 3.D: Elicit and support efforts by federal and state legislatures and agencies to address shortcomings in existing laws, programs and administrative rules related to hazard mitigation.	3.D.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, other land use tools, and environmental and other regulatory mechanisms via state requirements, reviews, and regulations. Coordinate with the State Planning Commission to integrate the State Development and Redevelopment Plan and the State Hazard Mitigation Plan.	High	GCOEM, NJDCA, State Planning Commission, municipal building inspectors, zoning boards	Ongoing	Existing resources	Guides communities in a more effective control and use of floodplains.
Objective 3.E: Provide for user-friendly hazard-data accessibility for mitigation and other planning efforts and for private citizens.	3.E.1: Develop a simple GIS platform, or build upon an existing platform, to maintain and analyze critical facilities inventories and information about hazards.	Medium	GCOEM, county agencies, in cooperation with other counties	1 year	Existing resources and staff	Provides a basis for understanding risks and maintaining most current information; provides a good means of maintaining data needed for period updates to the hazard mitigation plan; and (potentially) helps to identify promising sites mitigation actions and grant proposals.
Objective 3.F: Provide direct support, where possible, to municipal mitigation programs.	3.F.1: Explore potential for possible regionalization or consolidation of hazard mitigation planning, administration, and/or implementation at the county level	High	GCOEM	3 years	TBD	This could help support, coordinate, and consolidate hazard mitigation capabilities.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 4.A: Facilitate development and timely submittal of project applications meeting state and federal guidelines for funding (1) for RL and SRL properties and (2) for hardening/retrofitting infrastructure and critical facilities with highest vulnerability ratings.	4.A.1: Coordinate with state efforts to develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the county and municipalities for 90:10 cost share under the FEMA SRL program.	High	GCOEM, NJOEM	Immediate and ongoing	Existing local, state and federal funding programs.	Protects, people, property and response assets while removing high cost structures from the NFIP.
	4.A.2: Continue working with local and regional jurisdictions to encourage and support their efforts to mitigate RL (and SRL) properties, either individually through the use of cluster solutions and/or basin projects, as appropriate, and offer technical support in carrying out the requirements of FEMA mitigation programs. (see Table 9.3.3-1 for further detail).	High	GCOEM, NJOEM	Ongoing	Federal grants, Green Acres, other open space funds	Initiates a long-term process to protect property from effects of repetitive flooding.
	4.A.3: Implement mitigation projects and programs intended to reduce risk to critical facilities (see Table 9.3.3-1 for further detail).	Varied	Varied	Ongoing	Federal grants, other state and local sources	Reduces exposure and risk to critical facilities.
	4.A.4: Implement other mitigation projects and programs as appropriate at the municipal level (see Table 9.3.3-1 for further detail).	Varied	Varied	Ongoing	Federal grants, other state and local sources	Varied.
Objective 4.B: Maintain and enhance local planning and regulatory standards related to future development and investments.	4.B.1: Integrate hazard mitigation Plan and priorities into floodplain management, zoning, subdivision regulation, and other local regulations as appropriate.	High	Local permitting and planning offices	Ongoing	Existing County and Local Resources	Implements all goals by mitigating risk to new construction on a jurisdiction-wide basis
	4.B.2: Ensure full and effective enforcement of building codes, floodplain management, zoning, and other risk-reducing regulations.	High	Local permitting and planning offices	Ongoing	Existing County and Local Resources	Advances all goals in the plan by ensuring effectiveness of existing local tools

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 4.B, cont.:	4.B.3: Integrate hazard mitigation priorities into Capital Improvement Plans, transportation planning, and other capital planning	High	Local planning and engineering offices	Ongoing	Existing County and Local Resources	Advances all goals in the plan by ensuring consistency of major investments with mitigation priorities

Notes:

(1) Priority rankings were developed by GCOEM. See Appendix G and Table G-1 for details of STAPLEE analysis of these mitigation actions.

9.3.3 Municipality-Specific Mitigation Actions

Within Gloucester County, 21 municipalities signed letters-of-intent as participating municipalities. Strategies for hazard mitigation within Gloucester County and the municipalities were identified to reduce damage to those areas and conform to the requirements of the Interim Final Rule (IFR). The following indicates the specific mitigation actions on a community by community basis including the rankings assigned to the projects by the municipalities.

Each participating municipality in Gloucester County identified mitigation actions and programs based upon the risk assessment (Section 7) and capabilities assessment (Section 8). These are detailed in Table 9.3.3-1, below. In all cases, these actions support Goal 4, i.e., pursue opportunities to mitigate repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities.

Table 9.3.3-1
Municipality Specific Mitigation Actions

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
CLAYTON BOROUGH								
Clayton 1: Structural retrofit of homes located between North Street and Main Street	Flood	Existing	Floodplain Management Plan	Municipal Executive (or his/her designee)	One year	To be determined by engineer.	Clayton Borough	High
Clayton 2: Engineering study to assess risk from Silver Lake Dam located on West Clayton Avenue	Flood	Existing	Floodplain Management Plan	Municipal Executive (or his/her designee)	Three years	$60,000	Clayton Borough	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Clayton 3: Engineering study to determine appropriate flood mitigation action and envelope/ improved path structural retrofits of data storage (Clayton Community Recreation Center) on Washington Avenue	Flood/Wind	Existing	Floodplain Management Plan	Municipal Executive (or his/her designee)	One year	$40,000	HMGP; PDM	High
Clayton 4: Engineering study to determine appropriate flood mitigation action and envelope/ improved path/ structural retrofits and secure roof ballast of Emergency Operation Center (EOC) and Police (Municipal Building) on Route 47	Flood/Wind	Existing	Capital Improvement Plan	Municipal Executive (or his/her designee)	One year	$40,000	PDM	High
Clayton 5: Structural retrofit of Rustic Village Apartments - located on Route 47. (Buildings units A-K)	Wind	Existing	Capital Improvement Plan	Municipal Executive (or his/her designee)	Three years	To be determined by engineer.	HMGP; PDM	Low
Clayton 6: Secure roof ballast of shelter (Herma Simmons Elementary School) located on 300 West Chestnut Avenue	Wind	Existing	Capital Improvement Plan	Municipal Executive (or his/her designee)	Two year	To be determined by engineer.	HMGP; PDM	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Clayton 7: Critical facilities protection/ hazard threat recognition of hazmat (Propane Tank Farm) located on Delphi Drive Route 47	Hazmat -fixed site	Existing	Private Channel	Propane Tank Farm	One year	Unknown	Clayton Borough	Medium
Clayton 8: Critical facilities protection/ hazard threat recognition of hazmat (Aleris Light Aluminum Company)	Hazmat -fixed site	Existing	Private Channel	Aluminum Company	One year	Unknown	Clayton Borough	Medium
DEPTFORD TOWNSHIP								
Deptford 1: Hardening/ retrofitting EOC facility located in Municipal Building at 1101 Cooper Street	High Wind	Existing	Capital Improvement Plan	Office of Emergency Management	Two years	To be determined by engineer.	HMGP; PDM	Medium
Deptford 2: Engineering Assessment to assess risk from Almonesson Lake Dam located on Cooper Street	Flood	Existing	Unknown	Office of Emergency Management	One year	$60,000	Deptford Township	High
ELK TOWNSHIP								
Elk 1: Engineering Assessment to assess risk from dam located in Lake Garrison on County Road Route 553	Flood	Existing	Private Channel	Private	Five years	$60,000	Private	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Elk 2: Engineering assessment to assess risk from dam on Lake Gilman on County Road Route 641	Flood	Existing	Private Channel	Private	Five years	$60,000	Private	Low
Elk 3: Engineering Assessment to assess risk from Hackney Dam, 431 Richwood Road, County Road/Route 609	Flood	Existing	Private Channel	Private	Five years	$60,000	Private	Low
Elk 4: Retrofitting/ hardening of data storage facility located in Municipal Building on County Road, Route 667	Wind	Existing	Capital Improvement Plan	Office of Emergency Management	Two years	To be determined by engineer.	HMGP; PDM	Medium
Elk 5: Engineering Assessment to assess risk from dam on Silver Lake on Route 608 shared with Gilman municipality	Flood	Existing	Private Channel	Private	Two years	$60,000	Private	Low
Elk 6: Engineering Assessment to assess risk from Ewan Lake Dam−shared with Harrison municipality	Flood	Existing	Private Channel	Private	Two years	$60,000	Private	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
FRANKLIN TOWNSHIP								
Franklin 1: Engineering study to determine appropriate flood mitigation action for Police/ EOC center (municipality building) Located in floodplain area next to Sharon Lake on Delsea Drive	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year-five years	$60,000	PDM;	High
Franklin 2: Acquisition or floodproofing of houses around Franklin Lake, Iona Lake, McCarty's Lake, and other developed and flood prone lakes in municipality	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year-five years	To be determined by engineer.	HMGP; FMA; PDM	Low
Franklin 3: Modify building materials, revisit response and evacuation plans, fire lanes and education for populations in the Pinelands	Wildfires	Existing	Capital Improvement Plan	Office of Emergency Management	One year-five years	Unknown	Franklin Township	Low
Franklin 4: Envelope hardening/secure roof ballast of shelter (Regional High School)	High Wind	Existing	Capital Improvement Plan	Office of Emergency Management	Five years	To be determined by engineer.	HMGP; PDM	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Franklin 5: Engineering study to access risk and maintenance of Franklin Lake Dam, Iona Lake Dam, and McCarty's Lake Dam	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year	30,000-60,000 for evaluation per dam.	Franklin Township	High
Franklin 6: Critical facilities protection/ hazard threat recognition of hazmat (freight rail carries chlorine behind apartment building of 40-50 families)	Hazmat - transportation	Existing	Unknown	Private	Three years-five years	Unknown	Franklin Township	Low
Franklin 7: Critical facilities protection/ hazard threat recognition of hazmat site (Arrow Crop Service Airport)	Hazmat - transportation	Existing	Unknown	Arrow Crop Service Airport	Three years	Unknown	Franklin Township	Medium
GLASSBORO BOROUGH								
Glassboro 1: Engineering study to determine drainage/conveyance on Union Street	Flooding	Existing	Floodplain Management Plan	Office of Emergency Management	One Year	Unknown	HMGP; PDM	Medium
Glassboro 2: Engineering study to determine flood mitigation action for Police Department	Flooding	Existing	Floodplain Management Plan	Office of Emergency Management	Six months-one year	Unknown	PDM	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Glassboro 3: Critical facilities protection/ hazard threat recognition of hazmat (high pressure lines) running along Union Street, Ellis Street, and Delsea Drive	Hazmat-Fixed Site	Existing	Hazard Mitigation Plan	Office of Emergency Management	Six months-one year	Unknown	Glassboro Borough	Medium
GREENWICH TOWNSHIP								
Greenwich 1: Engineering study to determine appropriate flood mitigation action for EOC/Fire building located on E. Broad Street	Flooding	Existing	Floodplain Management Plan	Department of Emergency Management	Two years	$60,000	PDM	High
Greenwich 2: Engineering study to determine appropriate flood mitigation action for Wastewater Treatment facility located on Washington Street (located in a flood zone)	Flooding	Existing	Floodplain Management Plan	Department of Emergency Management	Three years	$60,000	PDM	Medium
Greenwich 3: Engineering study to determine appropriate flood mitigation action for shelter at Nehaunsey School located on Swedesboro Road	Flooding	Existing	Floodplain Management Plan	Department of Emergency Management	Three years	$60,000	PDM; Greenwich Township	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Greenwich 4: Engineering study to determine appropriate flood mitigation action for Valero Refinery located at Billingsport Road (in 100-year flood plain area)	Flooding	Existing	Floodplain Management Plan	Department of Emergency Management	Three years	$60,000	PDM	High
HARRISON TOWNSHIP								
Harrison 1: Property acquisition private house located at Ellis Mill Road at Lake Gilman	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Three years	Unknown	HMGP; PDM; FMA; RFC	Low
Harrison 2: Engineering study to determine appropriate flood mitigation action for Fire/EMS (Harrison Firehouse) located on 312 Ewan Road, Mullica Hill	Flood	Existing	Hazard Mitigation Plan	Office of Emergency Management	Three years	$40,000	Fire District; Capital Improvement	Medium
Harrison 3: Engineering study to determine appropriate flood mitigation action for Wastewater Treatment Facility, Woodland Avenue	Flood	Existing	Capital Improvement Plan	Office of Emergency Management	Three years	$40,000	Harrison Township Waste Water Treatment facility; PDM	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
LOGAN TOWNSHIP								
Logan 1: Repaupo Fire Station (shelter) generator/ back-up power	All	Existing	Hazard Mitigation Plan	Office of Emergency Management	Two years	$40,000	HMGP 5%	Medium
Logan 2: Beckett Fire Station (shelter) generator/ back-up power	All	Existing	Hazard Mitigation Plan	Office of Emergency Management	Two years	$40,000	HMGP 5%	Medium
Logan 3: Address recurring erosion/instability issue at Delaware River/ Repaupo Creek levee (end of Floodgate Rd.)	Flood, levee failure	Existing	USACE	USACE	Three to five years	TBD pending engineering	GCIA, state (engineering only: project funding not in place)	High
MANTUA TOWNSHIP								
Mantua 1: Engineering study to assess risk of dam located on Lambs Road and bordering Washington Township	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Two years	$60,000	Mantua Township	Medium
Mantua 2: Engineering study to determine appropriate flood mitigation action for Route 45	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Two years	$40,000	PDM	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Mantua 3: Engineering study to determine appropriate flood mitigation action for private houses located on Hickory Avenue next to Mantua Creek	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year	$60,000	Mantua Township	High
Mantua 4: Engineering study to determine appropriate flood mitigation action for police and data storage facility located on Main Street	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year	$40,000	PDM	High
Mantua 5: Relocate utility lines underground in the southern end of Mantua from Route 45 to Break Neck Road	Flood/High Wind	Existing	Unknown	Office of Emergency Management	Two years	To be determined by engineer.	PDM	High
Mantua 6: Engineering study to determine appropriate flood mitigation action of Water Facility (Harrison Township Waste Water Treatment Facility) located on Woodland Avenue)	Flood	Existing	Capital Improvement Plan	Harrison Township Waste Water Treatment Facility,	Two years	$40,000	Harrison Township Waste Water Treatment Facility; PDM	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
MONROE TOWNSHIP								
Monroe 1: Engineering study to determine appropriate flood mitigation action in Main Street Area	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Two years	$60,000	PDM	Medium
Monroe 2: Building evaluation of EOC located in Municipal Building on 125 Virginia Avenue	Flood	Existing	NA	Office of Emergency Management	Two years	To be determined by engineer.	HMGP; PDM	Medium
Monroe 3: Elevation and dry floodproofing of two homes located next to Victory Lake and Timber Lake	Flood	Existing	NA	Private Owner	Three years	To be determined by engineer.	Monroe Township	Low
Monroe 4: Fixing one dam located by Victory Lake	Flood	Existing	Project currently ongoing.	Office of Emergency Management	One year	To be determined by engineer.	Monroe Township	High
Monroe 5: Enhance floodplain management administration, staffing, and process	Flood	NA	Floodplain Management Plan	Office of Emergency Management	One year	$40,000	Monroe Township	High
Monroe 6: Create safety zones around critical facilities in wildfire risk areas	Wildfire	Existing	Hazard Mitigation Plan	Office of Emergency Management	One year-two years	To be determined.	Monroe Township	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
NATIONAL PARK BOROUGH								
National Park 1: Engineering study to determine appropriate flood mitigation action for 6 private houses on Princeton Avenue (non-RL/SRL)	Flood	Existing	NA	Department of Public Works	Two years	$30,000	CDBG; Green Acres	High
PAULSBORO BOROUGH								
Paulsboro 1: Engineering study to determine appropriate flood mitigation action for Huff Avenue, Thompson Avenue and the 500 block of Delaware Street	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Two years	$40,000	PDM	Medium
PITMAN BOROUGH								
Pitman 1: Engineering study to determine mitigation action for flooding on Howard Avenue, Lakeside Avenue, Lake Avenue, and Pointsett Avenue.	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Three years	$40,000	PDM	Low
Pitman 2: Monitor dam failure and flood risk/threat related to Alcyon Dam	Dam failure	Existing	Hazard Mitigation Plan	Office of Emergency Management	ongoing	Unknown	Staff resources	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
ROWAN UNIVERSITY								
Rowan University 1: Floodproofing, improved conveyance, and drainage of shelter in Recreation Center	Flood	Existing	NA	Rowan University	One year	To be determined by engineer.	HMGP; PDM	High
Rowan University 2: Construct bulkhead, improve retention, and conveyance of Chestnut Branch Creek	Flood	Existing	NA	Rowan University	Two years	Unknown	HMGP; PDM	High
Rowan University 3: Improve drainage of Triad Apartments and Bunce Academic Building	Flood	Existing	NA	Rowan University	One year	Unknown	HMGP; PDM	High
Rowan University 4: Initiatives to evaluate lock down processes, evacuation procedures, emergency communications, and other Homeland Security initiatives relating to campuses	All hazards	Existing	NA	Rowan University	One year-two years	Unknown	Rowan University	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
SOUTH HARRISON TOWNSHIP								
South Harrison 1: Engineering study to determine appropriate flood mitigation action and envelope hardening/improved load path for Fire/EMS building, Municipal building, and South Harrison Elementary School located on Main Street	Wind	Existing	Unknown	Office of Emergency Management	One year	$40,000	PDM	Low
South Harrison 2: Public education and outreach program for residents in trailer park (between Mullica Hill Road and Cedar Grove) for hurricane/ evacuation strategies	Hurricane	Existing	Unknown	Office of Emergency Management	One year	$50,000	HMGP (5%)	Medium
South Harrison 3: Assess wind risk to communications tower (repeater tower)	Wind/ Severe Weather/Flood	Existing	Unknown	Office of Emergency Management	Two years	Unknown	South Harrison Township	Low
SWEDESBORO BOROUGH								
Swedesboro 1: Engineering study to assess risk for Narraticon Lake Dam	Flood	Existing	Capital Improvement Plan	Department of Public Works	Three years	$60,000	Swedesboro Borough	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Swedesboro 2: Engineering study to determine appropriate action related to envelope hardening and improved load path for police station/ Borough Hall located on Kings Highway	Wind	Existing	Hazard Mitigation Plan	Department of Public Works	One year-two years	$40,000	PDM	Low
Swedesboro 3: Engineering study to determine appropriate action related to envelope hardening and improved load path for Fire/EMS (Swedesboro fire department) located at Kings Highway and Auburn Road	Wind	Existing	Hazard Mitigation Plan	Department of Public Works	One year-two years	$40,000	PDM	Low
WASHINGTON TOWNSHIP								
Washington 1. Engineering evaluation of drainage on Palomar	Flood	Existing	Capital Improvement Plan	Office of Emergency Management	One year-two years	$40,000	Washington Township	High
Washington 2. Improve Spring Lake Road culvert	Flood	Existing	Capital Improvement Plan	Office of Emergency Management	One year-two years	To be determined by engineer.	HMGP; PDM	High
Washington 3. Engineering evaluation to assess dam on Spring Lake	Flood	Existing	Capital Improvement Plan	Office of Emergency Management	One year-Two years	$40,000	Washington Township	High
Washington 4. Stream bank stabilization of Avonbrook Drive	Erosion	Existing	Capital Improvement Plan	Office of Emergency Management	Two years-three years	To be determined by engineer.	Washington Township	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Washington 5: Stream bank stabilization of Hyannis Drive	Erosion	Existing	Capital Improvement Plan	Office of Emergency Management	Two years-three years	To be determined by engineer.	Washington Township	High
WENONAH BOROUGH								
Wenonah 1: Risk assessment study of electrical/utility infrastructure in borough	Winter weather; high wind	Existing	Hazard Mitigation Plan	Atlantic Electric	One year	Unknown	Wenonah Borough	Medium
Wenonah 2: Threat recognition of railroad tracks carrying chlorine, ethanol, etc. near municipal building, EOC, data storage facility, and firehouse	All hazards	Existing	NA	ConRail/CSX	One year	Unknown	Wenonah Borough	High
WEST DEPTFORD TOWNSHIP								
West Deptford 1: Elevation of private trailers and improvements to berm around Willow Wood Trailer Park located off of Crown Point Road	Flood	Existing	Private Channel	Office of Emergency Management	Two years	Unknown	West Deptford Township	Medium
West Deptford 2: Elevation and easements on West 1st Avenue between Mantua and West Deptford municipalities	Flood	Existing	Hazard Mitigation Plan	Office of Emergency Management	One year	Unknown	West Deptford Township	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
WOODBURY CITY								
Woodbury 1: Engineering study to determine appropriate flood mitigation action for EOC/data storage (City Hall) located at 33 Delaware Street	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year	$40,000	PDM; Woodbury City	Medium
Woodbury 2: Engineering study to determine appropriate flood mitigation action and envelope hardening of Colonial Park Senior Citizen Center located at 401 S. Evergreen Street	Flood/Wind	Existing	Hazard Mitigation Plan	Office of Emergency Management	Three years	$40,000	PDM	Low
Woodbury 3: Engineering study to determine appropriate flood mitigation action on the following streets: East Red Bank Avenue, S. Evergreen Avenue, S. Barbara Avenue, Packard Avenue between Logan and S. Columbia Street, Delaware Street, Drexel Street, Child Street, Gerard Street between Salem Avenue and Glover Street	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Two years	$300,000 (minimum) per street	PDM	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Woodbury 4: Elevation of residences on Packard Avenue	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	One year	To be determined by engineer.	HMGP; PDM; FMA	Medium
WOODBURY HEIGHTS BOROUGH								
Woodbury Heights 1: Install under-drains in Summit Section of Woodbury Heights (Alliance Street between Fordham Road and Central Avenue; sections of Auburn Street and Fordham Road) connecting to the storm sewer; new drainage would drop the groundwater level below the sanitary sewer system to avoid infiltration	Flood	Existing	Sanitary Sewer System Infiltration Study Report (2006), Capital Improvement Plan	Municipal Executive (or his/her designee)	One year	Approximately $50,000 per street	HMPG; PDM; Woodbury Heights Borough	High
Woodbury Heights 2: System redundancy and hazard threat recognition of water/sewage facility/pipes	Flood	Existing	Floodplain Management Plan	Municipal Executive (or his/her designee)	One year	Unknown	Woodbury Heights Borough	High
Woodbury Heights 3: System redundancy of water facility (town well) located on Helen Avenue (water tank is on Grand View Street)	Flood	Existing	Floodplain Management Plan	Municipal Executive (or his/her designee)	One year	$65,000	Woodbury Heights Borough	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Planning/ Implementation Mechanism	Responsible Party	Target Date	Estimated Cost ($) (1)	Funding Source (2)	Priority (3)
Woodbury Heights 4: Back-up generator for EOC (municipality building)	Flood	New	Capital Improvement Plan	Municipal Executive (or his/her designee)	One year	Unknown	HMGP 5%; Woodbury Heights Borough	High
WOOLWICH TOWNSHIP								
Woolwich 1: Engineering study to determine course of action for elevation and floodproofing or acquisition of home on Liccardello Drive	Flood	Existing	Private Channel	Home Owner	One year-three years	50,000-100,000	HMGP; PDM; FMA; RFC; SRL	Low
Woolwich 2: Engineering study to determine course of action to improve floodwalls for High Hill Road and Moravian Road	Flood	Existing	Floodplain Management Plan	Office of Emergency Management	Three years	$60,000	Woolwich Township	Low
Woolwich 3: Critical facilities protection/ hazard threat recognition of Hazmat (Graso Food Products–the largest pepper packing plant in the country. Services all 50 states; tier one facility)	Hazmat-fixed Site	Existing	Private Channel	Graso Food Products Company	Two year	Unknown	Woolwich Township	Medium

Notes:

(1) Entries in the "Estimated Cost ($)" column that state "To be Determined" or "Unknown" indicate projects where initial cost estimates will need to be developed as part of project scoping and development activities.
(2) Entries in the "Funding Source" column with the name of the municipality indicate projects that are not good candidates for federal or state funding programs and may be funded by the community. However, none of the funding for these projects is necessarily allocated or appropriated for these projects at this time and funding by the municipalities is subject to the availability of funds in municipal capital improvement and operational budgets. Where federal grant programs such as HMGP or PDM are indicated, this only identifies that the project type is typically eligible for these grant programs; i.e., here is no guarantee that these projects will be funded by these programs. Eligibility requirements for these grants are subject to change and the projects themselves must be scoped, applied for and approved on a case-by-case basis.
(3) Priority rankings were developed with the participation of the municipalities. See Appendix G, Table G-2 for details of STAPLEE analysis of these mitigation actions.

9.4 Flood Mitigation Projects

A significant percentage of the projects identified in Table 9.3.3-1 are related to flooding; 59 projects in all are related to flood hazards in the participating municipalities. The following exhibit, Figure 9.4-1, shows the relationship between designated floodplains and these projects.

Figure 9.4-1: Flood Related Mitigation Projects in Gloucester County, New Jersey

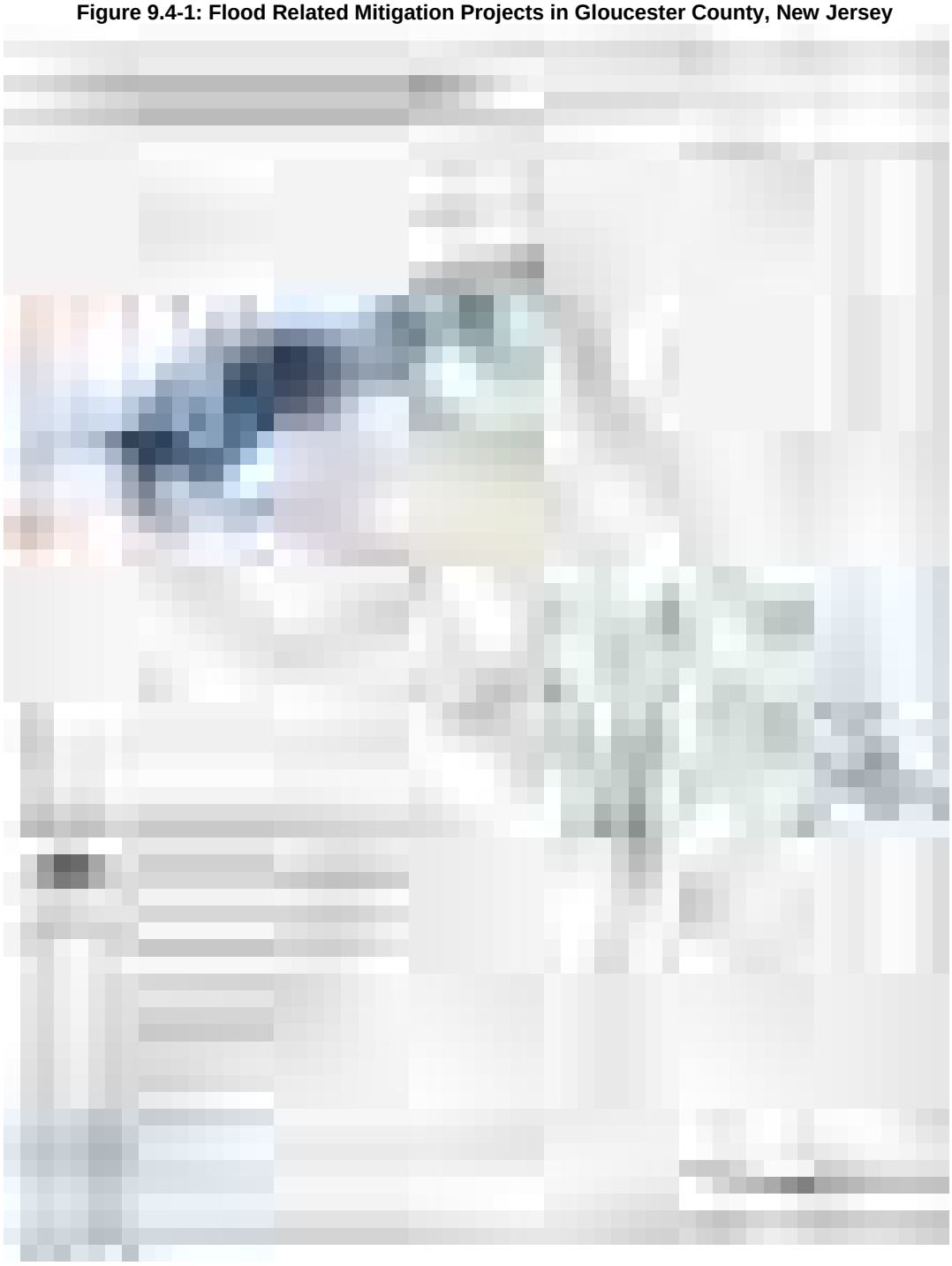

Table 9.4-1 shows the number of these projects that fall within the delineated flood zones[1]

Table 9.4-1−Flood Mitigation Projects versus Flood Zone Locations

Flood Zone	Number of Flood Mitigation Projects
A	2
AE	14
0.2% Annual Chance FHZ	2
X	41

According to this tabulation, 18 of the flood mitigation projects, or 30.5% fall into the A, AE, or the new 0.2% Annual Change Flood Hazard Zone. This is a relatively small percentage of the total number of projects. A visual inspection of the figure however shows that a much higher percentage of the projects appear to be located in or near delineated flood zones. The differences could be attributed to the following:

- Many of the flood mitigation projects are in fact out of the delineated flood zones but represent recurrent problem areas in close proximity of the delineated flood zones that the participating municipalities desire to address in their mitigation actions.
- Location information for the projects includes a margin of error.

Due to limitations in available data regarding structures in and around the flood zones, it is difficult to better correlate the current risk assessment and identified flood mitigation projects. However, there are several action items identified in this Section that are specifically intended to improve the available information for future Plan updates.

9.5 Prioritization and Implementation of Mitigation Actions

The preceding sections identify specific actions to achieve identified goals, an appropriate responsible party for each action, and a schedule for accomplishment and suggested funding sources. These tables also indicate an initial prioritization of the actions.

In the case of the countywide actions, priorities were initially determined on a qualitative basis by the HMSC and HMWG. The considerations were general feasibility and anticipated effectiveness in reducing risk. Detailed benefit cost analyses were not performed (see notes below) but general cost effectiveness of the types of actions being considered was taken into account.

In addition, an analysis of these actions was undertaken in a systematic way that is called the *Social, Technical, Administrative, Political, Legal, Economic, and Environmental* (STAPLEE) method. Table 9.5-1 describes the basic steps in the STAPLEE methodology.

[1] The flood zone delineations used in this figure are per the Preliminary DFIRMs that were made available to Gloucester County after the initial flood risk assessment was performed for this Plan. As referenced in the Mitigation Action Plan and in Section 10, GCOEM will consider updating the Plan when the DFIRMs are finalized and adopted by the Gloucester County Board of Freeholders.

Table 9.5-1−STAPLEE Methodology

STAPLEE	Criteria Explanation
S–Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T–Technical	Mitigation actions are technically most effective if they provide long term reduction of losses and have minimal secondary adverse impacts.
A–Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P–Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L–Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E–Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E–Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with federal, state, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

This method was used by GCOEM to weigh the various criteria for each of the identified actions and objectives including the relative cost-effectiveness as part of the "Economic" criteria. The resulting priority rankings are shown in Table 9.3.2-1. The detailed scoring of each action for each criterion is shown in Table G-1 in Appendix G.

For the municipal mitigation actions, initial priorities were set in a similar manner by the Local Coordinators; the mitigation action items with highest priority were generally considered to be the most cost effective and most compatible with the communities' social and cultural values.

The mitigation actions for the municipalities were also analyzed using the STAPLEE criteria and results reviewed and approved by each of the municipal coordinators. The resulting priority rankings are shown in Table 9.3.3-1. The detailed scoring of each action for each criterion is shown in Table G-2 in Appendix G.

Per the results of the Capability Assessment in Section 8, of particular concern regarding the effective implementation of mitigation actions and strategies is that there is often little to no staffing available at the local level to devote to hazard mitigation related activities. Staffing, resources, and coordination of effort are at a premium with little chance of significant change to these issues in the foreseeable future. Therefore, the inclusion of any specific action item in this document does not commit the county or municipalities to implementation. Each item will be considered for implementation in terms of the available staff and funding resources on a periodic basis. In addition, certain items may require regulatory changes or other decisions that must be implemented through standard processes, such as changing regulations.

Individual communities will implement identified projects with their own resources as they are able to program capital improvement funds. The individual municipalities will generally follow the priorities set in this

plan although variations in funding may alter the specific order. However, it is anticipated that the majority of the actions in the Plan will be implemented as funds become available through various federal mitigation grant programs.

The HMWG will also use the STAPLEE methodology to help them consider and prioritize potential action items for funding applications at that time.

The HMSC determined that it will be appropriate to revisit this STAPLEE analysis when funding is either available or being actively sought, because the qualitative characteristics of certain projects or priorities may shift over time or as a result of changing circumstance.

Once funding sources are identified (e.g., via grant announcements from NJOEM or FEMA) the list of mitigation actions will be reviewed to select actions that meet the particular grant criteria. Then, the HMWG will determine priority rankings for the short list of projects. Tentatively, the HMSC and HMWG have defined High, Medium, and Low priorities to be assigned in this process as follows:

- High: Meets five of the seven STAPLEE criteria
- Medium: Meets four of the seven STAPLEE criteria
- Low: Meets three of the seven STAPLEE criteria

Depending on the available grant funding, the HMWG will determine how many of the selected and prioritized projects should be submitted for funding starting with the highest priority projects as determined at the time.

Benefit-Cost Analysis

Per the IFR, communities are required to use benefit cost analysis to prioritize projects for implementation. At this stage, the analysis of costs and benefits has been done at a general level as part of the STAPLEE methodology. However, as project funding becomes available, the county and municipalities will undertake a more extensive process.

Benefit-cost analysis (BCA) compares the benefits of mitigation measures to the costs, and is a technique used for evaluating the cost-effectiveness of mitigation measures. FEMA requires a BCA for all mitigation projects that receive FEMA funding.

The HMSC and HMWG discussed the potential costs associated with each type of mitigation measure and decided that any project could be cost effective if its scope were properly tailored to the situation. For example, one of the most effective mitigation measures identified for repetitively flooded structures is elevation. It may not be cost effective to elevate every single repetitively flooded structure in the county, but it certainly would be cost effective to elevate those that cause the largest drain to the NFIP.

After discussing the possible costs of the various mitigation measures, the HMSC and HMWG decided that instead of working on developing a very generic BCA at this time for projects that may not ever be authorized, they would wait until specific funding sources are identified and available. For example, most municipalities are not financially capable of elevating or acquiring any repetitively flooded structures without federal grant assistance. However, at the time that grants become available (HMGP, after disasters or PDM and FMA grants annually), the county will collect detailed information on each structure that is interested in participating in the grant program and perform a BCA to help rank the structures as part of the STAPLEE process to determine which should receive funding first.

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Section 10
Plan Monitoring and Maintenance

Contents of this Section

10.1 Interim Final Rule Requirement for Plan Monitoring and Maintenance

*Requirement §201.6(c)(4)(i): [The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle*

*Requirement §201.6(c)(4)(ii): [The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

*Requirement §201.6(c)(4)(iii): [The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.*

10.2 Method for Monitoring the Plan

This Plan will be monitored by the Gloucester County Office of Emergency Management (GCOEM) for several related purposes:

- Maintain the currency of hazard and risk information.
- Ensure that mitigation projects and actions reflect the priorities of Gloucester County and stakeholders.
- To comply with Federal Emergency Management Agency (FEMA) and the State of New Jersey requirements for plan maintenance and maintain Gloucester County's eligibility for federal disaster assistance and mitigation grants.

The Gloucester County Emergency Management Coordinator will monitor the plan with respect to the purposes noted above, according to the schedule described in Section 10.3, and with respect to the update triggers noted in Section 10.5 below.

Specifically, monitoring activities will consist of:

- Soliciting and reviewing reports from participating municipalities regarding status of implementation of action items from the Plan. Status reports will indicate if projects have been:
  - Scoped and/or documented for FEMA grant applications;
  - Submitted for FEMA funding programs;
  - Approved (or denied approval) for FEMA funding;
  - Documented for funding by other means (e.g., municipal capital improvement plans);
  - Funded (or not approved for funding) by other means;
  - Under construction;
  - Completed; and
  - (for completed projects only) Subject to hazard conditions such that avoided losses can be documented.
- Tracking progress of sources of improved or revised data for use in subsequent Plan updates on an annual (at a minimum) basis.
- Preparing a report of the status of implementation of action items from the Plan and the availability of improved or revised data. The report will include recommendations to the Hazard Mitigation Working Group regarding the need and/or advantages of undertaking updates to all or part of the Plan prior to the five-year required update (see Section 10.4).

10.3 Schedule for Monitoring the Plan

Informal Plan monitoring activities will be ongoing. In addition to the FEMA mandated five year update cycle, the Gloucester County Emergency Management Coordinator or their designee (Coordinator) will perform monitoring activities for the Plan as described in Section 10.2 every six months, or more often as circumstances require.

In addition to the scheduled reports, the Coordinator will convene meetings after damage-causing natural hazard events to review the effects of such events. Based on those effects, adjustments to the mitigation priorities identified in Section 9 may be made or additional event-specific actions identified.

10.4 Method and Schedule for Evaluating and Updating the Plan

Comprehensive evaluation of and updates to this Plan will be undertaken on a five-year cycle (at a minimum). This Plan was adopted on August 19, 2009 and thus must undergo a formal FEMA-compliant update process by August, 2014. Approximately one year prior to the five year anniversary of Plan adoption or sooner if circumstances require, the Coordinator will initiate a comprehensive evaluation of the Plan with particular attention to FEMA guidance.

The criteria to be used in this evaluation include (but are not limited to) the following:

- Assessing whether or not goals and objectives in the Plan address current and expected conditions;
- Determining if there are any changes in risk factors and/or data that would be relevant to hazards in Gloucester County;
- Determining if capabilities have changed relative to the County and municipalities' ability to plan and implement hazard mitigation projects;
- Determining if significant changes have occurred in the availability of funding at federal and state levels to support hazard mitigation planning and implemention; and
- Results in implementing the Plan per monitoring reports (per Sections 10.2 and 10.3).

The Coordinator will prepare a report (1) describing the update requirements; (2) summarizing the staff evaluation of the Plan, highlighting areas that require updating and explaining the reasons why the updates are needed, and; (3) providing detailed recommendations about how the Plan should be updated, noting any technical work that may be required.

For example, as noted above in previous sections of the Plan, Gloucester County is due to receive updated DFIRM floodplain mapping for the entire county in 2009. This new mapping will be the basis for an improved flood risk assessment in the next Plan update and would be one of the reasons cited for why the modification is needed.

The report will sequentially be provided to the Gloucester County Hazard Mitigation Working Group (HMWG) and Gloucester County Board of Chosen Freeholders for consideration. The report will also be posted on the GCOEM website for public review and comment.

The HMWG and the Board of Chosen Freeholders will review the report and recommendations and advise the Coordinator how to proceed on the individual recommendations for the updates. The Coordinator will initiate activities to carry out the recommendations, and will prepare draft updates to the Plan on a schedule determined in cooperation with the HMWG and the Board of Chosen Freeholders.

When the draft updates are completed, the HMWG will be convened to conduct the comprehensive evaluation and revision. The HMWG and the Coordinator will produce a final draft of the updated Plan for consideration by the Board. The Board will review the updated Plan, indicate any desired changes, approve, and adopt the Plan in sufficient time to meet FEMA requirements.

10.5 Circumstances That Will Initiate Plan Review and Updates

This section identifies the circumstances or conditions under which GCOEM will initiate Plan reviews and updates.

- On the recommendation of the Coordinator or on its own initiative, the Gloucester County Board of Chosen Freeholders may initiate a Plan review at any time.
- At approximately the six month anniversary of the initial Plan adoption, and every six months thereafter.
- After natural hazard events that appear to significantly change the apparent risk to Gloucester County assets, operations and/or constituents.

10.6 Other Local Planning Mechanisms

It should be noted that Gloucester County has limited land use planning and zoning authority, so the county has few opportunities to incorporate this Plan into other local mechanisms, such as zoning and subdivision ordinances, or comprehensive land use plans. This plan will be incorporated, to the extent possible, into the county Open Space and Recreation Plan and the County Capital Improvement Program In addition, GCOEM will work with individual municipalities to incorporate the recommendations of the Plan into local comprehensive planning and capital improvement programs.

Participating municipalities in this Plan will work to incorporate the goals of this Plan into the next update of relevant plans and regulations, including comprehensive plans, zoning codes, and capital improvement plans. Table 10.6-1 shows dates of upcoming municipal updates to these plans and documents. It should be noted that counties and municipalities are not empowered to make alterations or improvements to the state's building code, the Uniform Construction Code.

Table 10.6-1
Scheduled Updates to Relevant Plans and Documents

Plan or Document	Next Update
Clayton Comprehensive Plan	2013
Clayton Zoning	Not updated on a regular schedule
Clayton CIP	2009
Deptford Comprehensive Plan	Not updated on a regular schedule, last updated in 2008
Deptford Zoning	2009-2010
Deptford CIP	Annually
Elk Comprehensive Plan	2011
Elk Zoning	Not updated on a regular schedule
Elk CIP	Not updated on a regular schedule
Franklin Comprehensive Plan	Not updated on a regular schedule
Franklin Zoning	Not updated on a regular schedule
Franklin CIP	Municipality does not have a CIP
Glassboro Comprehensive Plan	
Glassboro Zoning	
Glassboro CIP	
Greenwich Comprehensive Plan	Not updated on a regular schedule
Greenwich Zoning	Not updated on a regular schedule
Greenwich CIP	2010
Harrison Comprehensive Plan	Not updated on a regular schedule
Harrison Zoning	Not updated on a regular schedule
Harrison CIP	Not updated on a regular schedule
Logan Comprehensive Plan	Not updated on a regular schedule
Logan Zoning	Not updated on a regular schedule
Logan CIP	Not updated on a regular schedule
Mantua Comprehensive Plan	
Mantua Zoning	
Mantua CIP	
Monroe Comprehensive Plan	2010
Monroe Zoning	Not updated on a regular schedule
Monroe CIP	2010

Plan or Document	Next Update
National Park Comprehensive Plan	Not updated on a regular schedule
National Park Zoning	Not updated on a regular schedule
National Park CIP	2009
Paulsboro Comprehensive Plan	
Paulsboro Zoning	
Paulsboro CIP	
Pitman Comprehensive Plan	
Pitman Zoning	
Pitman CIP	
South Harrison Comprehensive Plan	
South Harrison Zoning	
South Harrison CIP	
Swedesboro Comprehensive Plan	Currently being reviewed (as of December 12, 2008)
Swedesboro Zoning	Not updated on a regular schedule
Swedesboro CIP	2009
Washington Comprehensive Plan	Not updated on a regular schedule
Washington Zoning	Not updated on a regular schedule
Washington CIP	Not updated on a regular schedule
Wenonah Comprehensive Plan	
Wenonah Zoning	
Wenonah CIP	
West Deptford Comprehensive Plan	Not updated on a regular schedule
West Deptford Zoning	Not updated on a regular schedule
West Deptford CIP	Not updated on a regular schedule
Woodbury Comprehensive Plan	Not updated on a regular schedule, last updated in 2006-7
Woodbury Zoning	Not updated on a regular schedule
Woodbury CIP	Not updated on a regular schedule, last updated in 2008
Woodbury Heights Comprehensive Plan	2010
Woodbury Heights Zoning	2010
Woodbury Heights CIP	2010
Woolwich Comprehensive Plan	Not updated on a regular schedule
Woolwich Zoning	2010
Woolwich CIP	Not updated on a regular schedule

10.7 Continued Public Involvement

As noted above, this Plan will be evaluated and updated periodically and when certain triggering events occur. Gloucester County will utilize public notices and a centralized website in an effort to include the public in the update process. In addition, GCOEM will undertake public outreach and awareness activities as outlined in the Mitigation Action Plan that will include continuing updates on the progress of implementing the Plan and future updates.