Warren County, New Jersey
All-Hazards Pre-Disaster Mitigation Plan

prepared by:

Warren County, New Jersey
Office of Emergency Management

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Table of Contents

List of Tables

List of Figures

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Section 1
Introduction

Contents of this Section

1.1 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 document, the Warren County, New Jersey All-Hazards Pre-Disaster 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. Warren 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 Warren County.

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The purpose of a mitigation plan is to rationalize the process of determining appropriate hazard mitigation actions. This document includes a detailed characterization of natural hazards in Warren 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 Warren County mitigation activities; and a detailed plan for implementing and monitoring the Plan.

This Plan focuses on five countywide hazards with the highest potential for damaging physical assets, people, and operations in Warren County. These hazards are dam failure, earthquake, flood, high wind – straight line, and severe weather - winter. 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 Warren County Hazard Mitigation Working Group (HMWG).

1.2 Organization of the Plan

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

Section 1	Introduction
Section 2	Planning Process
Section 3	Hazard Identification, Profiling and Prioritization
Section 4	Risk Assessment
Section 5	Capability Assessment
Section 6	Mitigation Action Plan
Section 7	Plan Monitoring and Maintenance
Appendices	

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.

1.3 Hazards and Risks

1.3.1 Hazards

Sections 3 and 4 of this Plan include detailed descriptions of the process that was used to assess and prioritize Warren County's risks from natural hazards, quantitative risk assessments for the Warren County as a whole, and more detailed assessments for certain asset classes. Eleven hazards were initially identified and profiled by the HMWG. These are:

- Dam Failure
- Drought
- Earthquake/Geological
- Flood
- Hazardous Materials Release
- High Wind–Straight-Line Winds
- High Wind–Tornado
- Landslide (non-seismic)
- Severe Weather-Summer
- Severe Weather-Winter
- Wildfire

For each of these hazards, the profiles in Section 3 include:

- Description of the Hazard
- Occurrence and Future Probability of Hazard
- Location and Extent of Hazard
- Severity
- Impact on Life and Property of the Hazard
- Prioritization and Rationale of the Hazard

After these initial 11 hazards were profiled, the HMWG used an evaluation system called Calculated Priority Risk Index (CPRI) based upon previous event history and hazard definitions, combined with the hazard's probability of future occurrence, magnitude or severity of the hazard's impacts, warning time before an event occurs, and the duration of the event. The intent of this evaluation was to reduce the range of hazards to those with the most potential to impact Warren County.

As a result of this evaluation, the HMWG determined that five hazards present the greatest risk to Warren County and its residents; dam failure, earthquake, flood, high wind – straight line, and severe weather - winter. These hazards were further examined to determine the extent of the risk and to help identify potential projects.

1.3.2 Risks

A risk calculation is a FEMA requirement and an important component of a hazard mitigation plan. Risk is a numerical indication of potential future damages. Although hazard events from winter weather to hurricanes all have potential to affect the Warren County area, dam failure, earthquake, flood, high wind – straight line, and severe weather - winter are clearly the most significant hazards.

The five countywide hazards were selected for more detailed assessments and estimations of future damages. Section 4 includes details about calculation methodologies and results of the countywide risk assessment which is summarized in Table 1.3.2-1.

Table 1.3.2-1: Summary of Countywide Hazard Risks in Warren County

Hazard	Annualized Losses (1)	Represents (2)
Dam Failure	N/A	-
Earthquake/Geological	$410,000	Economic - Total Property Damage (Capital Stock Losses) & Business Interruption Losses
Flood	$36,203,000	Economic – Property, Contents, & Inventory (Capital Stock Losses) & Business Interruption Losses
High Wind – Straight Line	$409,000	Economic - Total Property Damage (Capital Stock Losses) & Business Interruption Losses
Severe Weather – Winter	$137,091 ($1,734,646)	Estimated Average Annual Damages (includes deaths and injuries)

Notes:

(1) Due to a lack of data for historic losses, Annualized Losses for Dam Failure cannot be calculated on a reliable basis. See Section 4.3.1 for discussion of risk due to Dam Failure.
(2) This information is intended for planning purposes only. When conducting comparisons, be sure to use the same type of losses; for example do not use severe winter weather's value that includes deaths and injuries in comparison to flood's total property damage or you will not get an accurate portrayal.

1.4 Goals, Objectives, and Actions

Section 6 of this Plan describes Warren County's 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. This section also includes Warren County's hazard mitigation goals and objectives.

1.4.1 Warren County Hazard Mitigation Goals

Goals are general guidelines that explain what Warren County wants to achieve. Goals are expressed as broad policy statements representing desired long-term results. Warren County's 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 mitigate repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs, and activities

Please refer to Sections 6.4 and 6.5 for more information on goals for the Warren County All-Hazards Pre-Disaster Mitigation Plan.

1.4.2 Objectives

Objectives are well-defined intermediate points in the process of achieving goals. (*Objectives* are generally coterminous with *strategies.*) Warren County's 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 data available to the county and participating municipalities 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

- 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 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 of repetitive and severe repetitive loss properties and 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 Sections 6.4 and 6.5 for more information on objectives for the Warren County All-Hazards Pre-Disaster Mitigation Plan.

1.4.3 Actions

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

- Acquisition of flood-prone properties in Town of Belvidere.
- Culvert upgrade and improvement in Hardwick Township.
- Building hardening and retrofits at Frelinghuysen Township Municipal Building.
- Installation of rip-wrap in Independence Township.
- Install backup power/generator at the Emergency Operations Center in the Town of Hackettstown.
- Elevate utilities in homes in Blairstown Township.

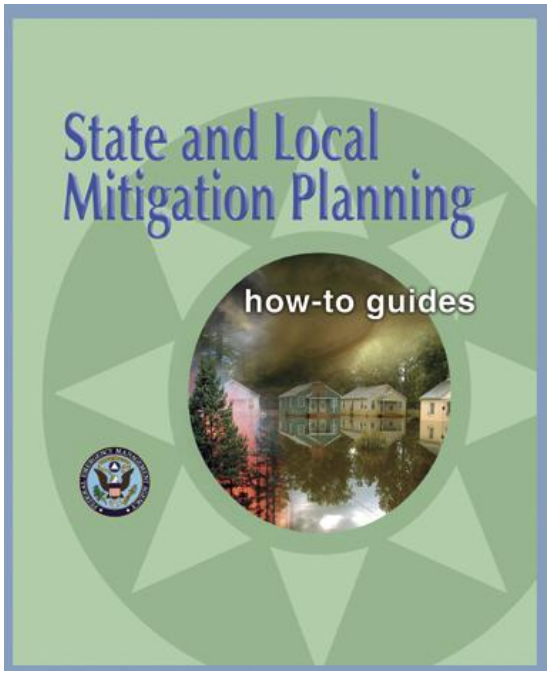
The above list is intended to be illustrative of the overall action items, rather than an exhaustive list. Please refer to Section 6.5 for more information on municipality specific mitigation actions.

1.5 Planning Process

Section 2 provides details about the process that was used to develop this Plan. The process closely followed the guidance in the Federal Emergency Management Agency (FEMA) *386* series of planning guidance, which recommends 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 2 (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, assessing risks, was completed by the HMWG. The Risk Assessment is included as Section 4 of the Plan, and is preceded by Hazard Identification, Profiling and Prioritization in Section 3.

Step 3, development of the mitigation plan, is described in Section 2 (Planning Process) and Section 6 (Mitigation Action Plan). Section 2 includes details about who was involved, the processes that were used, and the products that were developed. Section 6 includes specific details about the identification and development of mitigation goals, objectives, and actions based upon Section 4 (Risk Assessment) and Section 5 (Capability Assessment).

Step 4, implementing the plan, is described in the Mitigation Action Plan in Section 6, which includes details about who is responsible for implementation of specific strategies and actions; and in Section 7, the Plan Monitoring and Maintenance section, which describes long-term implementation through periodic updates and reviews.

1.6 Adoption and Approval

1.6.1 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.*

1.6.2 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 [Passaic] 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.

1.6.3 Adoption and Approval Procedure

[Note to NJOEM / FEMA Reviewers: The highlighted dates in Section 1.6.3 will be filled in after these events take place]

On [Insert DATE], the Federal Emergency Management Agency (FEMA) Region II determined that the Plan was "approvable pending adoption." On [Insert DATE], the Warren County HMWG met and recommended that Warren County and the participating municipalities should adopt the Plan. The Plan was submitted to the Warren 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 New Jersey Office of Emergency Management (NJOEM) for Warren County and each participating municipality that adopted the Plan. NJOEM, in turn issued approval letters to the approved jurisdictions.

1.6.4 Participating Municipalities

The following 22 municipalities and institutions as well as Warren County participated in the Plan by taking an active part in the planning process, identifying mitigation actions, and [will adopt] the Plan:

- Allamuchy Township
- Alpha Borough
- Town of Belvidere
- Blairstown Township
- Franklin Township
- Frelinghuysen Township
- Greenwich Township
- Town of Hackettstown
- Hardwick Township

[1] New Jersey Office of the Attorney General.

- Harmony Township (*)
- Hope Township
- Independence Township
- Knowlton Township
- Liberty Township
- Lopatcong Township
- Mansfield Township
- Oxford Township
- Phillipsburg Town
- Pohatcong Township
- Washington Borough
- Washington Township
- White Township

(*) Harmony Township has developed a Local Hazard Mitigation Plan but is also participating in this multi-jurisdictional plan.

To determine if municipal participation in the planning process was adequate for the purposes of this Plan and the FEMA plan review process, the following were established as minimum criteria

1. Attendance by a representative of each municipality at two (2) meetings where the development of the Plan was discussed;
2. Completion of portions of the capability assessment survey regarding the identify and participation of floodplain administrators, and the current status and update intervals for master plans, zoning plans and capital improvement plans;
3. Identification and documentation of at least two (2) mitigation actions for identified hazards; and
4. Adoption of the Plan after designation of the Plan as "approvable pending adoption" is received from NJOEM and FEMA.

1.6.5 Adoption Resolutions

Appendix E contains the signed Adoption Resolutions for Warren County and the participating municipalities.

1.6.6 Approval Letters

Appendix F contains the formal Approval Letters for Warren County and the participating municipalities.

Section 2
Planning Process

Contents of this Section

2.1 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.

2.2 Description of the Planning Process

The Warren County All-Hazards Pre-Disaster 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

2.2.1 Step 1: Organize Resources

The Warren County Office of Emergency Management (WCOEM) was the lead agency for the development of the Plan, which was completed in cooperation with Hazard Mitigation Plans for Hunterdon, Mercer, and Sussex Counties, collectively referred to as the Northern Delaware River Region for the purposes of this planning effort. At the beginning of the process, a consultant firm, James Lee Witt Associates, 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:

- Northern Delaware River Region Hazard Mitigation Steering Committee
- Warren County Hazard Mitigation Working Group

The Northern Delaware River Region Hazard Mitigation Steering Committee (HMSC) was comprised principally of the Office of Emergency Management (OEM) coordinators of the four participating counties; Hunterdon, Mercer, Sussex, and Warren. 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 and state agency staff, including representatives from county departments of planning, public works, and the New Jersey Office of Emergency Management (NJOEM). 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 Warren County Hazard Mitigation Working Group (HMWG) is comprised of the county OEM coordinator, all municipal OEM coordinators and related agencies within the county. 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.

Table 2.2.1-1 shows the primary membership of the HMSC.

Table 2.2.1-1: Northern Delaware River Region Hazard Mitigation Steering Committee (HMSC) Members

Name, Title	Organization
Eskil (Skip) Danielson, Coordinator, HMSC/Director	Sussex County Division of Emergency Management
William Duffy, Deputy Coordinator	Mercer County Office of Emergency Management
Laurene Fleming, County Coordinator of Emergency Management	Hunterdon County Office of Emergency Management
Frank Wheatley, Coordinator	Warren County Office of Emergency Management

Table 2.2.1-2 lists the membership of the Warren County HMWG.

Table 2.2.1-2: Warren County Hazard Mitigation Working Group (HMWG) Members

Name, Title	Organization
Frank Wheatley, OEM Coordinator	WCOEM
William Hunt, Preparedness Planner	WCOEM
David Gallant, County Director of Public Safety	WC Division of Public Safety
Albert Krouse, GIS Specialist	WC Planning Department
Art Charlton, Public Information Officer	WC Public Information Department
Frank Hafner, OEM Coordinator	Allamuchy Township
Bob Gara, OEM Coordinator	Alpha Boro
Sue Reeder, OEM Coordinator	Belvidere Township
Jeff Jablon, OEM Coordinator	Blairstown Township
Raymond Read, OEM Coordinator	Franklin Township
James Drylie, OEM Coordinator	Frelinghuysen Township
Gary Hill, OEM Coordinator	Greenwich Township
Charles Volkert, OEM Coordinator	Hackettstown Town
Joseph Dunn, OEM Coordinator	Hardwick Township
Richard Collins, OEM Coordinator	Harmony Township
Tim McDonough, OEM Coordinator	Hope Township
Keith Aiello, OEM Coordinator	Independence Township
Frank Makowski, OEM Coordinator	Knowlton Township
John Inscho, OEM Coordinator	Liberty Township
Gary Woolf, OEM Coordinator	Lopatcong Township
Bob Griffith, OEM Coordinator	Mansfield Township
Rick Calabrese, OEM Coordinator	Oxford Township
Rich Hay, OEM Coordinator	Phillipsburg Town
Don Grube, OEM Coordinator	Pohatcong Township
Frank LeClair, OEM Coordinator	Washington Borough
Tom Cicerelle, OEM Coordinator	Washington Township
Mike Ennis, OEM Coordinator	White Township

There were several meetings conducted during the development of the Plan per Table 2.2.2-3. 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.

[Note to Reviewers: Additional meeting(s) held before completion of the project will be noted in Table 2.2.1-3 including additional HMSC and HMWG meetings to review and recommend the Plan for adoption.]

Table 2.2.1-3: Committee Meeting Schedule

Date	Meeting	Attendees
January 26, 2010	HMSC Kick-off Meeting	HMSC, JLWA
February 19, 2010	LEPC/HMWG Kick-off Meeting	WCOEM, LEPC, HMWG, JLWA
February 24, 2010	HMWG/Municipal OEM Meeting	WCOEM, HMWG, JLWA

Date	Meeting	Attendees
March 10, 2010	HMSC Meeting	HMSC, JLWA
May 12, 2010	HMSC Meeting	HMSC, JLWA
May 19, 2010	HMWG Meeting	WCOEM, HMWG, JLWA
June 3rd-4th, 2010	Mitigation Actions Workshop Meetings	HMWG, JLWA
June 9, 2010	HMSC Meeting	HMSC, JLWA
July 14, 2010	HMSC Meeting	HMSC, JLWA
July 22, 2010	HMWG Meeting	WCOEM, HMWG, JLWA

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

2.2.2 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 man-made hazards affect Warren 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 3 and 4 of this Plan. The assessment determined several aspects of the risks of hazards faced by the county and the participating municipalities:

- Natural hazards that are most likely to affect Warren County
- How often hazards are expected to impact Warren County
- The expected severity of the hazards
- Areas of Warren County are likely to be affected by hazards
- How Warren County's assets, operations, people, and infrastructure may be impacted by hazards
- How private and commercial assets, operations, and infrastructure may be impacted by hazards
- 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 3), the HMSC reduced the initial list of hazards down to five hazards that were considered the most relevant for this type of planning process. The results of this selection process were discussed and validated by the HMWG. These hazards are described in the Hazard Identification, Profiling, and Prioritization portion of the Plan (Section 3).

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 five hazards: dam failure, earthquake, flood, high wind – straight line, and severe weather - winter. . These are considered by the HMSC to represent the most predominant risks to the area. The results of this prioritization 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 public presentations (see Section 2.3). The full process and results of this work is presented in the Risk Assessment portion of this Plan (Section 4).

2.2.3 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 5 and 6.

2.2.4 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 7 details the resulting monitoring, evaluation, and plan update procedures. This step was also reviewed and validated by the HMWG.

2.3 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 2.3-1. 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 Warren 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.

[**Note to Reviewers:** Additional meeting(s) held before completion of the project will be noted in Table.2.3-1 including additional HMSC and HMWG meetings to review and recommend the Plan for adoption.]

Table 2.3-1: Public Involvement

Date	Type of Involvement	Meeting Location
May 7, 2010	Website with hazard mitigation and Plan development information posted	n/a
May 15, 2010	Public meeting with presentation and open discussion	County Administrative building
July 22, 2010	Public meeting with presentation and open discussion	County Administrative building
August 6, 2010	Draft Plan posted on county website	n/a

As part of the development of the Plan and to the extent possible, 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 2.3-2. Proposed efforts to increase outreach to Floodplain Administrators will result in enhanced participation in the next Plan update.

Table 2.3-2: Warren County Floodplain Administrator Involvement

Municipality	Floodplain Administrator Name	Method of Involvement in Plan
Allamuchy Township	Paul Sturbenz	Reviewed work-in-progress
Alpha Boro	Stan Shrek	Reviewed work-in-progress
Belvidere Township	Charlie Huff	Reviewed work-in-progress
Blairstown Township	Dave Diehl	Reviewed work-in-progress
Franklin Township	Mike Finella	Reviewed work-in-progress
Frelinghuysen Township	Richard O'Conner	Reviewed work-in-progress
Greenwich Township	Mike Finelli	Reviewed work-in-progress
Hackettstown Town	Bill Custer	Reviewed work-in-progress
Hardwick Township	Ted Rodman	Reviewed work-in-progress
Harmony Township	Joe Neileo	Reviewed work-in-progress
Hope Township	Dave Diehl	Reviewed work-in-progress
Independence Township	Nevit Duvenick	Reviewed work-in-progress
Knowlton Township	Ted Rodman	Reviewed work-in-progress
Liberty Township	John Inscho	Municipal Point of Contact
Lopatcong Township	Paul Sterbenz	Reviewed work-in-progress
Mansfield Township	Drew DiSessa	Reviewed work-in-progress
Oxford Township	Rick Calabrese	Municipal Point of Contact
Phillipsburg Town	Kevin Duddy	Reviewed work-in-progress
Pohatcong Township	Rich McIntyre	Reviewed work-in-progress
Washington Borough	Frank LeClair	Municipal Point of Contact
Washington Township	Tom Backo	Reviewed work-in-progress
White Township	Tom Backo	Reviewed work-in-progress

Notes:
1.) Warren County does not include any unincorporated land not governed by municipalities and as a result 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 Warren 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. Minutes of meetings (and attendee lists) and copies of relevant correspondence are included in Appendix C.2 and C3.

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

2.4.1 Federal Government

Selected key federal sources of information and pre-existing planning work are presented in Table 2.4.1-1. Additional sources and detail can be found in Appendix B.

Table 2.4.1-1: 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 (DFIRM)	Used in developing HIRA, strategies and mitigation actions
FEMA Hazards US v.1.4 Patch 2	Used in developing various risk assessments and critical facilities inventories
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
FEMA 366: Estimated Annualized Earthquake Losses	Used in developing HIRA, strategies, and mitigation actions
FEMA Severe Repetitive Loss data	Used in developing HIRA, strategies, and mitigation actions
FEMA Repetitive Loss data	Used in developing HIRA, strategies, and mitigation actions

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
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
NOAA National Hurricane Center-Hurricane Preparedness, Storm Surge	Used in developing HIRA, strategies, and mitigation actions
The United States Army Corp of Engineers (Risk estimates)	Used in developing HIRA, strategies, and mitigation actions
US Census Bureau data	Used in developing various risk assessments and establishing planning context
US Geological Survey (USGS) National Hazard Seismic Mapping Project	Used in developing HIRA and history of loss data
USGS Large Floods in the United States database	Used in developing HIRA and history of loss data
USGS Fact Sheet 2004-3072 Landslide database	Used in developing HIRA and history of loss data
US Environmental Protection Agency Toxic Release Inventory	Used in developing hazard identification, strategies, and mitigation actions
US Department of Transportation Hazardous Materials Incident Data	Used in developing hazard identification, strategies, and mitigation actions

2.4.2 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 Hazard Mitigation 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 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 State Hazard Mitigation Plan Update 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 is also 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 State Hazard Mitigation Plan Update and were utilized in the development of the Warren County All-Hazards Pre-Disaster Mitigation Plan.

Other State of New Jersey Information

In addition to the State Hazard Mitigation Plan Update, selected state sources of information and pre-existing planning work are presented in Table 2.4.2-1. Additional sources and detail can be found in Appendix B.

Table 2.4.2-1: 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 Geological Survey 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
New Jersey Department of Environmental Protection (NJDEP), Department of Dam Safety and Flood Control data	Used in developing loss history and HIRA
New Jersey Department of Environmental Protection (NJDEP), NJ Geological Survey-DGS04-1 Earthquakes Epicentered in NJ	Used in hazard profiling and loss estimation
New Jersey Department of Environmental Protection (NJDEP), NJ Geological Survey's Digital Geodata Series	Used in hazard profiling and loss estimation
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
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
NJ Geological Survey's Study-Earthquake Risk in NJ	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

2.4.3 Warren 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 2.4.3-1. Additional sources and detail can be found in Appendix B.

Table 2.4.3-1: County Documents and Data Utilized

Existing Program/Policy/Technical Documents	Method of incorporation into the Plan
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
County GIS data-base-mapping, zoning, parcels, land use, redevelopment areas, topo, DFIRM, orthos	Used to validate data used in risk assessment and future development analysis
Cross-Acceptance Report February 23, 2005	Used to validate data used in future development analysis
Dams inventory and data	Used in development of HIRA and mitigation actions
Emergency Operations Plan	Used in hazard identification
Repetitive Loss/Severe Repetitive Loss inventory (RL/SRL) and data	Used in development of risk assessments and mitigation actions

2.4.4 Municipalities

Upon initiating the Plan development process, the WCOEM 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 of 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 WCOEM regularly provided guidance and support in this gathering effort through the use of e-mail inquiries, phone contact, and agenda items at the HMWG meetings.

Selected key municipal sources of information and pre-existing planning work are presented in Table 2.4.4-1. Additional sources and detail can be found in Appendix B.

In some cases, as noted in Table 2.4.4.2, information that may exist at the municipal level was not uniformly provided or available for this initial Plan. During the next 5 years, WCOEM and the municipal coordinators will be taking steps to locate, review and incorporate all the indicated documents in the next Plan update.

Table 2.4.4-1: 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
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 2.4.4-2: 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 Warren County)	Available for Plan	Status of Incorporation in Plan
Comprehensive Plan	Y	Reviewed. See Table 2.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Growth Management Plan	Y	Reviewed. See Table 2.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Capital Improvement Plan	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Flood Damage Prevention Ordinance	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Floodplain Management Plan	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Open Space Program Plan	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Flood Insurance Studies, DFIRMs or engineering studies for streams	Y	Reviewed. See Table 2.4.3-1
Hazard Vulnerability Analysis (by the local Emergency Management Agency)	Y	Reviewed. See Table 2.4.4-1
Emergency Management Plan/ Emergency Operations Plan	Y	Reviewed. See Table 2.4.3-1
Zoning Ordinance	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Building Code	Y	Reviewed. Standard UCC for all of NJ
Drainage Ordinance	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
Critical Facilities maps	Y	Reviewed. See Table 2.4.4-1
Existing Land Use maps	Y	Reviewed. See Table 2.4.3-1 (reviewed in summary form in Cross Acceptance Report)

Document or Data (for all Municipalities in Warren County)	Available for Plan	Status of Incorporation in Plan
Elevation Certificates	N	Not available for use in current planning process, to be reviewed (if available) and included in plan update
State plan	Y	Reviewed. See Table 2.4.2.1
HAZUS study	Y	Reviewed. See Table 2.4.1-1
SLOSH Studies	Y	Reviewed. See Table 2.4.1-1 (USACE Evacuation Study)
Hurricane Evacuation Plan	Y	Reviewed. See Table 2.4.1-1 (USACE Evacuation Study)

2.4.5 Other Resources

Selected other key sources of information and pre-existing planning work, including regional and academic resources, are presented in Table 2.4.5-1. Additional sources and detail can be found in Appendix B.

Table 2.4.5-1: 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 Valley Regional Planning Commission–data Bulletin 85	Used in establishing planning context
Public Entity Risk Institute–Presidential Disaster Declarations	Used in developing hazard profiling and loss estimation
New Jersey Association of County Tax Boards–parcel data	Used to validate data used in risk assessment
New Jersey Flood Mitigation Task Force data	Used in developing hazard profiling and loss estimation
Right-to-Know Network–biennial reporting, emergency response notification database	Used in developing hazard profiling
World Climate website, Audubon Station	Used in establishing planning context

Section 3
Hazard Identification, Profiling and Prioritization

Contents of this Section

3.1 IFR Requirement for Hazard Identification

IFR §201.6(c)(2)(i): *[The risk assessment shall include a] description of the…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.*

IFR §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.*

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

3.2 Hazard History and Identification

Per IFR requirements, and as the first step in the hazard mitigation planning process, Warren County identified hazards that can impact Warren County. The following subsections provide an overview of past hazard events in Warren County and identify the hazards included in the planning process.

Note: The term "planning area" as used in this Plan refers to the geographic limits of Warren County.

3.2.1 Warren County's Hazard History

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards. Unfortunately, no single source offers 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 and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database collects and maintains data about natural hazards in summary format.

The University of South Carolina's Hazards & Vulnerability Research Institute has compiled a county-level hazard data set for the U.S. for 18 different natural hazard events types, called the Spatial Hazard Events and Losses Database for the United States (SHELDUS). The data is derived from several existing national data sources, including the NCDC's monthly Storm Data publications and only contains events that had associated loss of life, injuries, or financial damages. The online NCDC database does not include some of the older events before 1973. However, SHELDUS 7.0 includes events derived from NCDC-provided hardcopies as far back as 1960 that are not included in NCDC's online database. The SHELDUS team also chose to manually determine when losses occurred within the queried county or in another location during the same event. When the location of the loss could not be determined based on the event description, SHELDUS methodology calls for the losses to be evenly distributed across the number of counties that were impacted by the event. NCDC combines all losses for an event and they appear for that county when queried, which causes overestimations within counties and duplicated losses across counties. SHELDUS also provides the option of adjusting for inflation. Adjusting for inflation is important when comparing monetary amounts across multiple years in order to standardize losses and to avoid underestimating older damages. SHELDUS only provides data up to 2008.

For these reasons, the SHELDUS database has been chosen for use in this Plan for events from 1960-2008 and cross-check them with events in the NCDC database, especially for events from 2008-2010. The data includes occurrences, dates, injuries, deaths, and costs.

According to the SHELDUS and NCDC databases, between 1960 and 2010, Warren County has experienced the following significant, loss-associated hazard events:

- 75 thunderstorm and high wind events
- 41winter storms/extreme cold temperature events
- 13 floods/flash floods
- 1 drought
- 6 extreme heat events
- 4 hail storms
- 4 hurricanes or tropical storms
- 17 lightning events
- 0 wildfires
- 1 tornadoes

According to the NCDC and SHELDUS, Warren County has experienced approximately 49 deaths and 13 injuries from natural hazards in the period from 1960 to 2010.[1] In addition to the events recorded in the NCDC database, other sources identified 9 earthquakes, one significant crop loss event, and 12 impactful landslides[2]. These figures are discussed in more detail in the hazard-specific subsections that follow.

Table 3.2.1-1 provides brief descriptions of particularly significant hazard events occurring in Warren County's recent history per the NCDC. This list is not meant to capture every event that has affected the area; rather it lists some of the more significant events that have occurred.

Warren County has received nine major Presidential Disaster Declarations and seven Emergency Declarations since 1950. Eight of the nine major disaster declarations were the result of significant flooding. All of the major and emergency declarations, and one non-declared event, are included as part of the summary in Table 3.2.1-1 below.

Table 3.2.1-1: Recent Declared Emergency and Major Disasters in Warren County, 1962-2010

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 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 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 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 the year 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 2003).

[1] Hazards & Vulnerability Research Institute (2009). The Spatial Hazard Events and Losses Database for the United States, Version 7.0 [Online Database]. Columbia, SC: University of South Carolina. Retrieved from http://www.sheldus.org NOAA/NCDC database. Retrieved from http://www.ncdc.noaa.gov/oa/climateresearch.html

[2] Crop loss data came from NOAA/NCDC. Earthquake data came from NJDEP - New Jersey Geological Survey - DGS04-1 Earthquakes Epicentered in New Jersey http://www.state.nj.us/dep/njgs/geodata/dgs04-1.htm#image

Landslide data came from NJDEP – New Jersey Geological Survey – DGS06-3 Landslides in New Jersey http://www.state.nj.us/dep/njgs/geodata/dgs06-3.htm

Date and Disaster (DR)	Nature of Event
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.
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.
9/18/1999 (DR-1295)	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 resulting in rainfall totals of between 10-14 inches in some parts of the state.
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).
9/19/2001 (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 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 Sunday day, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in Warren County ranged from 17″ to 20″. 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 Warren County. Statewide, the event resulted in damages estimated at approximately $30.2 million (damage estimate adjusted to dollar figures for the year 2003).
10/01/2004 (DR-1563	SEVERE STORMS AND FLOODING - Hurricane Ivan initially made landfall along the Gulf Coast on September 16, 2004 near the border of Alabama and Florida as a Category 4 Hurricane. As the storm moved inland, it weakened and was eventually downgraded to a tropical depression before reaching New Jersey. As a tropical depression, the storm continued to cause extensive damages from heavy rains that totaled up to six inches in some parts of New Jersey. The heavy rains resulted in significant flood damages particularly along the Delaware River. As a result of the event, a Presidentially-Declared Disaster was declared on October 1st, 2004, for four Counties in northwestern New Jersey (FEMA DR-1563). The majority of the infrastructure damages occurred in neighboring Warren County where FEMA Public Assistance totaled almost three million dollars.

Date and Disaster (DR)	Nature of Event
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. The crests along the Delaware River were the highest crests since 1955. In many places, it was the second or third highest crest on record for the Delaware River. In Sussex, Warren, Hunterdon, Mercer, and Morris Counties, about 1,800 homes and businesses were flooded, and 25 homes were destroyed.
7/07/2006 (DR-1653)	SEVERE STORMS AND FLOODING - Beginning on June 23, 2006, portions of northwestern New Jersey were impacted by severe storms and flooding. The severe storms and heavy rains resulted in flooding along the Delaware River. On July 7, 2006 a Presidentially Declared Disaster was declared for four counties in northwestern New Jersey.
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. The heavy rain caused several creeks and streams to flood in Warren County and forced the closure of eighteen major roadways. In Blairstown both the Paulins Kill and Blair Creek flooded. There were a few evacuations near the flooded creek and one home suffered flood damage. Flooding was also reported along the Pohatcong Creek and the Musconetcong River.

Sources: NOAA/NCDC; FEMA; New Jersey Office of Emergency Management and the Public Entity Risk Institute.

3.2.2 Hazard Identification

At the outset of the planning process, the Northern Delaware River Region Steering Committee (NDRR SC) and the Warren County Hazard Mitigation Working Group (HMWG) identified 11 natural and technological hazards and the risks they pose for the county and its material assets, operations, and staff as the focus of the Plan. These hazards were identified per the experience of the NDRR SC and the HMWG and according to other references (e.g., Mitigation 20/20 data entry forms from participating municipalities, county EOPs, the New Jersey State Hazard Mitigation Plan, etc.). The resulting preliminary hazard list is shown in Table 3.2.2-1.

Table 3.2.2-1: Preliminary Hazard List, Warren County

Hazard	Type (1)	NDRR PDM Application	County EOP	Mitigation 20/20	NJ SHMPU (2)	NDRR RFP (3)	Profiled in HMP?
Dam Failure	T		✓			✓	✓
Drought	N	✓		✓	✓	✓	✓
Earthquake/Geological (4)	N			✓		✓	✓
Flood (5)	N	✓	✓	✓	✓	✓	✓
Hazardous Materials Release	T		✓	✓		✓	✓
High Wind–Straight-Line Winds (6)	N		✓	✓	✓	✓	✓
High Wind–Tornado	N	✓			✓	✓	✓
Landslide (non-seismic)	N			✓	✓	✓	✓
Severe Weather - Summer	N			✓		✓	✓
Severe Weather - Winter	N	✓	✓		✓	✓	✓
Wildfire	N	✓		✓	✓	✓	✓

Notes:

(1) Type Legend: N = Natural; T = Technological/Manmade.
(2) NJSHMPU = State of New Jersey Hazard Mitigation Plan, approved by FEMA in April 2008.
(3) Hazards indicated as likely candidates to include in planning for Warren County per Northern Delaware River Region Request for Proposals (RFP).
(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.

The following section profiles the 11 hazards listed above, and includes a description of the hazard, location and extent of the hazard, severity of the hazard, documented impacts on life and property, and past occurrences.

3.3 Hazard Profiles

Per IFR requirements, Warren County profiled hazards that can impact the county. Each hazard section contains the following subsections:

Description of the Hazard

Definition and description of the hazard, including widely accepted indices and classifications.

Occurrence and Future Probability of Hazard

This is an overview of past significant events from national databases, state, and local sources. Our focus will be on events that caused losses in the form of death, injuries, property damages, and/or crop losses. All dollar amounts have been adjusted to 2010 figures for inflation for easier comparison and rounded to the nearest dollar. Probability of future events is based on the number of past events divided by the number of years to obtain a percentage. Any other pertinent information on probability will be considered, including relevant available studies.

Location and Extent of Hazard

Identify geographic area of the county that could potentially be affected by the hazard and its impacts, including maps when possible. Discuss the anticipated degree and severity of potential hazards, such as wind speeds, depth of flooding, peak ground acceleration, etc. Also discuss specific characteristics of the county that may affect the extent of the hazard such as geography, geology, topography, or vegetative cover, and when possible, include maps.

Impact on Life and Property of the Hazard

This is a summary of past event losses of human life, injury, property damages, and crop damages, and the severity of impacts on the county. All dollar amounts have been adjusted to 2010 figures for inflation for easier comparison and rounded to the nearest dollar. Sources include national, state, and local databases and any relevant available studies.

Prioritization and Rationale of the Hazard

In order to summarize the massive amounts of information and provide a level playing field for comparing hazards, each hazard is analysed and the risk to the county is evaluated based on the Calculated Priority Risk Index (CPRI). The purpose of the CPRI is not to replace scientific or local knowledge or to have the final say on a hazard, but to provide the county with a means for looking at the hazards for further vulnerability analysis. Each CPRI is accompanied by a rationale for why that particular hazard will be included or excluded for further exploration in Section 4. In some cases, the county will chose to further review a hazard that has a low CPRI value, and the reasoning for this decision will be provided.

CPRI values are based upon previous event history and hazard definitions, and combine the hazard's probability of future occurrence, magnitude or severity of the hazard's impacts, warning time before an event occurs, and the duration of the event. The categories are shown in Tables 3.3-1 through 3.3-4.

Table 3.3-1: Probability of Future Occurrence Based on Previous Hazard Events

Probability	Index Value	Description
Highly Likely	4	• Frequent significant events with a well documented history of occurrence. • Event has up to 1 in 1 year chance of occurring. (1/1 = 100%) • History of events is 33%-100% likely per year.
Likely	3	• Occasional significant occurrences with at least two or more documented historic significant events. • Event has up to 1 in 3 years chance of occurring. (1/3 = 33%) • History of events is 20%-33% likely per year.
Possibly	2	• Rare significant occurrences with at least one documented or anecdotal historic significant event • Event has up to 1 in 5 years chance of occurring. (1/5=20%) • History of events is 10%-20% likely per year.
Unlikely	1	• Extremely rare with no documented history of significant events occurring. • Event has up to 1 in 10 years chance of occurring. (1/10=10%) • History of events is 0%-10% likely per year.

Table 3.3-2: Magnitude/Severity of Potential Impacts Based on Previous Hazard Events

Magnitude/ Severity	Index Value	Description
Catastrophic	4	• Multiple deaths • More than 50% of property is severely damaged • Complete shutdown of facilities for more than 1 month
Critical	3	• Injuries and/or illnesses result in permanent disability • More than 25% of property is severely damaged • Complete shutdown of critical facilities for at least 14 days
Limited	2	• Injuries and/or illnesses do no result in permanent disability • More than 10% of property is severely damaged • Complete shutdown of critical facilities for at least 1 day
Negligible	1	• Injuries and/or illnesses are treatable with first aid • Less than 25% of property is severely damaged • Shutdown of critical facilities for 24 hours or less

Table 3.3-3: Warning Time of Hazard Event Based on Hazard Definition

Warning Time	Index Value	Description
Less than 6 Hours	4	Less than 6 Hours warning time before event occurs
6-12 Hours	3	6-12 Hours warning time before event occurs
12-24 hours	2	12-24 Hours warning time before event occurs
24+ Hours	1	At least 24 Hours warning time before event occurs

Table 3.3-4: Duration of Hazard Event Based on Hazard Definition

Warning Time	Index Value	Description
More than 1 week	4	Event lasts more than 1 week
Less than 1 week	3	Event lasts less than 1 week
Less than 1 day	2	Event lasts less than 1 day
Less than 6 hours	1	Event lasts less than 6 hours

3.3.1 Dam Failure

Description of the Dam Failure Hazard

According to the New Jersey Department of Environmental Protection (NJDEP), "A dam is any artificial dike, levee or other barrier, together with appurtenant works, which 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."[3]

Dams are manmade structures that serve a variety of uses such as flood protection, power production, agricultural, water supply, and to form recreational areas. They are typically constructed of earth, rock, or concrete, and come in all shapes and sizes. Dam failure is the uncontrolled release of impounded water resulting in downstream flooding, and other impacts that can affect lives and property. Dams can fail because water heights or flows are above the capacity the structure was designed for (including flooding), or because the structure failed in some way. Structures fail for many reasons, including lack of maintenance, erosion, seismic events, insufficient design, development or alteration of the floodplain, or improper construction. Concrete/masonry dams usually fail from loss of a section or undermining, while the primary causes of earthen dam failure are overtopping, followed by piping failure, and then foundation failure. Concrete or masonry dams tend to fail suddenly, while earthen dams usually take longer to fail.

Dam safety inspections and monitoring have become important tools in evaluating dam failure risk, ensuring proper maintenance, and prioritizing actions. The ranking of inspections are often based on a classification system according to the potential impact a dam failure or mis-operation would have on nearby populations and property. FEMA utilizes a Hazard Potential Classification System for Dams that categorizes them as Low, Significant, or High as described in Table 3.3.1-1.

[3] NJDEP's Dam Safety & Flood Control retrieved from http://www.state.nj.us/dep/damsafety/faq.htm

Table 3.3.1-1: Dam Hazard Potential Classification System

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low (L)	None Expected	Low and Generally Limited to Owner
Significant (S)	None Expected	Yes
High (H)	Probable; One or More Expected	Yes

Source: FEMA

See Table 3.3.1-2 for the Dam Class categories that New Jersey utilizes to determine the inspection cycle and type of inspection for dams.

Table 3.3.1-2: New Jersey Dam Classification and Inspection Schedule

Dam Class	Description	Regular Inspection	Formal Inspection
Class I Large Dam (High-Hazard Potential)	Failure of dam may result in probable loss of life and/or extensive property damage.	Annually	Once every 3 years
Class I Dam (High-Hazard Potential)	Failure of dam may result in probable loss of life and/or extensive property damage.	Once every 2 years	Once every 6 years
Class II Dam (Significant-Hazard Potential)	Failure of the dam may result in significant property damage, but loss of life not envisioned.	Once every 2 years	Once every 10 years
Class III Dam (Low-Hazard Potential)	Failure of the dam is not expected to result in loss of life and/or significant property damage.	Once every 4 years	Only as required
Class IV Dam (Small-Dam Low-Hazard Potential)	Failure of the dam is not expected to result in loss of life or significant property damage.	Once every 4 years	Only as required

Source: NJDEP's Dam Safety and Flood Control. Retrieved from http://www.state.nj.us/dep/damsafety/faq.htm#q7

Occurrences and Probability of the Dam Failure Hazard

According to the "Flood Mitigation Plan for the Non-tidal, New Jersey Section of the Delaware River Basin" from November 2008, there have not been any catastrophic dam failures in New Jersey. However, there have been an increasing amount of small dam failures. This may be due in part to the age of the dam infrastructure in the state and insufficient maintenance. Stanford University's Department of Civil and Environmental Engineering maintains the National Performance of Dams Program database and website.[4] The database information is based on a library of dam incident files, including a 1975 and 1988 report from the U.S. Committee on Large Dams, and from reports by users. The level of completion for the records is unknown, but when queried, Warren County had no reported dam incidents.

[4] Stanford University. Retrieved from http://npdp.stanford.edu/index.html

There have been no recorded events of dam incidents in Warren County. However, unlike natural events, dam failure probability involves manmade structures that have a specific life expectancy and were designed to meet certain situations that may have changed since the time they were designed and built. Based on the National Inventory of Dams data, the dams in Warren County are an average of fifty-two years old. This does not account for a number of dams, probably older ones, that the build date is unknown. Predicting the likelihood of a future dam failure is extremely difficult, but the probability is that a dam failure is possible.

Location and Extent of the Dam Failure Hazard

In Warren County, there are 15 high hazard dams, 7 significant hazard dams, and 62 low hazard dams as shown in Figure 3.3.1-2. The high hazard dams are in Blairstown Township, Harmony Township, Hardwick Township, and Oxford Township. If a dam failure were to occur, the magnitude of the event would depend on many factors including the type, size, condition, design, and construction of the structure, type of failure, the amount of water, water velocity, and the growth within the floodplain.

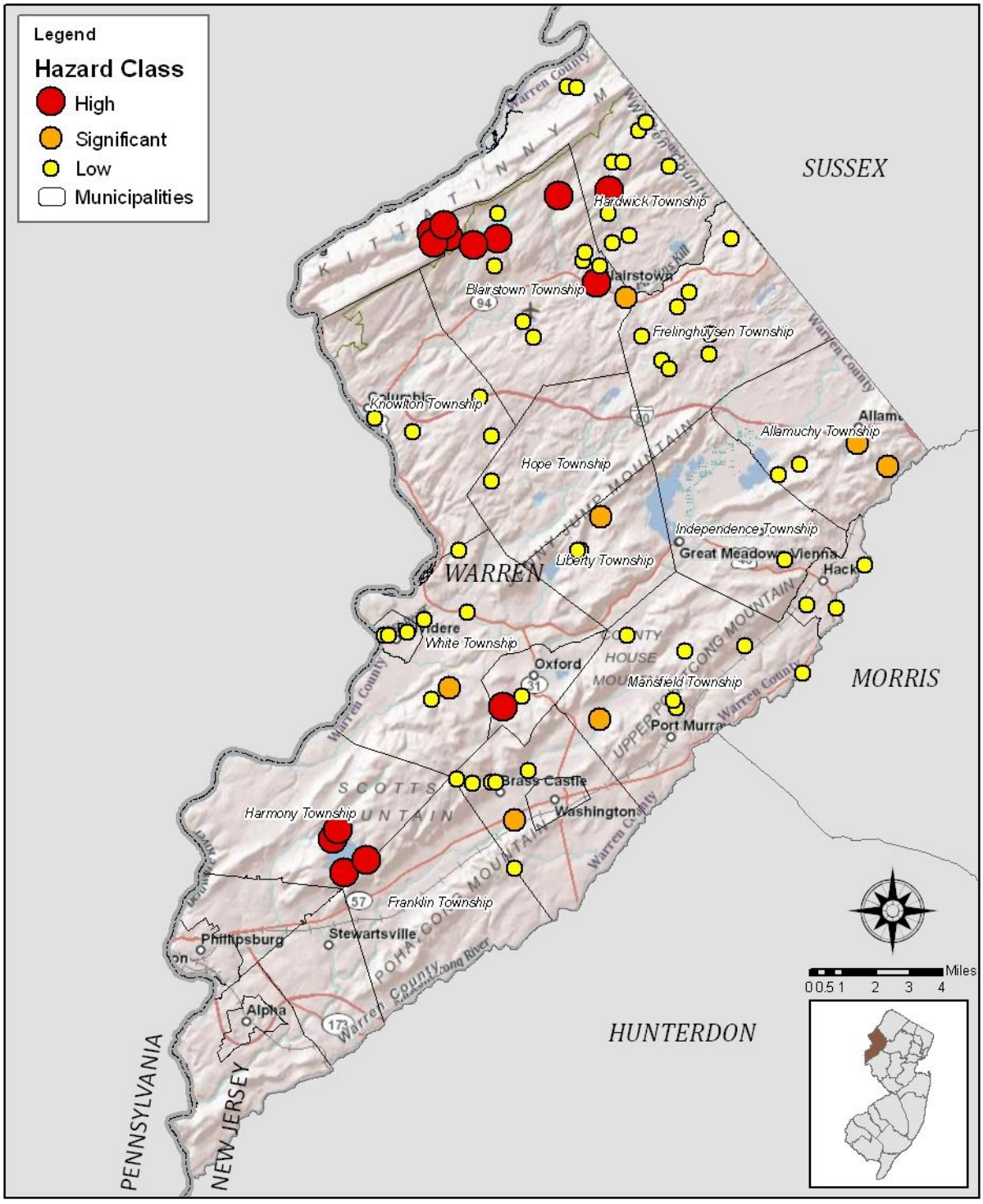
Impact on Life and Property of the Dam Failure Hazard

Based on a dam's hazard classification, the expected losses can be inferred. If a high (H) hazard dam failed, it is anticipated that lives would be lost. If a significant (S) hazard dam failed, then significant property losses could be expected. If a low (L) hazard dam failed, then the losses would not be wide-spread or catastrophic. All of the high hazard dams in Warren County have submitted an Emergency Action Plan to Dam Safety, which should reduce the potential impacts of an event. Emergency Action Plans typically include preventative actions based on the situation, contacts, a list of supplies and resources, and evacuation plans.

Within the U.S. Army Corps of Engineers (USACE) is the Risk Management Center under the Institute for Water Resources. They are working to manage and assess risks for USACE dams and levee systems through screening efforts, periodic assessment, and dam safety analysis. They are utilizing HEC-FIA and LifeSim modeling software in conjunction with the Federal Emergency Management Agency's (FEMA) HAZUS inventory data to analyze the life safety, economic, and environmental consequences of dam and levee failures.[5] These assessments are not shared with the public, but are utilized by the USACE and federal agencies to mitigate risks of USACE dams and levees. USACE and FEMA are also working together on efforts to accurately depict risks of flooding behind levees on flood maps. Levee owners must provide documentation to prove the levee meets design, operation, and maintenance standards for protection against the 1% annual chance flood in order to be shown as flood protecting on FEMA flood maps.

[5] "Consequence Assessment for USACE Risk Estimates" presentation by Jason Needham, P.E. Senior Consequence Specialist with USACE Risk Management Center on May 25, 2010.

Figure 3.3.1-1: Warren County Dam Location and Classification



Source: GIS data obtained from NJDEP

Notes:

(1) Dam inventory may not show some privately owned dams and/or small dams that do not meet certain reporting guidelines.

Prioritization and Rationale of the Dam Failure Hazard

Based on operation and maintenance requirements and local knowledge of the dams in Warren County, the probability of dam failure is "possible" for an index value of 2. The severity or magnitude of the damage from a dam failure could range from critical to negligible. In order to balance these two possibilities, an index value of 2 will be used for the magnitude/severity of dam failure in the county. Although there are some predictive conditions that can be observed from an inspection, most dam failures seem to have "less than 6 hours warning time before an event occurs" for an index value of 4. It should be noted that most dam failures occur as a secondary event to a flooding event, which may give some indication of where and when a failure may occur. A dam failure event would have a short duration, for a classification of "the event lasts less than 6 hours" for an index value of 1.

Table 3.3.1-3: CPRI for Degree of Risk for Dam Failure in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
2 x .45	+	2 x .30	+	4 x .15	+	1 x .10	=	2.2

Although dam failure can occur in Warren County, there have been no previously recorded dam failure events. Based on the lack of past events and increased inspection efforts versus the age of the dams in the area, the likelihood of a dam failure event occurring is possible, but not likely.

3.3.2 Drought

Description of the Drought Hazard

A drought is defined as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area."[6] Droughts are extended periods of dry weather that cause problems such as crop damage, affects water supplies, and/or increased fire danger. Droughts are often brought on by lack of rainfall or snow over a long period of time, although the amount of time that low precipitation amounts take to impact an area varies in different geographic locations. The Palmer Drought Severity Index (PDSI) is the main classification system used for droughts in the United States and is based on supply and demand. The PDSI assesses total moisture by using temperature and precipitation to compute water supply and demand and soil moisture, and is most effective for long-term predictions. PSDI is also used to describe extended wet conditions using corresponding numbers, with zero representing near normal conditions. NOAA publishes weekly national and regional Palmer Drought maps. There are other indices that can be used for specific situations, ecosystems, or terrain.

[6] Glossary of Meteorology (1959)

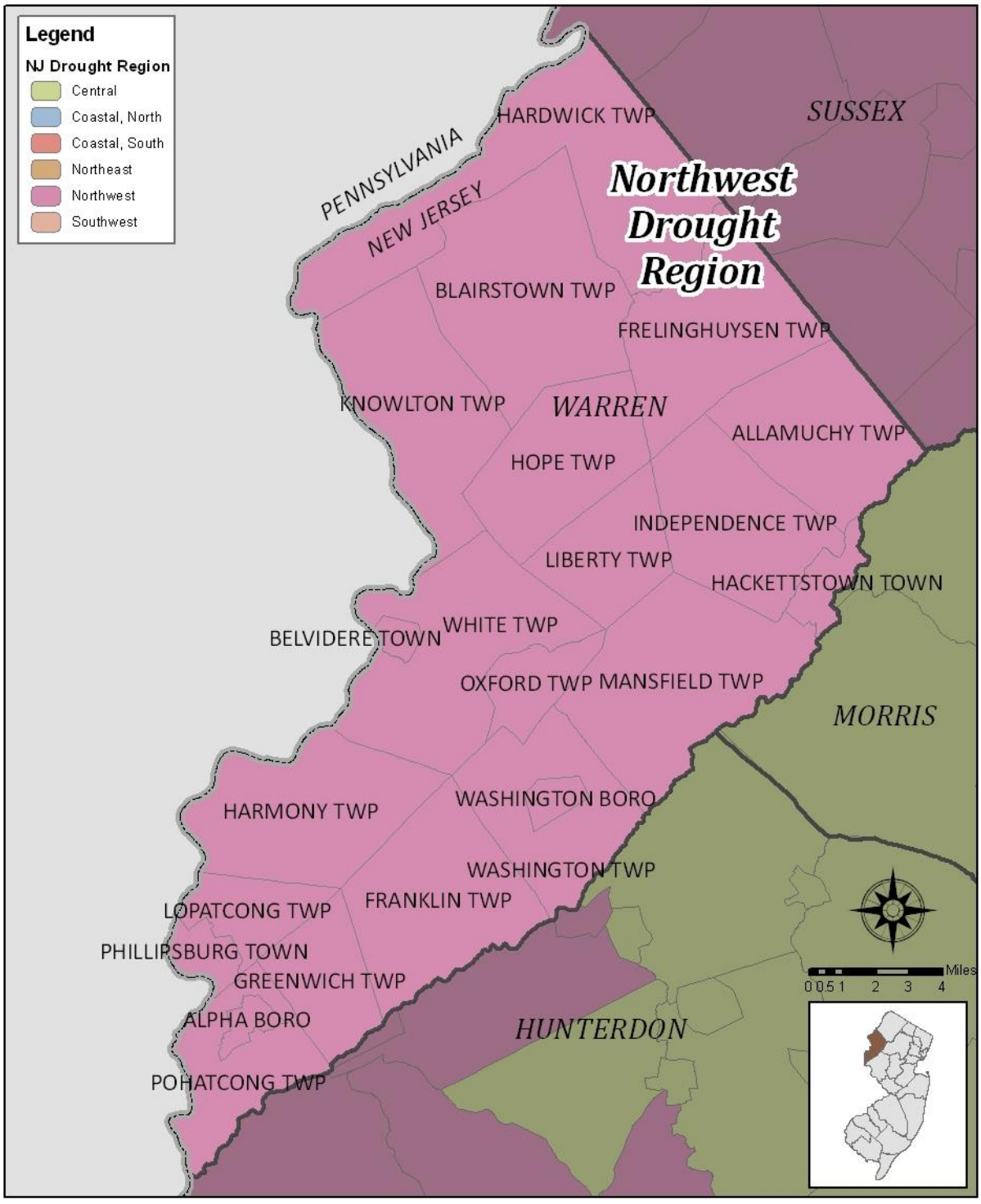
Table 3.3.2-1: Palmer Drought Severity Index

PDSI	Description
4.0 or more	Extremely wet
3.0 to 3.99	Very wet
2.0 to 2.99	Moderately wet
1.0 to 1.99	Slightly wet
0.5 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.5 to -0.99	Incipient dry spell
-1.0 to -1.99	Mild drought
-2.0 to -2.99	Moderate drought
-3.0 to -3.99	Severe drought
-4.0 or less	Extreme drought

Source: NOAA

The State of New Jersey utilizes auxiliary indices for regional precipitation, stream-flow, reservoir levels, and ground-water levels in addition to the PDSI. The state created six drought regions in order to plan and manage restrictions in separate areas during droughts. The drought regions are grouped based on similar hydrologic characteristics and watershed boundaries and follow municipal boundaries. As seen in Figure 3.3.2-1, Warren County is in the Northwest Drought Region.

Figure 3.3.2-1: Warren County Municipalities and Drought Regions



Source: GIS data from NJDEP's NJ Geological Survey's Digital Geodata Series from May 2004. Retrieved from http://www.njgeology.org/geodata/dgs00-1.htm

Occurrence and Future Probability of Drought Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there has been one drought event within Warren County that resulted in losses. It began on September 1, 1999 and lasted until September 27, 1999 and there was a drought emergency throughout eight New Jersey counties. Agricultural losses throughout the state were estimated at around $80 million in 1999 monetary values.

Table 3.3.2-2: Significant Drought Events, Warren County, 1960 - 2010

Location	Date	Type	Deaths	Injuries	Property Damage	Crop Damage
Warren	9/1/1999 – 9/27/1999	Drought	0	0	$0	$6,581,700

Source: SHELDUS 7.0 and NCDC

Notes:

(1) Property Damage and Crop Damage amounts have been adjusted to 2010 inflation amounts using the average Consumer Price Index from the U.S. Department of Labor's Bureau of Labor Statistics.

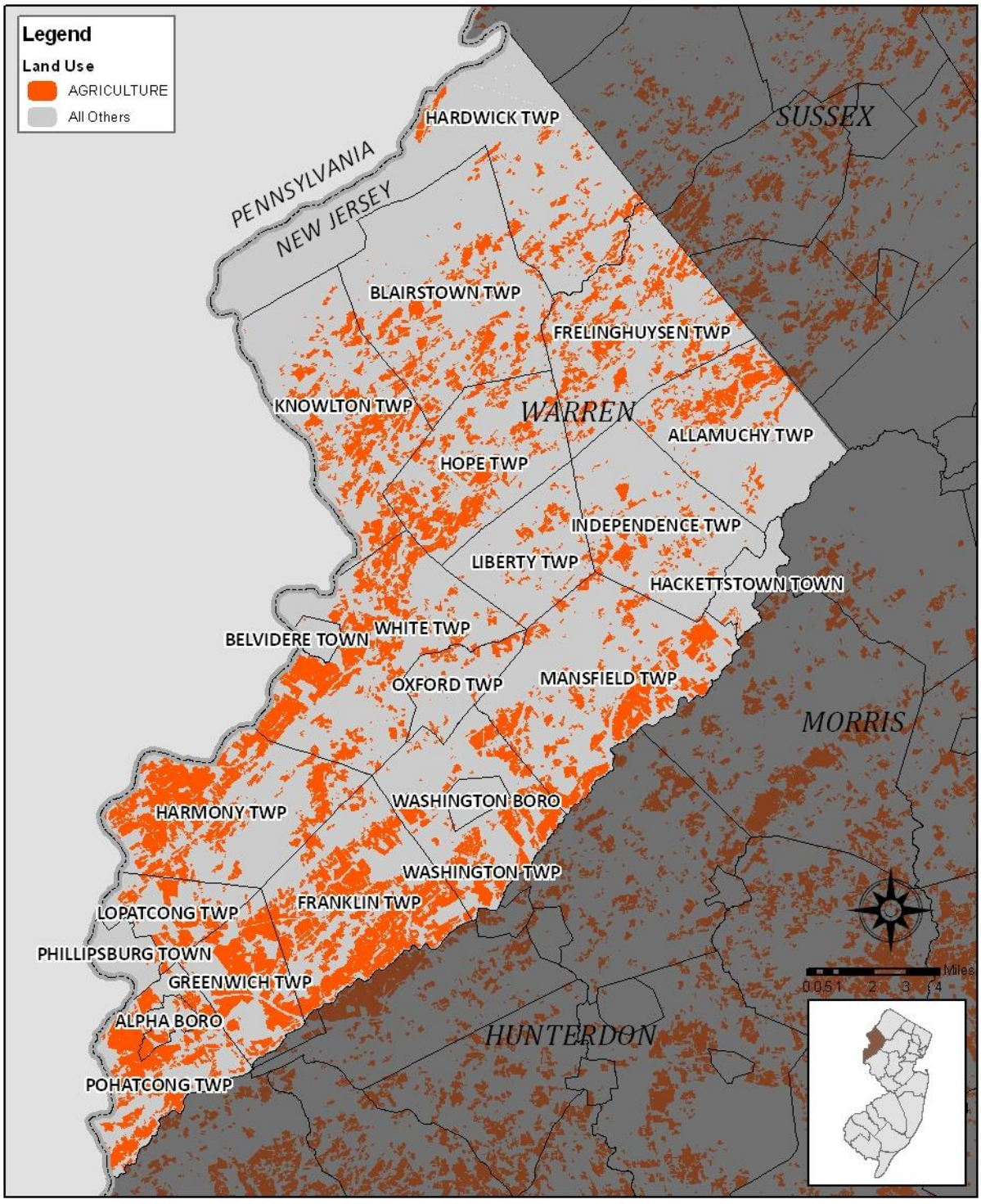
Based on the occurrence of one significant drought event in fifty years, the probability of future loss-causing drought events in Warren County is 2% likelihood per year.

Location and Extent of Drought Hazard

The entire county has approximately the same risk for drought. Generally, droughts are a regional phenomena and dependent on the extent of the heat and range of precipitation in the area. Predicting dry spells and therefore potential droughts is very difficult because there are multiple factors involved that are challenging to anticipate including precipitation, pressure and temperature, soil moisture, surface water, and other water-related variables. Due to the nature of droughts, agricultural areas are most likely to suffer financial losses during a long-term drought event. Figure 3.3.2-2 shows an overview of the agricultural land use in Warren County. As of 2002, Warren County had 56,409 acres of agricultural land, a decrease of 3,762 acres since 1995.[7]

[7] NJDEP, http://www.state.nj.us/dep/gis/lulc2002stattablescounty.htm

Figure 3.3.2-2: Warren County Municipalities and Agricultural Land Use



Source: GIS data from NJDEP's 2002 Landuse/Landcover dataset. Retrieved from http://www.state.nj.us/dep/gis/lulc02shp.html

Impact on Life and Property of the Drought Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there has been one drought event in Warren County that has resulted in losses. There have been no documented deaths, injuries, or property damages due to droughts during this time in the county. However, the estimated amount of agricultural damage for that single event is more than $6.58 million in 2010 currency.

Prioritization and Rationale of the Drought Hazard

Since the probability of future significant droughts in the county is 2%, this is considered 'unlikely' for an index value of 1. Based on previous occurrences, the magnitude or severity for anticipated drought hazard impacts is considered 'negligible' because although the estimated agricultural losses were extreme, there was no loss of life, injury, or property damage, for an index value of 1. The warning time for a drought is usually "at least 24 hours before an event occurs" for an index value of 1. Droughts can last for extended periods of time, so the classification would be that "the event lasts more than 1 week" for an index value of 4.

Table 3.3.2-3: CPRI for Degree of Risk for Drought Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	1 x .30	+	1 x .15	+	4 x .10	=	1.3

Although droughts can occur in Warren County, there has been no risk to residents' health and non-agricultural property over the past fifty years. Based on past events, the likelihood of a severe drought event occurring is unlikely, though possible. For these reasons, droughts will not be studied in further detail in this Plan.

3.3.3 Earthquake/Geological

Description of the Earthquake Hazard

An earthquake is a sudden, rapid movement of the earth caused by the breaking and shifting of rock beneath the earth's surface. The earth's surface is broken into shifting slabs or tectonic plates, which continents move along with. At the plate boundaries, the plates interact by sliding past one another, running into one another, or moving away from one another. Sometimes these movements are slow and gradual, at other times the plates are locked together unable to release the accumulating energy. Most active faults are located along or near boundaries between shifting plates, although some are located in the interior of plates (intra-plate earthquakes, such as the New Madrid). Earthquakes occur when rock suddenly moves, or slips, along these faults and accumulated energy is released. This energy causes seismic waves that when strong enough, may be experienced by us as ground shaking. The amount of energy released, combined with the physical environment, will impact the amount of damage to buildings and infrastructure. The main earthquake is often followed by smaller magnitude

earthquakes, called aftershocks. Earthquakes may also cause additional hazards such as ground rupture, landslides, avalanches, fires, soil liquefaction, tsunamis, floods, and tidal forces.

There are two main types of scales for measuring earthquakes: intensity and magnitude.

Intensity scales measure the amount of shaking at a particular location, so the intensity of an earthquake will vary depending on the location, although people tend to use the maximum intensity level produced when referring to a particular earthquake. Intensity is determined from effects on people, human structures, and the natural environment. Intensity scales include the Modified Mercalli Scale, shown in Table 3.3.3-1, and the Rossi-Forel Scale.

Magnitude scales measure the energy released or size of the earthquake at its source, so it will not vary based on location. Magnitude is determined from measurements on seismographs. Magnitude scales include the Richter Magnitude (Local Magnitude) and Moment Magnitude. Moment Magnitude Scale is newer and more precise, but more complex to calculate.

Table 3.3.3-1: Abbreviated Modified Mercalli Intensity Scale

Mercalli Intensity	Description
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: US Geological Survey (USGS). Retrieved from http://earthquake.usgs.gov/learn/topics/mercalli.php

Table 3.3.3-2 shows the intensities that are typically observed at locations near the epicenter of earthquakes of different magnitudes.

Table 3.3.3-2: Earthquake Magnitude versus Modified Mercalli Intensity Scale

Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 – 3.0 (Very Minor)	I
3.0 – 3.9 (Minor)	II – III
4.0 – 4.9 (Light)	IV – V
5.0 – 5.9 (Moderate)	VI – VII
6.0 – 6.9 (Strong)	VII – IX
7.0 and Higher (Major to Great)	VIII and Higher

Source: USGS. Retrieved from http://earthquake.usgs.gov/learn/topics/mag_vs_int.php

Occurrence and Future Probability of Earthquake Hazard

According to USGS and NJDEP, New Jersey has been affected by a number of earthquakes to a minor degree, as shown in Table 3.3.3-2

Table 3.3.3-3: Earthquake Events That Have Affected New Jersey

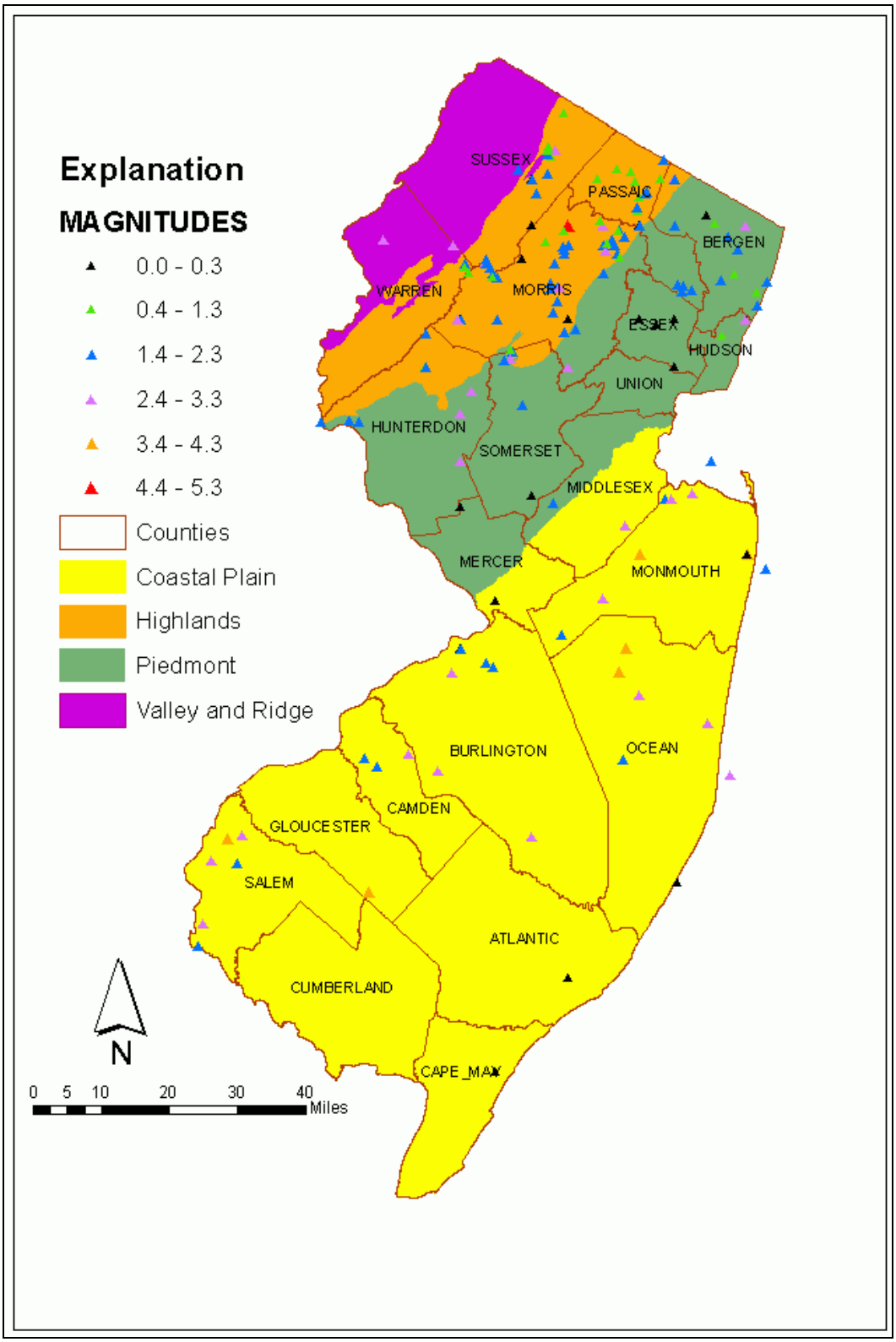
Epicenter Location	Date	Intensity (Max in NJ)	Magnitude	Effects in NJ
Near NYC	12/18/1737	VII	-	Chimneys down in NYC. Felt in Boston, MA and Philadelphia, PA.
Cape Ann, MA	11/18/1755	IV	6.0	Chimneys and brick buildings down in Boston. Caused a tsunami that grounded boats in West Indies.
West of NYC	11/30/1783	VII	5.3	Felt from NH to PA.
New Madrid, Missouri Area	1811 – 1812	IV-V	8.0 to 8.8	Four great earthquakes. Changed course of Mississippi River. Town of New Madrid destroyed. Loss of life low due to sparse settlement. Damage in Chicago.
Riviere-Ouelle, Canada	1860	-	-	Unknown
Wilmington, DE	10/09/1871	VII	-	Chimneys toppled and windows broke in DE. Reported felt in NJ.
NYC	1884	VII	5.5	Toppled chimneys in NYC and NJ. Cracked masonry from Hartford, CT to West Chester, PA. Felt from ME to VA, and eastern OH.
Charleston, SC	1886	IV	7.7	Sixty killed. Over 10,000 chimneys down.
High Bridge, NJ	09/01/1895	VI	-	Felt from ME to VA. In Hunterdon County towns, articles fell from shelves and buildings rocked. Philadelphia reported broken windows.
Moorestown/Riverton, NJ	01/26/1921	V	-	Moderate shaking. Rumbling noise heard.
Asbury Park, NJ	06/01/1927	VII	-	Highest intensity earthquake observed in NJ. Three shocks felt along the coast from Sandy Hook to Toms River. Maximum intensities of VII at Asbury Park and Long Branch, NJ. Several chimneys fell, plaster cracked, and articles thrown from shelves.

Epicenter Location	Date	Intensity (Max in NJ)	Magnitude	Effects in NJ
Lakehurst, NJ	01/24/1933	V	-	Sharp jolt felt over central NJ from Lakehurst to Trenton. Unclear if shock of seismic origin. Lakehurst people rolled out of bed.
Central NJ	08/22/1938	V	-	Caused minor damage at Gloucester City and Hightstown. Glassware broken and furniture moved, some windows broken. Four smaller shocks on August 23 and one on August 27.
Salem County	11/14/1939	-	-	Disturbance felt from Trenton to Baltimore, MD and from Cape May to Philadelphia. Little to no damage noted.
Rockland County, NY	09/03/1951	VI	-	Northeastern NJ experienced minor effects. Chimneys cracked, windows and dishes broke, and pictures fell at Lebanon and other towns.
Northeastern Philadelphia, PA Area	12/27/1961	V	-	Rumbling sounds and tremor felt in Bordentown and Trenton, where houses shook and windows and dishes rattled.
Burlington County, NJ	12/10/1968	V	2.5	Some broken windows with intensity V effects noted at Camden, Moorestown, Darby, and Philadelphia. Toll booths on Benjamin Franklin and Walt Whitman Bridges from NJ to Philadelphia, PA trembled during shock.
Salem County, NJ	02/28/1973	V	3.8	Moderately strong earthquake cracked plaster at Laurel Springs and Penns Grove and cracked cinder blocks at Harrisonville. Minor damage in areas of DE, MD, and PA.

Source: USGS. Retrieved from http://earthquake.usgs.gov/earthquakes/states/new_jersey/history.php and NJDEP's Land Use Management & NJ Geological Survey's study *Earthquake Risk in New Jersey* (1998, Revised 2005). Retrieved from http://www.state.nj.us/dep/njgs/enviroed/freedwn/e-quake.pdf

Figure 3.3.1 shows earthquakes whose epicenter is located in New Jersey from New Jersey Geological Survey Report DGS04-1, *Earthquakes Epicentered in New Jersey* that includes 166 earthquakes. Most were minor events, with magnitudes ranging from 0.4 to 5.3 and depths up to 25 km below sea level. The oldest event in the dataset is from 1783 and there are three recorded epicenters located within Warren County, with the highest listed magnitude at 2.8 with a depth of 5 km that occurred in 1980 near Hainesburg.

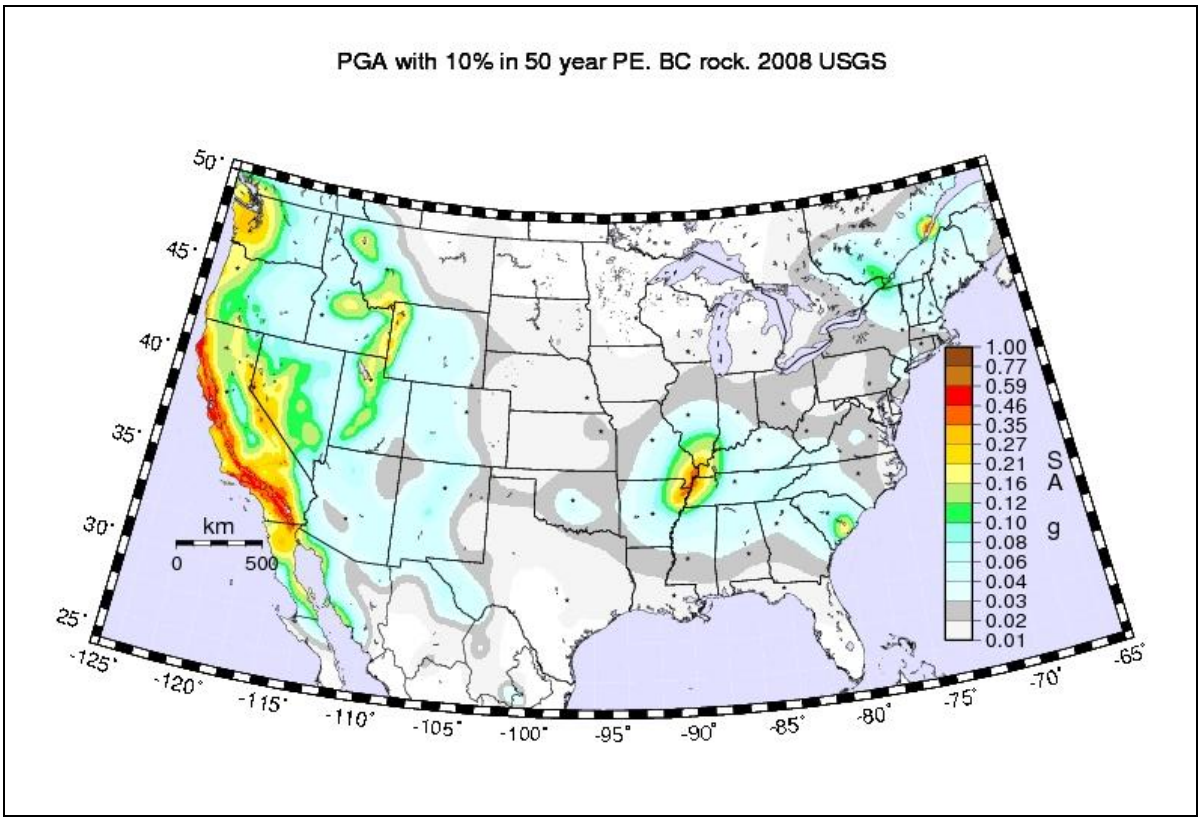
Figure 3.3.3-1: Earthquakes Epicentered in New Jersey



Source: NJDEP. Retrieved from http://www.state.nj.us/dep/njgs/geodata/dgs04-1.htm

Figures 3.3.3-2 and 3.3.3-3 depict future earthquake hazard by using contour lines and different colors to show the earthquake ground motions that have a similar probability of being exceeded in 50 years. On a given map, for a given probability of exceedance (10% in Figure 3.3.3-2 and 2% in Figure 3.3.3-3), locations shaken more frequently will have larger ground motions.[8] The 10% exceedance probability map will show lower ground motions than the 2% exceedance probability map, while the 2% exceedance probability map will be a better depiction of less likely but larger magnitude and/or nearer events. The maps are designed this way so that when building codes are being determined, one can look at the map and see what ground motion level the structures should be able to resist at a specific location. These particular maps are based on peak ground acceleration, which is best used as an index to hazard for short, stiff structures.

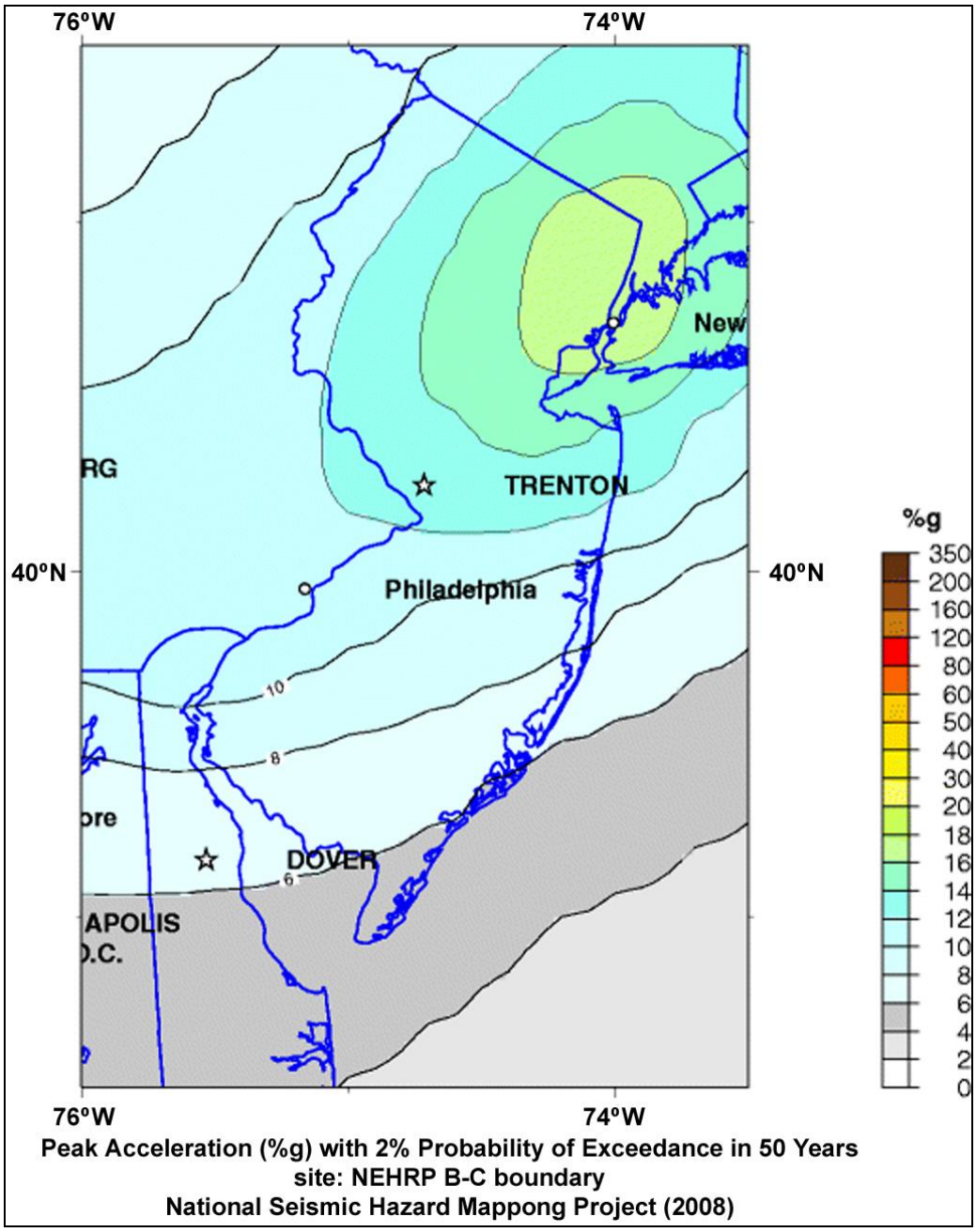
Figure 3.3.3-2: U.S. Seismic Hazard Map (2008) – Return Period 10% in 50 Years



Source: USGS. Retrieved from
http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/

[8] USGS from http://earthquake.usgs.gov/learn/faq/?faqID=207

Figure 3.3.3-3: New Jersey Seismic Hazard Map (2008) – Return Period 2% in 50 Years



Source: USGS. Retrieved from http://earthquake.usgs.gov/earthquakes/states/new_jersey/hazards.php

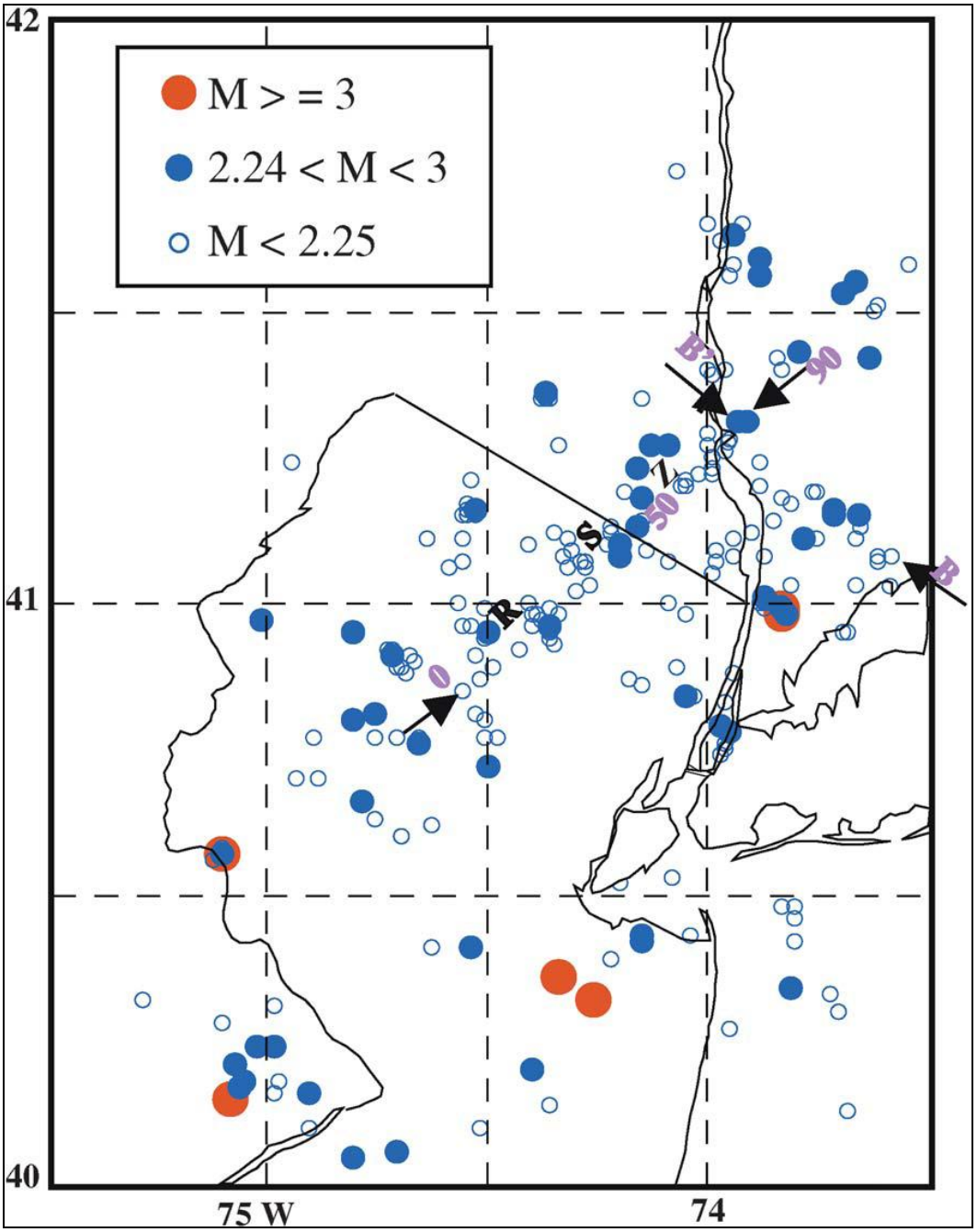
Based on Figures 3.3.3-1 and 3.3.3-2, Warren County has a great enough peak ground acceleration (%g) that warrants further assessment. According to USGS's 2009 Earthquake Probability Mapping Tool, and utilizing the center of Warren County as the location, the probability of future 5.0M earthquakes in the county is approximately 5% probability within a 100 year time span and a 4% probability for an 8.0M within a 100 year time span.[9] This makes the probability of an earthquake that could affect Warren County possible.

[9] USGS. Retrieved from http://geohazards.usgs.gov/eqprob/2009/index.php

Location and Extent of Earthquake Hazard

The entire county is at risk for the impacts of an earthquake. Fault lines are throughout the state, with the Ramapo Seismic Zone of particular concern. Ramapo runs from New York to New Jersey to Pennsylvania and consists of a braid of smaller fractures, including a set of nearly parallel northwest-southeast faults. A June 2007 study from Lamont-Doherty Earth Observatory of Columbia University by Sykes, et al entitled *Observations and Tectonic Settings of Historic and Instrumentally Located Earthquakes in the Greater New York City-Philadelphia Area* casts faults in the greater New York City area in a new, riskier light. Unlike the existing west coast model concerned with one large obvious fault, they voice concerns about a network of more subtle faults, previously thought to be inactive, that could add up to something big.

Figure 3.3.3-4: Quakes Located By Instruments 1974-2007 with Ramapo Seismic Zone



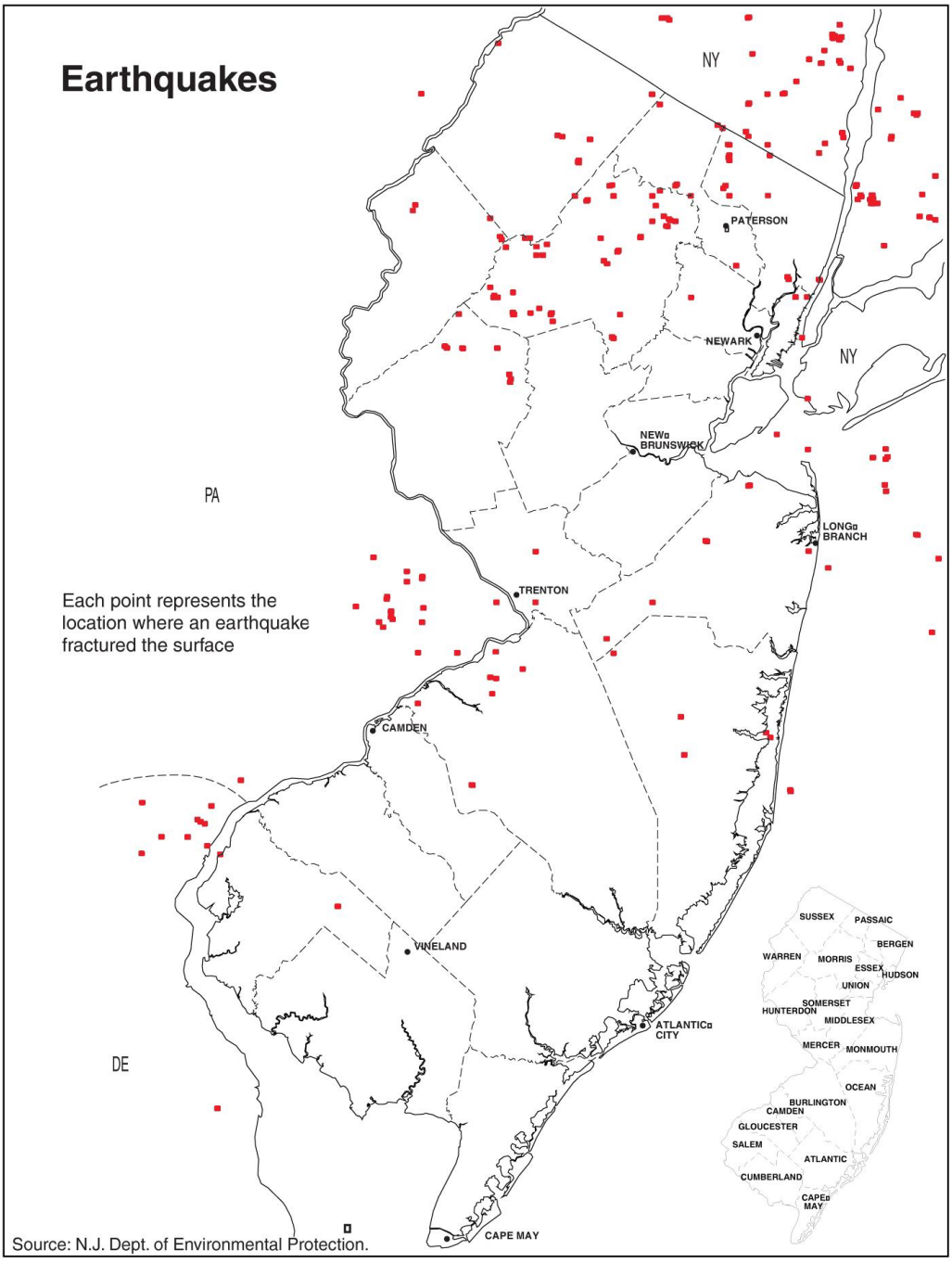
Source: Sykes et al., Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York 10964 (June 29, 2007) *Observations and Tectonic Settings of Historic and Instrumentally Located Earthquakes in the Greater New York City-Philadelphia Area.* Retrieved from http://www.ldeo.columbia.edu/files/sykespdf.pdf

Notes:

(1) Arrows denote approximate southeastern boundary of the Ramapo Seismic Zone and northwest-striking seismic boundary of the Peekskill-Stamford seismic line.

Figure 3.3.3-5 shows points where earthquakes have fractured the surface of the earth over the years. Warren County has experienced multiple surface fractures in the past.

Figure 3.3.3-5: Map of Surface Fractures from New Jersey Earthquakes



Source: NJDEP.

Impact on Life and Property of the Earthquake Hazard

There are no known deaths or injuries from earthquakes in Warren County, although there have been reports on multiple occasions of people feeling the effects of earthquakes. If a strong earthquake event were to occur in the region, ground shaking could cause the collapse of buildings and bridges, disrupt utility lines, and/or trigger landslides, avalanches, flash floods, and fires. When earthquakes occur in a populated area, they can cause deaths, injuries, and extensive property damage.

According to NJDEP's study *Earthquake Risk in New Jersey*, an earthquake occurring in the eastern part of the United States could inflict ten times more damage than one occurring west of the Rocky Mountains, due to higher population and density in the east. In New Jersey, structures built before 1977 may have been designed and constructed without seismic considerations. Under the NJ Rehabilitation Sub-code there are limited requirements for retrofitting existing buildings for seismic safety, such as when a conversion to a public facility occurs.[10]

According to *FEMA 366: Estimated Annualized Earthquake Losses for the United States* [11], it is estimated that New Jersey is ranked 14th in the nation for annualized earthquake losses (AEL) of $39.7 million, with Warren County's building inventory around $10 to $50 billion, and AEL approximately $0.5 to $1 million. This study is based on HAZUS-MH MR2 probabilistic analyses utilizing a thick alluvium soil type throughout the nation. See Section 3.4 for a more localized earthquake loss analysis utilizing HAZUS-MH MR4.

Prioritization and Rationale of the Earthquake Hazard

The probability of future significant earthquake in the county is 'possibly' for an index value of 2. The magnitude of a future earthquake is very difficult to predict, however recent studies support that an event could be severe or "catastrophic" for an index value of 4. Earthquakes can occur unexpectedly and therefore the warning time is "less than 6 hours warning time" for an index value of 4. Earthquake duration can vary, but generally "lasts less than 1 day" for an index value of 2.

Table 3.3.3-4: CPRI for Degree of Risk for Earthquake in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
2 x .45	+	4 x .30	+	4 x .15	+	2 x .10	=	2.9

Based on USGS, NJDEP, and Lamont-Doherty Earth Observatory of Columbia University studies, there is a possibility that an earthquake event could occur with a high magnitude that impacts Warren County severely. For these reasons, earthquakes will be studied in further detail in this Plan.

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[10] NJDEP's Land Use Management & NJ Geological Survey's study *Earthquake Risk in New Jersey* (1998, Revised 2005). Retrieved from http://www.state.nj.us/dep/njgs/enviroed/freedwn/e-quake.pdf

[11] FEMA, *FEMA 366: Estimated Annualized Earthquake Losses for the United States* (April 2008). Retrieved from http://www.fema.gov/library/viewRecord.do?id=3265

3.3.4 Flood

Description of the Flood Hazard

In simple terms, a flood is an excess of water on land that is normally dry. Floods are usually caused by weather events that deliver more precipitation to a drainage basin then can be easily absorbed or stored within the basin. Flooding is a significant natural hazard through the United States. Causes include heavy precipitation, snowmelt, ice jams, dam failures, hurricanes, reservoir overflows, and local thunderstorms. Flood waters can bring down structures, topple trees, destroy infrastructure, sweep people and vehicles away, and alter landscapes. Floods can occur quickly and without warning, such as flash floods or floods caused by dam breaks, or can build slowly, becoming more significant over time. There may be a lag time between precipitation and the time when the flood peaks, which in some situations may allow for warning and evacuating populations.

FEMA is responsible for the National Flood Insurance Program (NFIP) which was created in 1968 by Congress to provide a means for property owners to purchase flood insurance if their community participates in the NFIP. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding. As part of the NFIP, FEMA produces Flood Insurance Rate Maps (FIRMs) and Digital FIRM (DFIRM) databases for communities that describe the risk of flooding in different locations. The risk areas are shown using Special Flood Hazard Areas (SFHAs) to show high risk, also referred to as regulatory floodplains. The 1% annual chance flooding areas (often shown on FIRMs as a Zone A or Zone AE) are areas that have a 1 in 100 chance of flooding each year, and are commonly referred to as "100-year recurrence interval floods" or "100-year return period events", or "base floods". A recurrence interval is the average time within which the magnitude of a given flood event will be equaled or exceeded one time. But, this does not mean that a flood will only occur once every 100 years, actually they can occur much closer together than 100 years or much further apart; two 100-year flood events can occur in the same week. A home located within a SFHA has a 26% chance of suffering flood damage during the term of a 30-year mortgage.[12]

Areas outside the SFHA are considered to have moderate to low risk of flooding and are not in immediate danger, however they still have a risk of flooding. Another common quantity to describe a flood risk area is .2% annual chance of flooding each year, which is the equivalent as a 500-year recurrence interval flood area and often shown as a Shaded Zone X or 0.2% Annual Chance Flood Hazard Zone on FIRMs. These areas are expected to flood less often than those in the 1% annual chance areas, but this may not always be the case.

SFHAs boundaries are based on a number of factors, including flood history, hydrologic and hydraulic factors, topography, and flood control measures. Engineering studies have been completed and are summarized in the accompanying Flood Insurance Study (FIS). The FIS and FIRMs also contain useful information regarding discharges and cross-sections with Base Flood Elevations (BFEs) that can be used by communities for planning purposes and considered when designing building code standards.

[12] FEMA. Retrieved from http://www.floodsmart.gov/floodsmart/pages/faqs/what-is-a-special-flood-hazard-area.jsp

In 1972, New Jersey legislature adopted a statute which authorized the Division of Water Policy and Supply (now the NJDEP) to delineate and mark flood hazard areas and to adopt regulations for these areas.[13] The State developed flood hazard area maps that delineated the New Jersey Flood Hazard Area (NJFHA), based on discharge 25% larger than the 100-year flood discharge. These maps predated the FIRMs. The NJFHA is important because it is the State's regulatory standard. On November 5, 2007, NJDRP adopted new Flood Hazard Area Control Act rules which incorporate more stringent standards for development in flood hazard areas, including a 0% net-fill requirement for all non-tidal flood hazard areas of the State.[14]

Occurrence and Future Probability of the Flood Hazard

According to the 2008 *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* there were severe floods on the Delaware River in the county in October 1903, August 1955, and May 1972. The 1955 flood was the worst event recorded on the Delaware River, with an approximate 150-year recurrence interval and between 25 and 99 deaths. This event followed three heavy rain storms and Hurricane Diane. Impacts were minimal, due to limited development in the area.[15]

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been thirteen flood events within Warren County that resulted in losses, shown in Table 3.3.4-1.

Table 3.3.4-1: Significant Flood Events, Warren County, 1960 - 2010

Location	Date	Type	Deaths	Injuries	Property Damage	Crop Damage
Warren	7/27/1969	Heavy Rain, Flood	0	0	$139,293	$0
Warren	8/15/1969	Heavy Rain, Flood, High Wind	0	0	$29,251	$0
Warren	11/13/1970	Local Flood	0	0	$1,848	$0
Warren	8/2/1973	Rain, Flood	0	0.5	$2,089,459	$0
Warren	11/6/1977	Rain, Flood	0	0	$8,645,784	$0
Warren	1/19/1996	Flood after Blizzard of 1996	0.14	0	$2,118,017	$0
Warren	9/16/1999	Flood	0	0	$9,214,381	$0
Warren	8/12/2000	Flash Flood	0	0	$126,876	$0
Warren	8/4/2003	Flood	1	0	$0	$0
Warren	9/18/2004	Flood	0	0	$32,402,187	$0
Warren	4/2/2005	Flood	0	0	$2,800,709	$0
Warren	6/27/2006	Flood	0	0	$16,284,644	$0
Warren	4/15/2007	Flood	0	0	$2,106,139	$0

Source: SHELDUS 7.0 and NCDC

[13] NJDEP, Flood Control Section, Bureau of Dam Safety and Flood Control. Retrieved from http://nj.gov/dep/floodcontrol/about.htm#mapping

[14] NJ Flood Mitigation Task Force. Retrieved from http://www.njflood.org/current.html

[15] Delaware River Basin Commission's *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* November 2008, p57. Retrieved from *http://www.state.nj.us/drbc/Flood_Website/NJmitigation/index.htm*

Notes:

(1) Property Damage and Crop Damage amounts have been adjusted to 2010 inflation amounts using the average Consumer Price Index from the U.S. Department of Labor's Bureau of Labor Statistics.

The following descriptions of major floods are taken from excerpts from NCDC database.

- The Blizzard of 1996 paralyzed the east coast with heavy snow and winds from January 6 to 8, with another storm on January 12, then the weather warmed up and heavy rainfall followed, melting the snowpack quickly. According to NCDC, flash flooding began on January 19 which led to larger river flooding through January 21, 1996. Delaware River crested at its highest since 1955, and caused the worst damage. Damage estimates exceeded $10 million. Hunterdon, Morris, Sussex, and Warren Counties were declared disaster areas. About 800 people were evacuated by boat, half from Harmony Township. Hardest hit in Warren County were Harmony Township, Pohatcong, White, and Knowlton Townships. Water from the Delaware surrounded many homes with some water damage reaching second floors. Porches were washed away and chunks of ice were left behind. It was estimated that 130 residences, including mobile homes and apartment buildings, were badly damaged along with about twenty businesses. In addition to the Delaware River, the Musconetcong River inundated homes in Hackettstown, Shabbecong Creek forced the evacuation of fifty people and caused water damage to seventy homes, and Pequest River inundated homes and businesses on Water and Wall Streets in Belvidere.

- In September 1999, Hurricane Floyd brought heavy rainfall and winds to the area and caused extensive flooding and damage. According to NCDC, the hurricane is the greatest natural disaster to date to affect the State of New Jersey. Raritan River Basin experienced record breaking flooding, with approximately ten inches. Some water treatment plants were also inundated and many municipalities did not have water or had to boil it, while raw sewage was released and contaminated water in other areas. Structures and property were damaged by floodwaters, roads were flooded, and some areas were cut-off. On a relative basis, the effects of Floyd diminished across Warren and Sussex Counties. Approximately 38,000 homes and businesses lost power. In Franklin Township, a trailer exploded after flood waters caused a short in the wiring of a propane stove and spread to the tanks outside, but no one was injured due to previous evacuations.

- In mid-September, 2004, the remnants of Hurricane Ivan created heavy rainfall in the upper and middle sections of the Delaware River Valley. Runoff from heavy rain upstream of Warren County caused the worst flooding along the Delaware River since 1955. Damage was estimated at over $32.4 million in 2010 currency in Warren County alone.

- Many of the same areas that flooded in September 2004 were in a similar or worse flood situation in April 2005 when heavy rains were caused by a low pressure system from the Gulf. The flooding was exacerbated by the already wet soil conditions due to heavy rain during the end of March, snowmelt in the Delaware River's upper basin, and full capacity reservoirs in New York. In Sussex, Warren, Hunterdon, Mercer, and Morris Counties about 1,800 homes and businesses were flooded, twenty-five homes were destroyed, and about 4,000 people were evacuated. Many major roads were closed and about a dozen low-lying bridges were damaged, partially due to debris in the

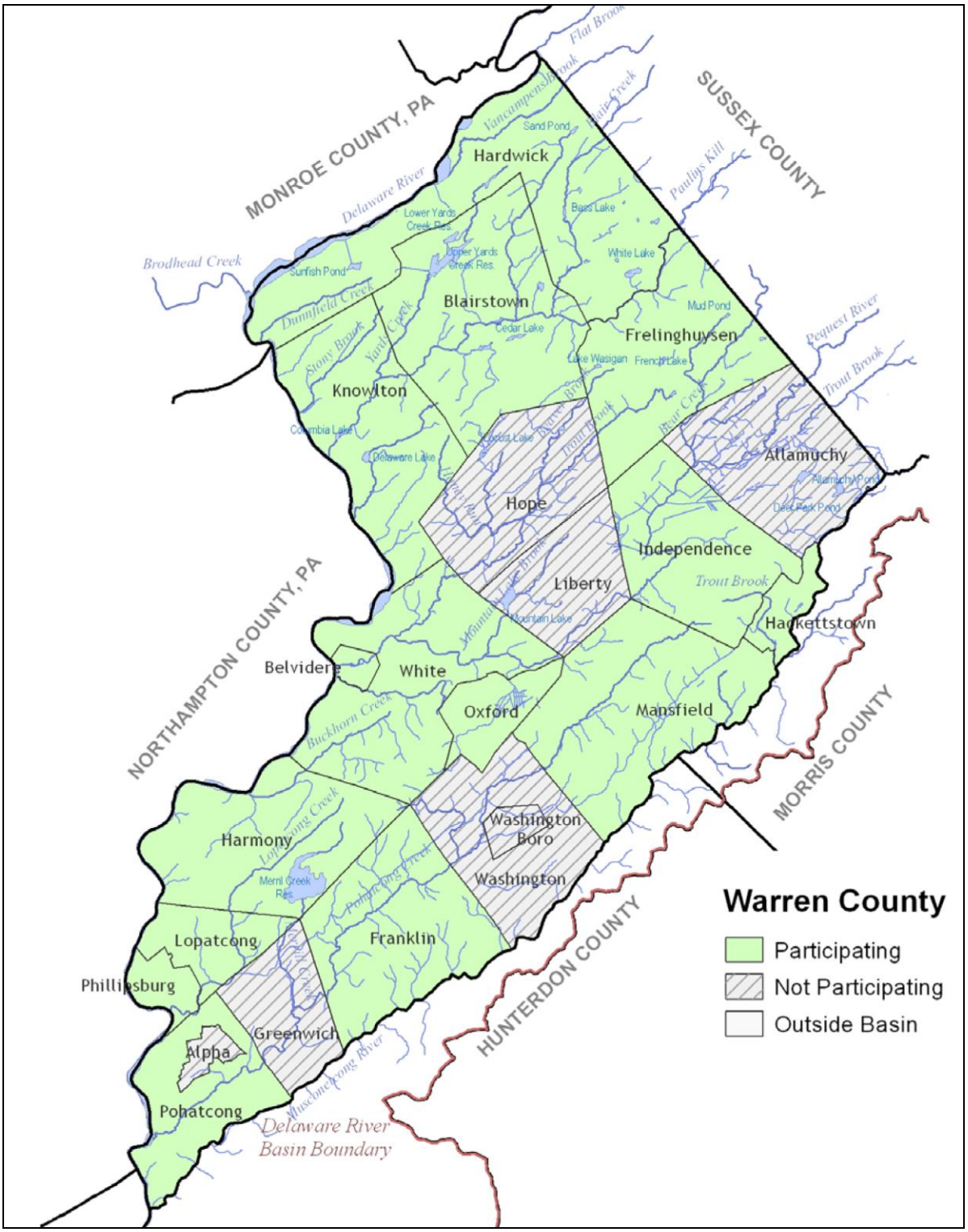
floodwaters. The worst damage in Warren County was reported in Knowlton and Harmony Townships along the Delaware River. But flooding extended further inland as the Musconetcong, Paulins Kill, and Pequest Rivers all flooded. Fourteen homes in the county were destroyed, 192 suffered major damage, 125 suffered minor damage, and an additional 84 had water in their basements. The Easton-Phillipsburg Bridge was closed for a few days. There were no deaths or major injuries. Raw sewage was an issue again, and some basements were contaminated with oil from storage tanks. On April 19th, a Major Disaster Declaration was announced for Gloucester, Hunterdon, Mercer, Morris, Sussex, and Warren Counties.

- On June 28, 2006 flooding occurred throughout the Delaware River Basin following several days of heavy rain. It was the second to fourth highest crest on record for the Delaware River along Warren County. Event totals in Warren County averaged three to eight inches, but storm totals exceeded ten inches in parts of the Upper Delaware Basin in New York State. In Warren County, about 400 homes, businesses, and apartments were affected by the flooding and 1,300 people were evacuated from seven riverside municipalities. Three homes and one business were destroyed, nearly 200 homes suffered major damage. A shelter was opened in Phillipsburg where up to 900 people were evacuated, about a dozen roads were closed, and fourteen streets evacuated. Evacuations also occurred in Belvidere, Harmony, Knowlton, Pohatcong, and White Townships.

Following these three events in 2004, 2005, and 2006, a multi-agency and local partnership formed to produce the *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* which was finalized in November 2008. The goal of the plan is "to make the Delaware River Basin more disaster resilient by reducing long-term risks to loss of life and property damage from flooding. The aim is to empower local communities to mitigate and support a sustainable community plan so that, when confronted by a natural disaster, they will sustain fewer losses and recover more quickly."[16] Fifteen Warren County municipalities, out of the twenty-two that were eligible, chose to participate including: Town of Belvidere, Blairstown Township, Franklin Township, Frelinghuysen Township, Hackettstown, Hardwick Township, Harmony Township, Independence Township, Knowlton Township, Lopatcong Township, Mansfield Township, Oxford Township, Phillipsburg, Pohatcong Township, and White Township, shown in green in Figure 3.3.4-1. Only the municipalities within the designated Delaware River Basin were eligible to participate. The Flood Mitigation Plan also contains recommended mitigation actions specific to the local communities that participated in the plan.

[16] Delaware River Basin Commission's *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* November 2008, p9. Retrieved from http://www.state.nj.us/drbc/Flood_Website/NJmitigation/index.htm

Figure 3.3.4-1: Warren County Municipalities Participating in the 2008 Multi-Jurisdictional Flood Mitigation Plan for the Non-tidal Section of the Delaware River Basin



Source: Delaware River Basin Commission's *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* November 2008, p193. Retrieved from http://www.state.nj.us/drbc/Flood_Website/NJmitigation/index.htm

Based on the occurrence of 13 significant flood events in fifty years, the probability of future loss-causing flood events in Warren County is 26% likelihood per year.

Location and Extent of the Flood Hazard

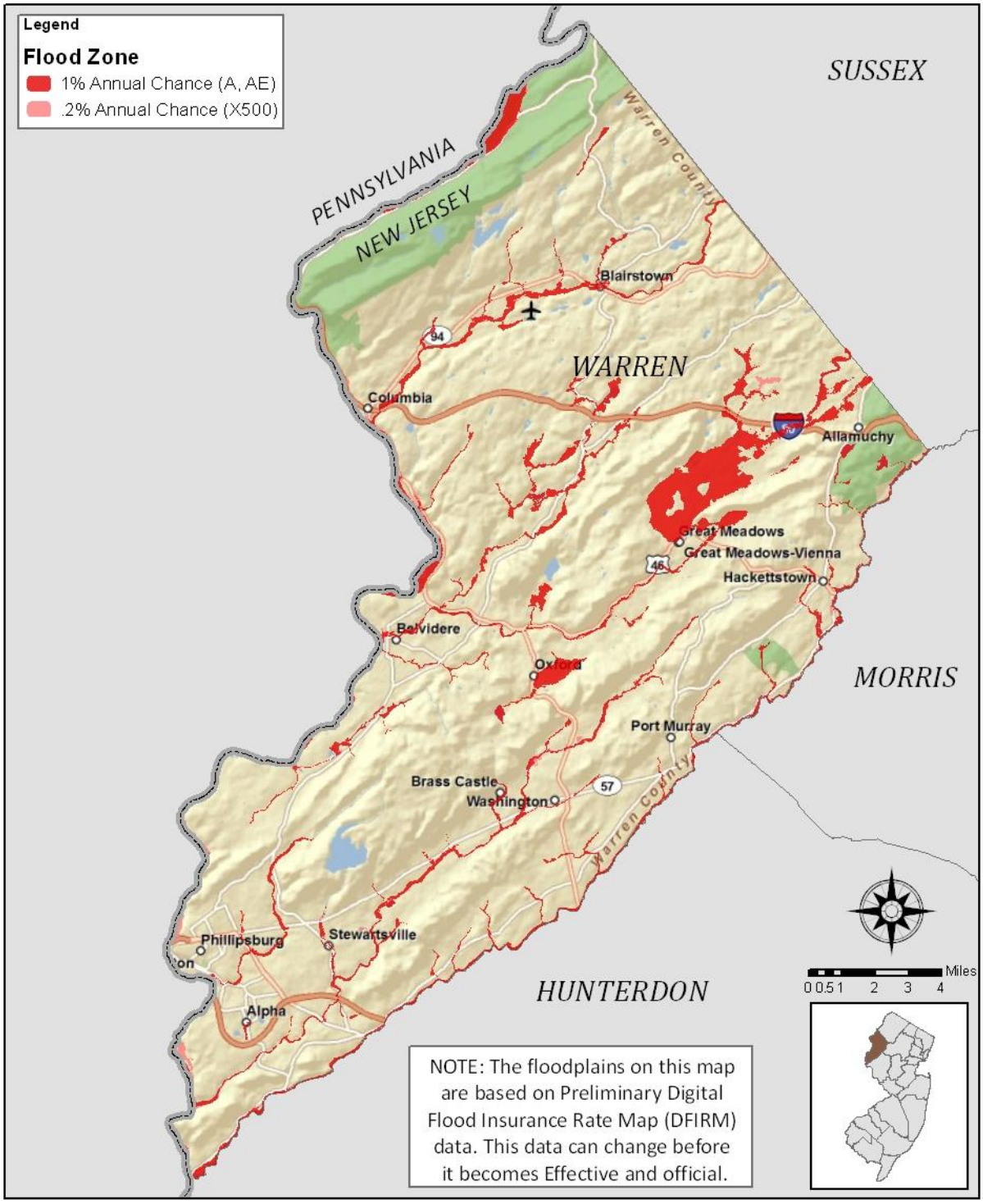
The area's characteristics can also impact the severity of a flood, such as topography, current soil moisture, vegetation, reservoir levels, and manmade alterations to the landscape. Densely populated areas are also at a high risk for flash floods because the construction of buildings, highways, driveways, and parking lots increases runoff by reducing the amount of rain absorbed by the ground.[17]

Certain areas of the county are at higher risk for flooding than others. As previously mentioned, the Delaware River has been the source of many damaging previous events. Flooding in this area is commonly due to snow melt combined with a rain event, heavy rains, or cyclonic events (including hurricanes, tropical storms, or nor'easters). Areas depicted on FIRMs as being in both the 1% and .2% annual chance of flood have a higher risk of flooding than areas outside of the floodplain, as shown in Figure 3.3.4-1. According to Warren County's Preliminary DFIRM data (which is subject to change at any time before going Effective), of Warren County's 232,060.43 acres, 16,535.98 acres are in the SFHA and at higher risk for flooding, or 7.13% of the county's land.

Another way to look at where flooding has caused damages in the past is to review information and general locations of Repetitive Loss and Severe Repetitive Loss Properties. A Repetitive Loss (RL) property is a structure covered under an NFIP flood insurance policy that has submitted at least two insurance claims of more than $1,000 in a ten-year period. According to the National Flood Insurance Act, a Severe Repetitive Loss (SRL) property is residential property covered under an NFIP flood insurance policy and 1) that 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 2) 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. In either case, two of the referenced claims must have occurred within a ten-year period and are greater than 10 days apart.

[17] NOAA. Retrieved from http://www.nssl.noaa.gov/primer/flood/fld_basics.html

Figure 3.3.4-2: Warren County Floodplains from Preliminary DFIRM Data



Source: FEMA DFIRM Preliminary data, which is subject to change at any time before becoming Effective.

Table 3.3.4-2 and Figure 3.3.4-3 show the county's RL properties. The top five municipalities with the highest paid RL claims are: Phillipsburg, Knowlton Township, Belvidere, Harmony Township, and Blairstown Township. The first four municipalities share a boundary with the Delaware River, whose overflow was the cause of many of the RL flood events in the county. In Blairstown Township, Paulins Kill, and Blair Creek are sources of flooding.

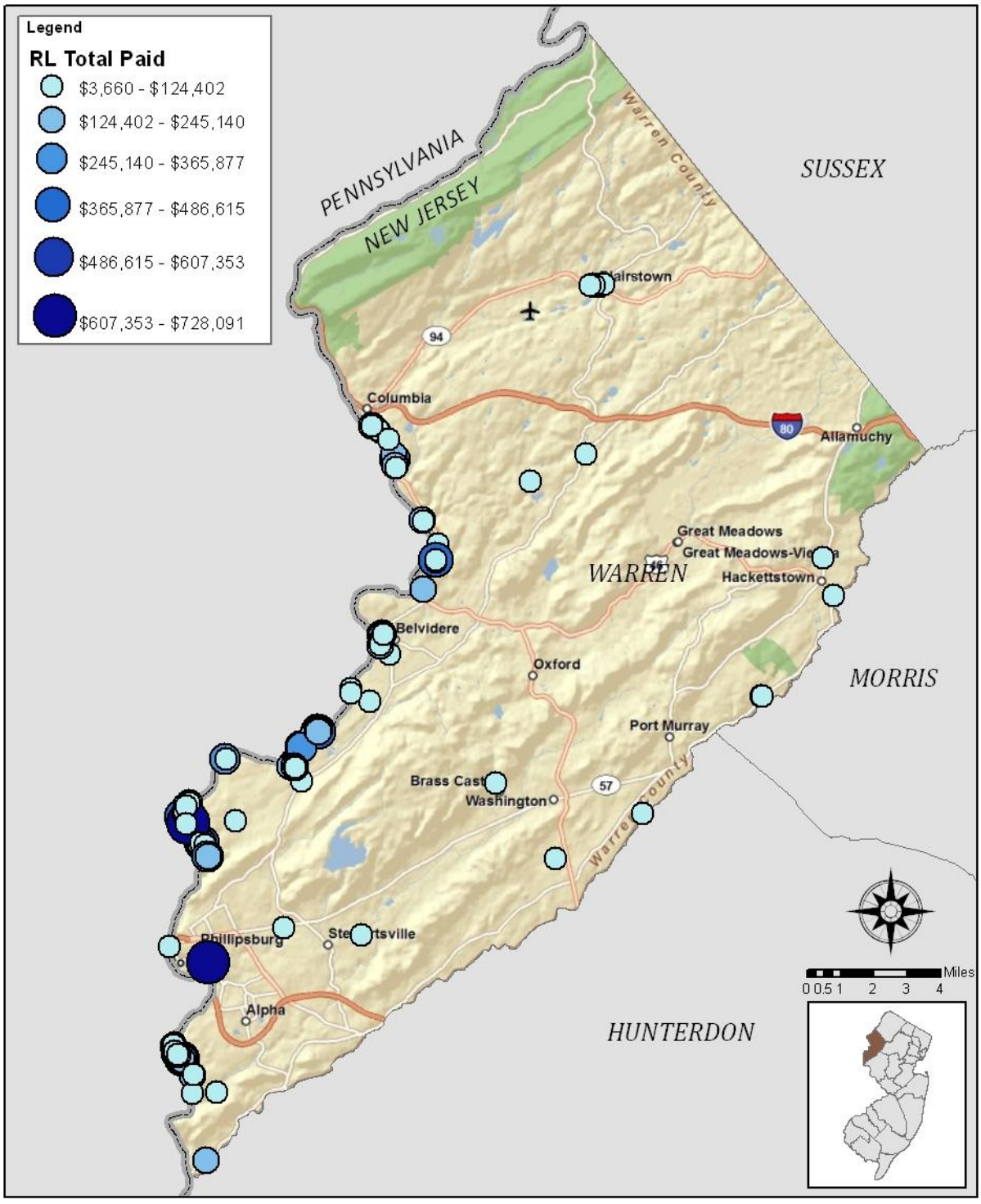
Table 3.3.4-3 and Figure 3.3.4-4 show the county's SRL properties. The six municipalities with paid SRL claims are: Harmony Township, Knowlton Township, Pohatcong Township, Belvidere, White Township, and Washington Township.

Table 3.3.4-2: Warren County Municipality Repetitive Loss Properties by Total Paid

Municipality	# Residential Properties	# Non-Residential Properties	Building Claims Paid	Contents Claims Paid	# Claims	Total Paid
Phillipsburg	125	3	$15,101,462	$2,895,239	385	$17,996,701
Knowlton Township	36	4	$4,032,191	$389,033	104	$4,421,224
Belvidere	41	1	$1,896,926	$213,128	106	$2,110,053
Harmony Township	5	0	$327,662	$142,478	13	$470,140
Blairstown Township	7	1	$194,398	$2,726	16	$197,124
Pohatcong	2	0	$85,513	$1,386	5	$86,899
Hackettstown	2	0	$61,971	$15,177	6	$77,149
Washington	3	0	$55,862	$14,813	9	$70,674
Port Murray	3	0	$38,707	$29,131	8	$67,838
Delaware	1	0	$44,262	$726	3	$44,988
Ramseyburg	1	0	$23,380	$0	2	$23,380
Stewartsville	1	0	$11,199	$2,239	2	$13,438
Franklin	1	0	$7,416	$0	3	$7,416
Hope Township	1	0	$3,996	$1,690	2	$5,686
Warren County RL Totals	229	9	$21,884,945	$3,707,766	664	$25,592,710

Source: FEMA Repetitive Losses Queried May 10, 2010.

Figure 3.3.4-3: Warren County Repetitive Loss Properties



Source: FEMA Repetitive Losses Queried May 10, 2010.

Notes:

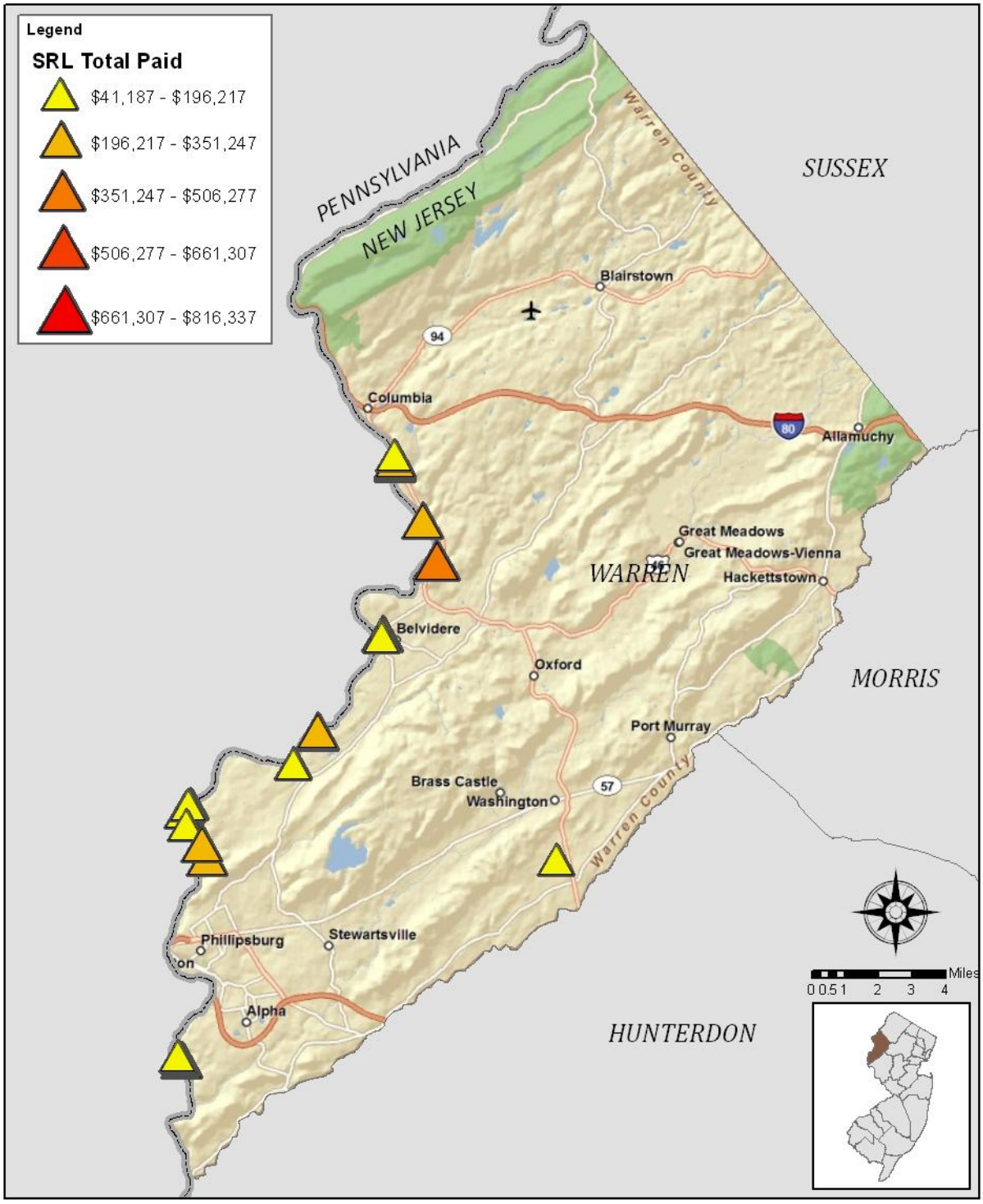
(1) Fifteen RL properties could not be geocoded based on data provided, these include: six in Phillipsburg, one in Delaware, three in Columbia, one in Port Murray, two in Pohatcong, and one in Belvidere.

Table 3.3.4-3: Warren County Municipality Severe Repetitive Loss Properties by Total Paid

Municipality	# Residential Properties	Building Claims Paid	Contents Claims Paid	# Claims	Total Paid
Harmony Township	17	$2,301,768	$320,328	68	$2,622,096
Knowlton Township	7	$1,365,594	$80,640	23	$1,446,234
Pohatcong Township	4	$728,711	$54,076	17	$782,788
Belvidere	4	$550,668	$44,703	15	$595,371
White Township	1	$299,977	$116,390	3	$416,367
Washington Township	1	$43,339	$14,697	5	$58,036
Warren County RL Totals	34	$5,290,057	$630,834	131	$5,920,892

Source: FEMA Severe Repetitive Losses Queried May 10, 2010.

Figure 3.3.4-4: Warren County Severe Repetitive Loss Properties



Source: FEMA Severe Repetitive Losses Queried May 10, 2010.

Impact on Life and Property of the Flood Hazard

According to the USGS, "Floods are the most chronic and costly natural hazard in the United States, causing an average of 140 fatalities and $5 billion damage each year (Schildgen, 1999)."[18] More than half of all fatalities during floods are auto related, and usually the result of drivers misjudging the depth of water on a road and the force of moving water – a car can float in just a few inches of water. In the U.S. in the past 50 years, loss of life to floods has declined, mostly due to improved warning systems, however economic losses have continued to rise due to increased urbanization and coastal development.[19]

Flood events have severely impacted the county in the past, including deaths, injuries, significant property damage, sewage and storm water drainage issues, road damage, dam damage, and utility damage. According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been thirteen flood events within Warren County that resulted in losses, summarized in Table 3.3.4-1. These thirteen flood events are estimated to have caused 1 to 2 deaths, 0 to 1 injury, and $75,958,586 in property damages in 2010 currency. The NFIP has paid out a total of $25,592,710 in 664 Repetitive Loss claims.

According to the 2008 *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin*, residential flood risk calculated using a simple methodology using the FEMA default present-value coefficients from the benefit-cost analysis software models show that Harmony Township has the highest projected flood risk over 100 years of the municipalities studied, at $10.3 million. Knowlton Township also ranked in the top with a projected 100-year flood risk of $4 million.[20] The Flood Mitigation Plan also lists the Town of Belvidere, Blairstown Township, Harmony Township, Knowlton Township, Phillipsburg, and Pohatcong Township as having the highest flood vulnerability in Warren County.

The USACE Philadelphia District, in partnership with NJDEP, is currently working on an Interim Feasibility Study for New Jersey which is expected to be submitted around 2013. The purpose is to evaluate possible flood mitigation options, including flood-proofing and removing or relocating structures within the floodplain of the Delaware River Basin which aim to reduce flood losses.

The Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act of 2007 authorized $12 million for acquisition of lands in the floodways of the Delaware River, Passaic River or Raritan River, and their tributaries, for recreation and conservation purposes.[21] Properties that have been damaged by flooding, or are prone to incurring flood damage, are eligible for acquisition. There have also been recent approved funding and efforts for improving flood warning and education in the Delaware River Basin area.

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[18] USGS *Large Floods in the United States: Where They Happen and Why Circular 1245,* 2003, p1. Retrieved from http://pubs.usgs.gov/circ/2003/circ1245/pdf/circ1245.pdf

[19] USGS *Flood Hazards – A National Threat Circular*. Retrieved from http://pubs.usgs.gov/fs/2006/3026/2006-3026.pdf

[20] Delaware River Basin Commission's *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin,* November 2008, p10. Retrieved from *http://www.state.nj.us/drbc/Flood_Website/NJmitigation/index.htm*

[21] NJDEP. Retrieved from http://www.nj.gov/dep/greenacres/

Prioritization and Rationale of the Flood Hazard

The probability of future significant flood events in the county is 26%, or 'likely' for an index value of 3. Based on previous impacts from flood events, the magnitude of a future event could be "critical" for an index value of 3. Floods can occur unexpectedly, but are usually followed by some type of predicted weather event, so the warning time for a flood event will be "6-12 hours" for an index value of 3. Flood duration can vary, but generally "lasts less than 1 week" for an index value of 3.

Table 3.3.4-4: CPRI for Degree of Risk for Flood in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
3 x .45	+	3 x .30	+	3 x .15	+	3 x .10	=	3

Based on previous flood history and serious impacts in Warren County, floods will continue to severely affect the county. For these reasons, floods will be studied in further detail in this Plan.

3.3.5 Hazardous Materials Release

Description of the Hazardous Materials Release Hazard

In general terms, 'hazardous materials' refers to hazardous substances, petroleum, natural gas, synthetic gas, and acutely toxic chemicals. They can come in many forms. The term Extremely Hazardous Substance is used in Title III of the Superfund Amendments and Reauthorization Act of 1986 to refer to those chemicals that could cause serious health effects following short-term exposure from accidental releases. Hazardous material releases can occur as a result of transportation accidents or a release from a fixed site due to flooding, earth movement, an accident, or an attack. Nuclear power generating facilities have the greatest concentration of radioactive materials of any private source. Usually the most immediate threat to public safety is caused when a hazardous material release causes an explosion.

Starting in 1986, the Emergency Planning and Community Right-to-know Act (EPCRA) required certain industries to report the locations and quantities of chemicals stored on-site to government officials. EPCRA Section 313 requires the EPA and the States to collect this data annually and make it publicly available. The Toxic Release Inventory (TRI) database is the vehicle to make public the information about releases and transfers of toxic chemicals from facilities in certain industrial sectors, including manufacturing, waste handling, mining, and electricity generation. Reporting is mandatory for facilities that use specific Standard Industrial Classification Codes, have at least 10 full-time workers, manufacture/process/use more than minimum amounts of the chemical, and have chemical on the TRI list. Therefore, not all toxic on-site occurrences are recorded in TRI.

Occurrences and Probability of the Hazardous Materials Release Hazard

According the Right-To-Know Network's Toxics Release Inventory (TRI), Warren County facilities had a total of 22,769,203 pounds of releases and 177,640,557 pounds of waste from 1987 to 2008. The types of chemicals that are reported through the TRI were originally established by Congress (based on lists that Maryland and New Jersey were using at the time), with the intent that the list would be improved through a process for listing and de-listing hazardous chemicals and categories.[22] Table 3.3.5-1 lists the county's top 5 types of chemicals for onsite releases from 1987 to 2008. The top chemical released in the county during this time period was nitrate compounds. However, nitrate compounds only became a TRI reportable category in 1995 (previously ammonium nitrate solution was listed as an individual chemical from 1987 to 1995), so this large amount of nitrate compounds were actually released from 1995 to 2008.[23] Nitrate compounds are often created as a byproduct to wastewater treatment, and excess exposure can cause serious illness or death. Excess levels can also cause environmental damage that includes algae blooms that can lead to fish kills.

Table 3.3.5-1: Warren County's Top 5 Chemicals for On-Site Releases from 1987 - 2008

Chemical Name	Quantity Releases (in Pounds)
Nitrate Compounds	4,406,803
Toluene	4,162,735
Acetone	3,426,929
Methanol	2,958,476
Chloroform	923,788

Source: RTK TRI. Retrieved from www.rtknet.org

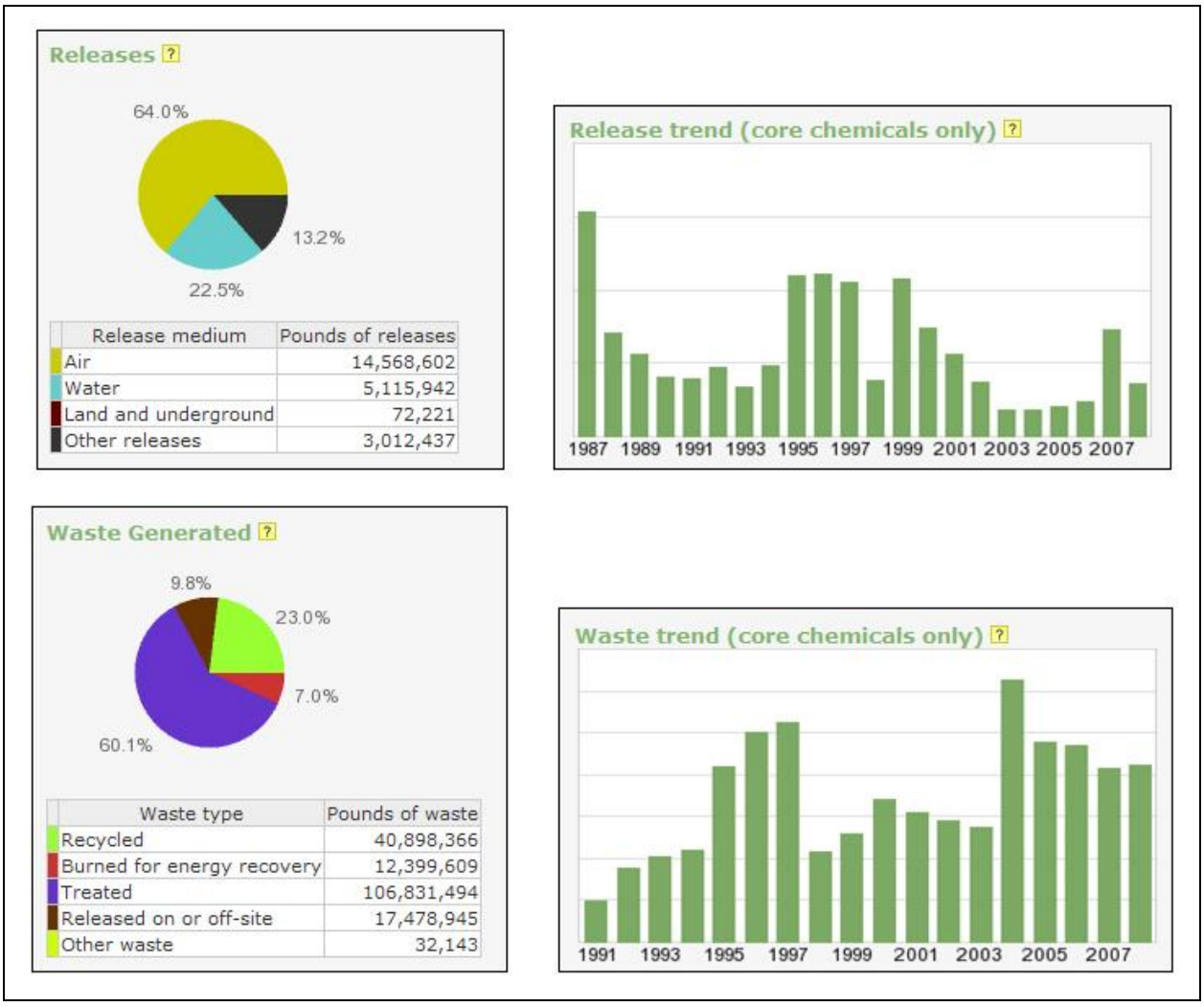
Table 3.3.5-2: Warren County's Top 5 Industries for On-Site Releases from 1987 - 2008

Top Industries for On-Site Releases	Quantity Releases (in Pounds)
Chemicals	16,039,751
Miscellaneous or No Industry Code	3,189,167
Primary Metals	2,403,939
Fabricated Metals	450,045
Paper	241,137

Source: RTK TRI. Retrieved from www.rtknet.org

[22] RTK TRI. Retrieved from http://www.rtknet.org/node/630
[23] Environmental Protection Agency. Retrieved from http://www.epa.gov/compliance/resources/newsletters/civil/enfalert/nitrates.pdf

Figure 3.3.5-1: Warren County's Waste Released and Generated - Totals and Trends from 1987 - 2008



Source: RTK TRI. Retrieved from www.rtknet.org

Another component to hazardous material events is the possibility of a release of chemicals during transport. The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) maintains the Hazmat Incident Database which records events that occurred during transport. The database contains data from the past ten years, and indicates if an incident was a "serious incident" or not. A "serious incident" is defined as a hazardous material release incident that caused a fatality or major injury, the evacuation of 25 or more persons, closure of a major transportation artery, alteration of aircraft flight plan or operation, the release of radioactive materials from Type B packaging, the release of more than 11.9 gallons or 88.2 pounds of a severe marine pollutant, or the release of a bulk quantity of a hazardous material.[24] Warren County had no "serious incidents" listed in the past ten years.

[24] PHSA. Retrieved from https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/

It is highly likely that smaller hazardous material releases will continue to occur. However, Warren County has not experienced a severe large-scale hazardous material incident at a fixed site or during transport resulting in deaths or serious injuries. The probability of a severe event occurring in Warren County is unlikely.

Location and Extent of the Hazardous Materials Release Hazard

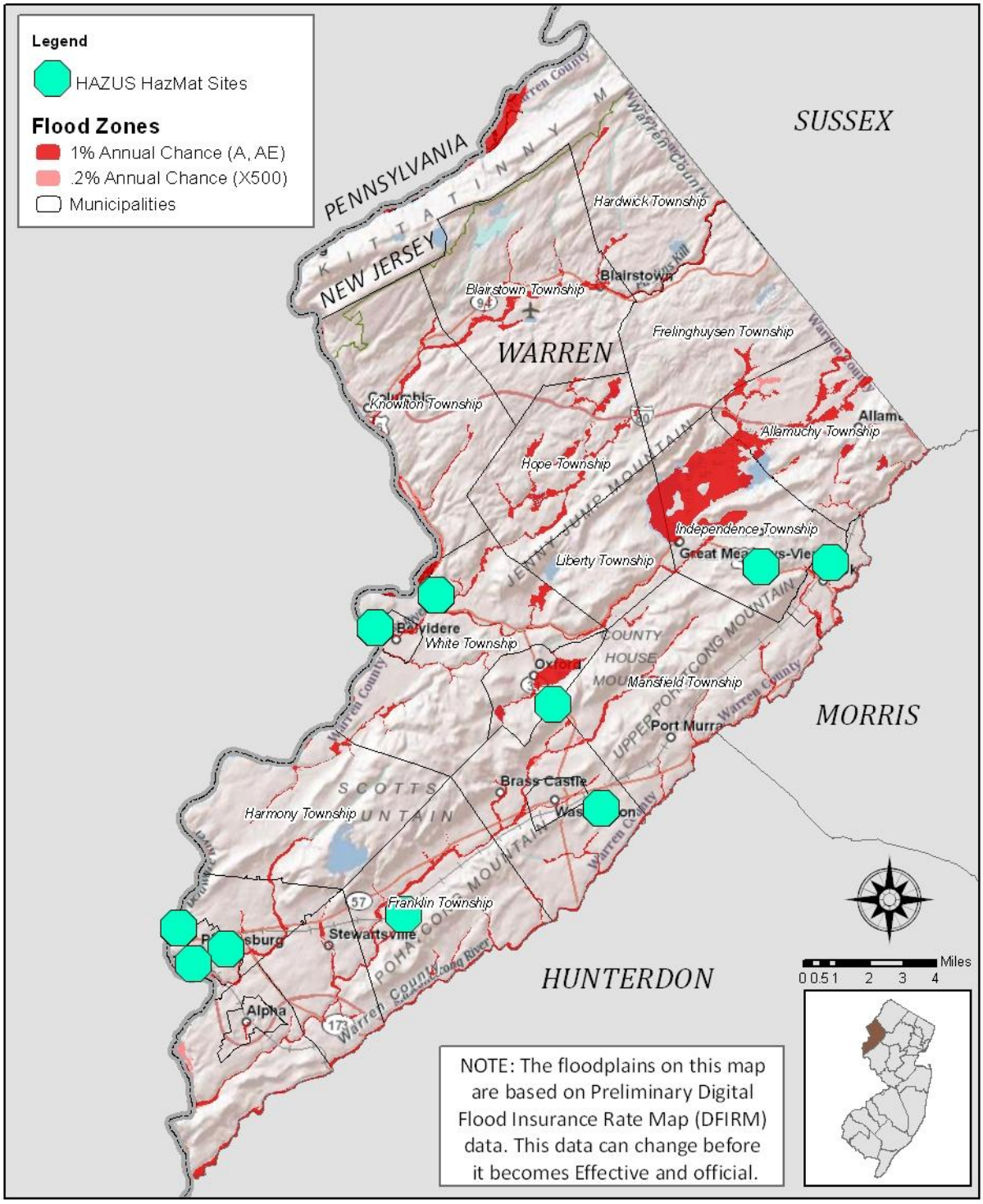
Hazardous material releases are more likely to occur in areas surrounding fixed site facilities and along major transport routes in Warren County. Figure 3.3.5-2 shows hazardous material sites according to the HAZUS-MR4 inventory data. There is one facility with twenty-one types of chemicals that is located within the .2% annual chance Special Flood Hazard Area (often referred to as the 500-year floodplain). Nuclear sites are not included in the HAZUS data, but the only New Jersey nuclear sites are located in Salem and Ocean Counties.

Table 3.3.5-3: Warren County's Top 5 Municipalities for On-Site Releases from 1987 - 2008

Municipality	Quantity Releases (in Pounds)
Belvidere	12,206,601
Phillipsburg	6,5,10,870
Oxford	368,601
Washington	255,768
Hackettstown	164,874

Source: RTK TRI. Retrieved from www.rtknet.org

Figure 3.3.5-2: Warren County Hazardous Materials Facilities



Source: GIS Hazardous Material site data from HAZUS MR4. Floodplain GIS data from FEMA's Preliminary Digital Flood Insurance Rate Map database which is subject to change at any time before becoming Effective in the future.

Impact on Life and Property of the Hazardous Materials Release Hazard

Public health impacts of a hazardous material release can be varied, ranging from temporary minor skin irritation to death. Mechanisms are in place to prevent catastrophic hazardous materials releases from occurring, but they are still possible. In Warren County, it is more likely that smaller scale controlled and accidental chemical releases will occur. New Jersey State Police and Warren County have Hazardous Materials Response Units, and offers training for first responders on how to deal with hazardous materials and related emergency response.

Prioritization and Rationale of the Hazardous Materials Release Hazard

Since the probability of future catastrophic hazardous materials release events are unlikely, this is considered an index value of 1. Based on previous occurrences, the magnitude or severity for anticipated hazardous materials release event impacts is considered 'negligible' because "less than 25% of property that is severely damaged" for an index value of 1. The warning time for a hazardous materials release event is "less than 6 hours warning time before an event occurs" for an index value of 4. Hazardous material release events, can end very quickly or last an entire day, therefore they would be classified as "the event lasts less than one day" for an index value of 2.

Table 3.3.5-4: CPRI for Degree of Risk for Hazardous Materials Release Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	1 x .30	+	4 x .15	+	2 x .10	=	1.55

Although hazardous material releases can occur in Warren County, as documented by historical reports, there have been no previously reported deaths or injuries, and the financial impacts have been extremely low in the past. Based on past events, the likelihood of a severe hazardous material release event occurring is very unlikely, though possible. For these reasons, hazardous materials release events will not be studied in further detail in this Plan.

3.3.6 High Wind – Straight Line Winds

Description of the High Wind – Straight Line Winds Hazard

Straight line high wind hazards include tropical cyclone winds (hurricanes, tropical storms, and tropical depressions), nor'easter storm winds, and winds created by any other type of severe storm such as thunderstorms. Many of these storms have the potential to create both wind and water damages. This section addresses only the wind hazard impacts, although in some cases it is difficult to separate the consequences of the two hazards. Tornado wind events are addressed separately in Section 3.3.7.

Tropical cyclones are formed as a developing center moves over warm water, the pressure drops in the center of the storm and as the pressure drops, the system becomes better organized and the winds begin to rotate around the low pressure, pulling the warm and moist ocean air. Tropical cyclones can evolve from a tropical depression to a tropical storm to a hurricane as they intensify as shown in Table 3.3.6-1. In the Northern Hemisphere, hurricane winds rotate in a counter-clockwise direction with different wind speeds and characteristics in each quadrant, with the most severe effects in the right-front quadrant.

Table 3.3.6-1: Types of Tropical Cyclones

Name	Maximum Sustained Surface Wind Speed (Using the U.S. 1-minute average)		
Tropical Depression	33 kt or less	38 mph or less	62 km/hr or less
Tropical Storm	34kt to 63 kt	39 mph to 73 mph	63 km/hr to 118 km/hr
Hurricane	64 kt or more	74 mph or more	119 km/hr or more

Source: NOAA, National Hurricane Center (NHC). Retrieved from http://www.nhc.noaa.gov/aboutgloss.shtml#h

The Saffir-Simpson Hurricane Scale defines hurricane strength by categories, with a Category 1 storm being the weakest and Category 5 being the strongest as shown in Table 3.3.6-2. Depending on where and how hurricanes strike, it is possible for a lower category storm to inflict greater damage than a higher category storm.

Table 3.3.6-2: Saffir-Simpson Hurricane Scale

Category	Wind Speeds	Likely Effects
1	74 to 95 mph	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also some coastal road flooding and minor pier damage.
2	96 to 110 mph	Some roofing material, door, and window damage to buildings. Considerable damage to vegetation, mobile homes, and piers. Small craft in unprotected anchorages break moorings.
3	111 to 130 mph	Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures, mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.

Category	Wind Speeds	Likely Effects
4	131 to 155 mph	More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Major damage to lower floors of structures near the shore. Terrain may be flooded well inland.
5	155 mph or more	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Major damage to lower floors of all structures located near the shoreline. Massive evacuation of residential areas may be required.

Source: NOAA, NHC. Retrieved from http://www.nhc.noaa.gov/

Notes:

(2) The scale corresponds to the 1-minute average sustained wind speed as opposed to gusts which could be 20 percent higher or more.
(3) Effects depend on a number of factors and may differ from the examples here.

A nor'easter is a cyclonic storm that moves along the east coast of North America with winds that blow from a northeasterly direction. They may occur at any time of the year, but are most common and strongest in the winter months. These storms are usually most intense near New England and Canada. Nor'easters can produce heavy snow and rain, and may bring gale force winds greater than 58 miles per hour and can cause rough seas, coastal flooding, and beach erosion.[25]

Thunderstorms often bring strong winds in addition to hail and lightening. A thunderstorm is considered severe when the hail is .75" or larger, frequent and dangerous lightening is present, or has wind speeds 58 miles per hour or greater.

Occurrences and Probability of the High Wind – Straight Line Winds Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been four hurricane/tropical storm events within Warren County that have resulted in losses. It is difficult to determine the losses due to wind damage versus the losses due to flooding damage. Table 3.3.6-3 shows the events with total losses from both types of damage. In addition to these four hurricane/tropical storm events, NCDC and SHELDUS also list Hurricane Floyd as separate 'Wind' and 'Flooding' events in the database, stating in the description that Hurricane Floyd will go down in history as the greatest natural disaster to ever effect the state of New Jersey to date. Hurricane Floyd hit New Jersey on September 16, 1999 and caused $1.1 billion dollars of damage and six deaths in the State. Estimates for wind damage only in Warren County are $329.085 in 2010 adjusted dollars, with no deaths, injuries, or crop damages.

[25] NOAA, from http://www.noaa.gov/features/03_protecting/noreasters.html

Table 3.3.6-3: Significant Hurricane/Tropical Storm Events with Wind and Flooding Losses, Warren County, 1960 - 2010

Location	Date	Name	Deaths	Injuries	Property Damage	Crop Damage
Warren	7/30/1960	Tropical Storm Brenda	0	0	$17,909	$0
Warren	9/12/1960	Hurricane Donna	0.14	0.43	$179,088	$179,088
Warren	8/28/1971	Tropical Storm Doria	0	0.14	$12,536,410	$12,536
Warren	6/22/1972	Tropical Storm Agnes	0	0	$125,364	$1,253,641

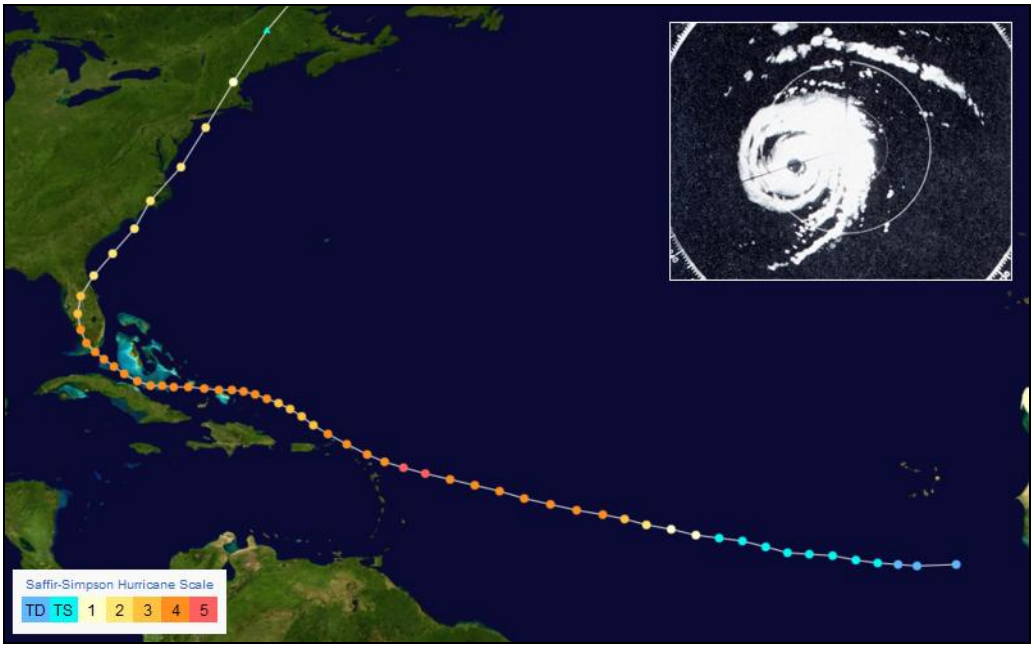
Source: SHELDUS 7.0, NCDC, and NOAA's NWS Storm Prediction Center GIS data

Notes:

(1) All efforts were made to research the actual location of deaths and injuries associated with a specific event, however when a specific county could not be determined then the number of deaths or injuries were divided by the number of counties associated with that event according to NCDC. This is the methodology utilized by SHELDUS 7.0. This can cause fractions of deaths or injuries associated with a specific county for an event.

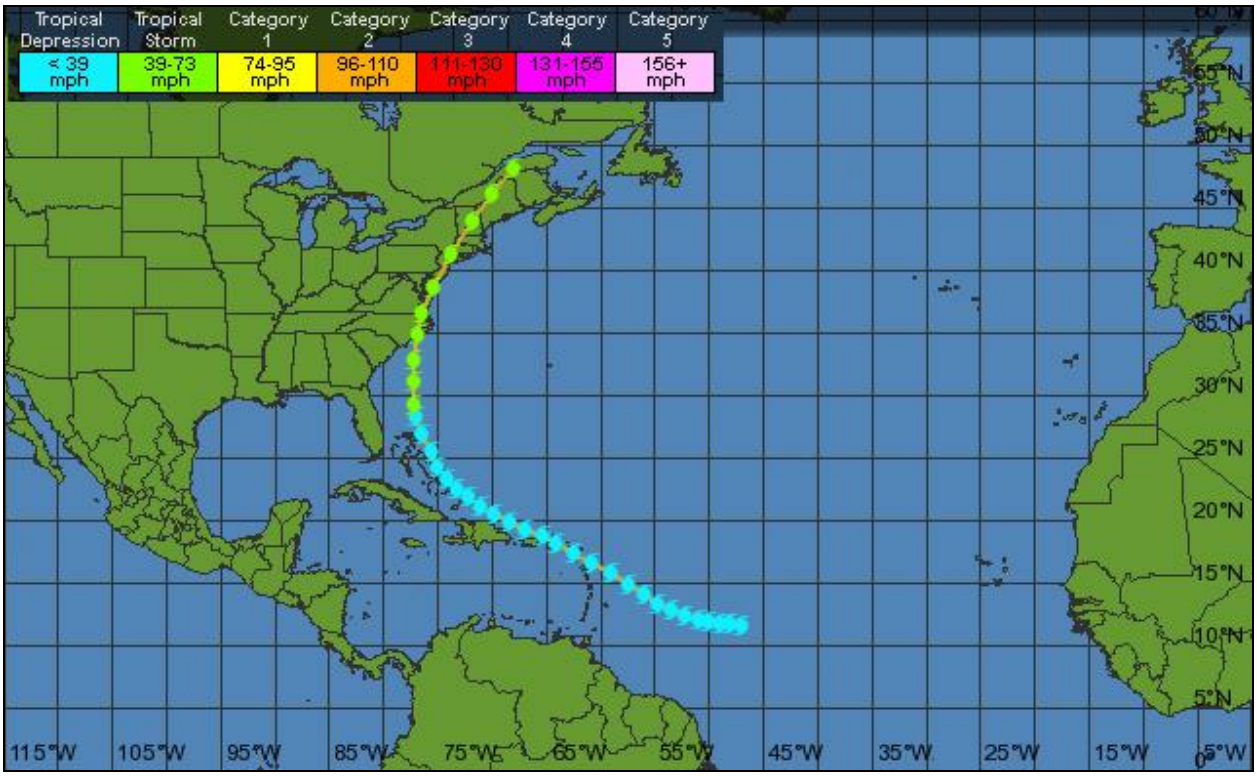
(2) Property Damage and Crop Damage amounts have been adjusted to 2010 inflation amounts using the average Consumer Price Index from the U.S. Department of Labor's Bureau of Labor Statistics.

Figure 3.3.6-1: Hurricane Donna Track and Radar Image, September 1960



Source: NOAA.

Figure 3.3.6-2: Tropical Storm Doria Track, August 1971



Source: NOAA.

Nor'easters are not a separate category in the NCDC or SHELDUS databases, but upon cross-referencing a list of known significant nor'easters against the significant winter weather events and wind events in the database, it was determined that the blizzard of 1996 was a nor'easter with significant impacts. See Section 3.3 and Figure 3.3.10-2 for further information regarding this event. On February 14-19, 2003, another nor'easter known as the "Presidents' Day Storm II", hit Warren County and had significant impacts. It is unclear if any of the damages reported for Warren County were due to wind damage.

According to the SHELDUS and NCDC databases, an additional 70 straight line wind events that caused damages in Warren County occurred between 1960 and 2010. These were caused by straight line high wind damage associated with thunderstorms and other severe storms.

Based on the occurrence of four significant hurricane/tropical storm wind events, two nor'easter wind events, and seventy other wind-related events in fifty years, the probability of future loss-causing straight line high wind events in Warren County is above 100% likelihood per year.

Location and Extent of the High Wind – Straight Line Winds Hazard

The entire county has approximately the same risk for occurrence of straight line high wind events. They can occur at any location within Warren County, although weather patterns will affect where the severity is the greatest. As cyclonic storms come inland, they begin to lose some of their intensity; however this does not lessen the effects for one part of the county as opposed to another.

Impact on Life and Property of the High Wind – Straight Line Winds Hazard

Wind events can create windblown debris that become damage-causing missiles, cause failure of structures, and cause destruction of infrastructure including utility lines and bridges. Trees are often uprooted in severe winds and after acting as missiles, become debris that must be dealt with before access to some areas and repair work can commence.

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been four hurricane/tropical storm events as summarized in Table 3.3.6-3. These four events may have caused 1 death and 1 injury, and totaled $12,858,770 in property damages and $1,445,265 in crop damages in 2010 currency. Again, it is important to note that these damages may be due more to flooding than to winds. In Warren County, the two previously mentioned nor'easters caused 1 death and 1 potential injury, and approximately $3.187 million in property damages in adjusted for 2010 values. However, these losses are mostly attributed to the high snowfall during these two nor'easters, and the true amount of wind damage is unknown.

The additional seventy other wind-related storms (including Hurricane Floyd) that caused losses in Warren County caused an estimated 9 or 10 deaths, 1 potential injury, $1,738,824 in property damages, and $167 in crop damage, based on 2010 inflation values. These losses may be most reflective of true wind losses in Warren County as opposed to the cyclone event losses that are a combination of wind and precipitation losses.

Prioritization and Rationale of the High Wind – Straight Line Winds Hazard

Since the probability of future significant straight line high wind events in the county is greater than 100%, this is considered 'highly likely' for an index value of 4. Based on previous occurrences, the magnitude or severity for anticipated tornado hazard impacts is considered 'catastrophic' due to the previous multiple deaths, injuries, and property damages for an index value of 4. The warning time for a straight line high wind event can vary depending on the type of event, with cyclonic events prompting a warning from NOAA's National Hurricane Center in advance, but thunderstorms may have less lead time. The issued warnings often change as a storm approaches, therefore the category of "12 to 24 hours warning time before an event occurs" for an index value of 2 will be used. The duration of the event can also vary, but generally the "event lasts less than 1 day" for an index value of 2.

Table 3.3.6-4: CPRI for Degree of Risk for High Wind – Straight Line Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
4 x .45	+	4 x .30	+	2 x .15	+	2 x .10	=	3.5

As documented by previous reports, many straight line high winds have occurred in Warren County over the past fifty years. Based on past events, straight line high wind events will continue to occur in Warren County and cause significant losses. For these reasons, straight line high winds will be analyzed in further detail in Section 3.4 of this Plan.

3.3.7 High Wind – Tornado

Description of the High Wind – Tornado Hazard

Tornadoes are defined as violently rotating columns of air extending from thunderstorms down to the ground. Tornadoes are unpredictable and can occur at any time of day or night, and at any season throughout the year. The Fujita Tornado Scale (F-Scale) was introduced in 1971, and is a damage scale (not a wind speed scale) that categorizes each tornado by intensity and area.[26] The F-Scale categories range from low intensity F0 with estimated wind speeds of 40 to 72 miles per hour up to F5 with estimated wind speeds of over 260 miles per hour. In 2007, the Enhanced Fujita Scale (EF-Scale) was introduced, and although it relates to the original Fujita Scale, it is more complex and has different wind speed ranges associated with the classifications. To determine an EF rating, begin with the 28 Damage Indicators, then determine the Degree of Damage (DOD), and based on the DOD, each category is given an expected estimate of wind speed.[27]

Table 3.3.7-1: F-Scale and EF-Scale Wind Speed Range Comparison

F-Scale			EF-Scale	
F-Scale	Fastest ¼-mile Wind Speeds (mph)	3-Second Gust Speed (mph)	EF-Scale	3-Second Gust Speed (mph)
F0	40 - 72	45 - 78	EF0	65 - 85
F1	73 - 112	79 - 117	EF1	86 - 109
F2	113 – 157	118 – 161	EF2	110 – 137
F3	158 207	162 – 209	EF3	138 – 167
F4	208 – 260	210 – 261	EF4	168 – 199
F5	261 – 318	262 – 317	EF5	200 - 234

Source: Wind Science and Engineering Center at Texas Tech University and NOAA/National Weather Service.

[26] "Proposed Characterization of Tornadoes and Hurricanes by Area and Intensity" (Feb, 1971). Dr. T. Fujita
[27] NOAA from http://www.spc.noaa.gov/efscale/

Occurrences and Probability of the High Wind – Tornado Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1957 there has been one tornado in Warren County that has resulted in losses.

Table 3.3.7-2: Significant Tornado Events, Warren County, 1960 - 2010

Location	Date	Type	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Warren	11/19/1957	Tornado	F1	0	0	$1,915,507	$0

Source: SHELDUS 7.0, NCDC, and NOAA's NWS Storm Prediction Center GIS data

Notes:

(7) Property Damage and Crop Damage amounts have been adjusted to 2010 inflation amounts using the average Consumer Price Index from the U.S. Department of Labor's Bureau of Labor Statistics.

Figure 3.3.7-1 is based on USGS data, and shows where previous tornadoes have occurred in Warren County from 1950 to 2009. Not all events have known tracks, so touchdown points are used for an approximation of where the tornado occurred.

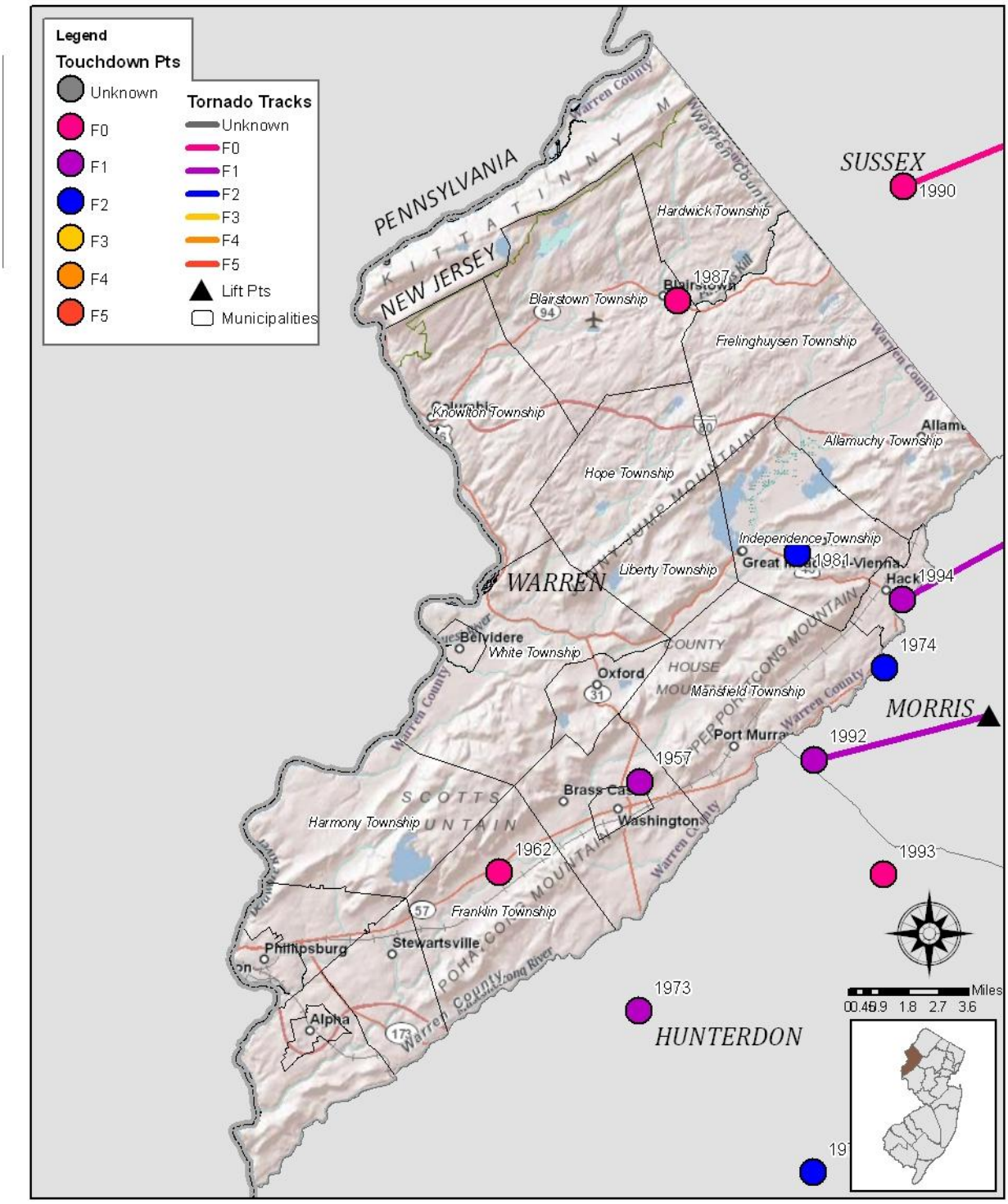
According to NOAA's National Severe Storms Laboratory (NSSL), Warren County had between 0.6 and 0.8 tornado days per year for any tornado, regardless of strength, and approximately five days per century for significant tornadoes (F2 or greater).[28] Based on the occurrence of one significant event in fifty-three years, the probability of future loss-causing tornado events in Warren County is about 2% likelihood per year.

Location and Extent of the High Wind – Tornado Hazard

The entire county has approximately the same risk for occurrence of tornadoes. They can occur at any location within Warren County, although tornado events tend to occur more frequently in flatter terrain. See Figure 3.3.7-1 for an overview of the county's terrain. Tornado paths can range from 100 yards to a mile wide and are usually less than 15 miles long. The most severe recorded tornado event to occur in the county was an F1 in 1957, which is associated with 'moderate damage' and estimated wind speeds of 73 to 112 miles per hour.

[28] NOAA NSSL. Retrieved from http://www.nssl.noaa.gov/primer/tornado/tor_hazardgraph.html

Figure 3.3.7-1: Tornado Events, Warren County, 1950 - 2010



Source: NOAA. GIS data retrieved from http://www.spc.ncep.noaa.gov/gis/svrgis/

Impact on Life and Property of the High Wind – Tornado Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there has been one tornado event within Warren County that has resulted in losses. There have been no documented deaths or injuries due to tornadoes during this time in the county, and the estimated amount of total property damages is nearly $1.916 million in 2010 currency. When the event occurred in 1957, damages were estimated at $250,000 but inflation increases this number dramatically. A wind velocity of 200 miles per hour will result in a wind pressure of 102.4 pounds per square foot of surface area; a load that exceeds the tolerance limits of most buildings and cause high amounts of property damage. According to reports, Warren County has not experienced a F3 or higher tornado.

The National Weather Service tries to provide accurate and timely warnings for tornadoes to reduce the loss of life and property. However, it is difficult to ensure the public knows how to react and find shelter to a tornado, particularly when tornadoes are such rare events in the county that can occur at any time of year. According to a recent study by National Severe Storms Laboratory Research Meteorologist Dr. Harold Brooks, violent tornadoes rated F4 or higher are responsible for 67% of the total deaths from 1921 to 1995.[29] The most severe recorded tornado in Warren County was only an F1. The most vulnerable population in the path of tornadoes are residents of manufactured or mobile homes. According to the 2000 Census, Warren County has 467 manufactured housing units, with an average household size of 2.61 for an estimated 1,219 people at higher risk.[30]

Prioritization and Rationale of the High Wind – Tornado Hazard

Since the probability of future significant tornadoes in the county is just under 2%, this is considered 'unlikely' for an index value of 1. Based on previous occurrences, the magnitude or severity for anticipated tornado hazard impacts is considered 'negligible' because although the property damage seems high, there have been no deaths or injuries reported for an index value of 1. The warning time for a tornado is "less than 6 hours warning time before an event occurs" for an index value of 4. Tornadoes begin and end relatively quickly, therefore they would fall into "the event lasts less than 6 hours" classification for an index value of 1.

Table 3.3.7-3: CPRI for Degree of Risk for Tornado Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	1 x .30	+	4 x .15	+	1 x .10	=	1.45

Although tornadoes can occur in Warren County, as documented by historical reports, there have been no previously recorded deaths or injuries, and the likelihood of a severe tornado event occurring is relatively unlikely. The most severe recorded tornado in Warren County was only an F1. For these reasons, tornadoes will not be studied in further detail in this Plan.

[29] NOAA. Retrieved from http://www.oar.noaa.gov/spotlite/archive/spot_climatology.html
[30] Bureau of the Census. Retrieved from http://factfinder.census.gov

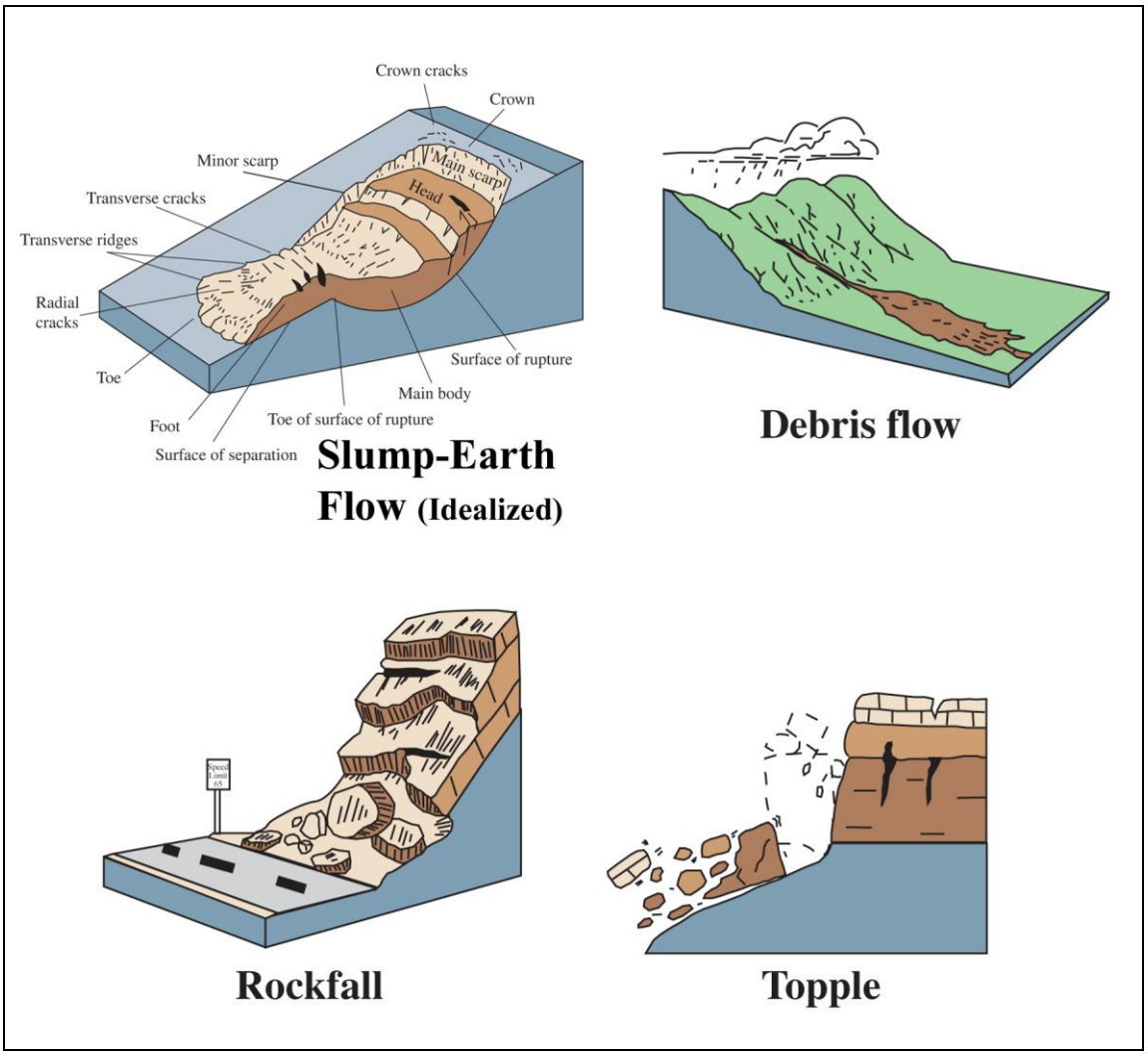
3.3.8 Landslide (Non-Seismic)

Description of the Landslide Hazard

A landslide is defined as "the movement of a mass of rock, debris, or earth down a slope"[31]. The term 'landslide' includes events such as rock falls, slides, topples, spreads, and flows. A debris flow is a form of rapid mass movement in which a combination of loose soil, rock, organic matter, air, and water mobilize as slurry that flows down slope.[32] Landslides are more likely on certain combinations of soil, moisture, angle of slope, and following wildfires. They may occur suddenly or in slow gradual slides. They can be triggered by rains, floods, earthquakes, and other natural causes as well as man-made causes such as grading, terrain cutting and filling, reservoir draw-downs and excessive development. This section does not include earthquake caused landslides; see Sections 3.3.3 and 4.3.2 for a further discussion on earthquake-related landslides. The U.S. Geological Survey National Landslide Hazards Program (NLHP) conducts research and provides public products to try to reduce long-term losses from landslides.

[31] Cruden, D.M., 1991. A Simple Definition of a Landslide. Bulletin of the International Association of Engineering Geology, No. 43, pp. 27-29
[32] USGS Fact Sheet 2004-3072 Landslide Types and Processes retrieved from http://pubs.usgs.gov/fs/2004/3072/

Figure 3.3.8-1: Examples of Common Types of Landslides



Source: USGS Fact Sheet 2004-3072 *Landslide Types and Processes* Retrieved from http://pubs.usgs.gov/fs/2004/3072/

Occurrence and Future Probability of Landslide Hazard

NJDEP's NJ Geological Survey maintains a dataset for landslides in the State, with 171 locations to date. Table 3.3.8-1 and Figure 3.3.8-2 provide a summary of events in Warren County that caused damages or had unknown impacts.

Table 3.3.8-1: Landslide Events with Damages or Unknown Severity, Warren County, 1782 - 2009

Location	Date	Type	Trigger	Description	Deaths	Injuries	Property Damage
Knowlton Township	07/1887	Debris Flow	Heavy Rain/ Poor Drainage	Two people killed and railroad tracks damaged by a debris flow after heavy rains near Manunka Chunk Mountain	2	0	Yes
Alpha Borough	04/1915	Rockslide	Quarrying	A quarry worker at the Vulcanite Cement Works was killed by a slide of rock.	1	0	No
Mansfield Township	06/1925	Debris Flow	Heavy Rain	Passenger train derailed after hitting landslide material on railroad tracks caused by heavy rain. The train exploded causing death and injuries.	50	38	Yes
Oxford	07/1929	Rockslide	Quarrying	A rockslide killed one worker and injured five others at the Edison Portland cement quarry.	1	5	No
Frelinghuysen Township	1942	Rockslide	Weathering	Rockslide blocked the main rail line near Johnsonburg train station, track eventually redug and rerouted.	0	0	Yes
Phillipsburg	07/1945	Debris Flow	Heavy Rain/ Poor Drainage	Four people died when their apartment was destroyed by a debris flow after a retaining wall collapsed during heavy rain.	4	0	Yes
Liberty Township	08/1955	Debris Flow	Heavy Rain	Heavy rain from Hurricane Diane triggered a debris flow on Rt. 46 just west of Great Meadows, closing Rt. 46	0	0	Yes
Knowlton Township	08/1967	Rockfall	Heavy Rain	A rockslide after heavy rain blocked part of Rt. 46 near the Delaware River.	0	0	Unknown
Hardwick Township	1982	Rockfall	Weathering	Roadway damage from rockfall.	0	0	Yes
Hardwick Township	1999	Rockfall	Heavy Rain	Landslide partially blocked road.	0	0	Yes

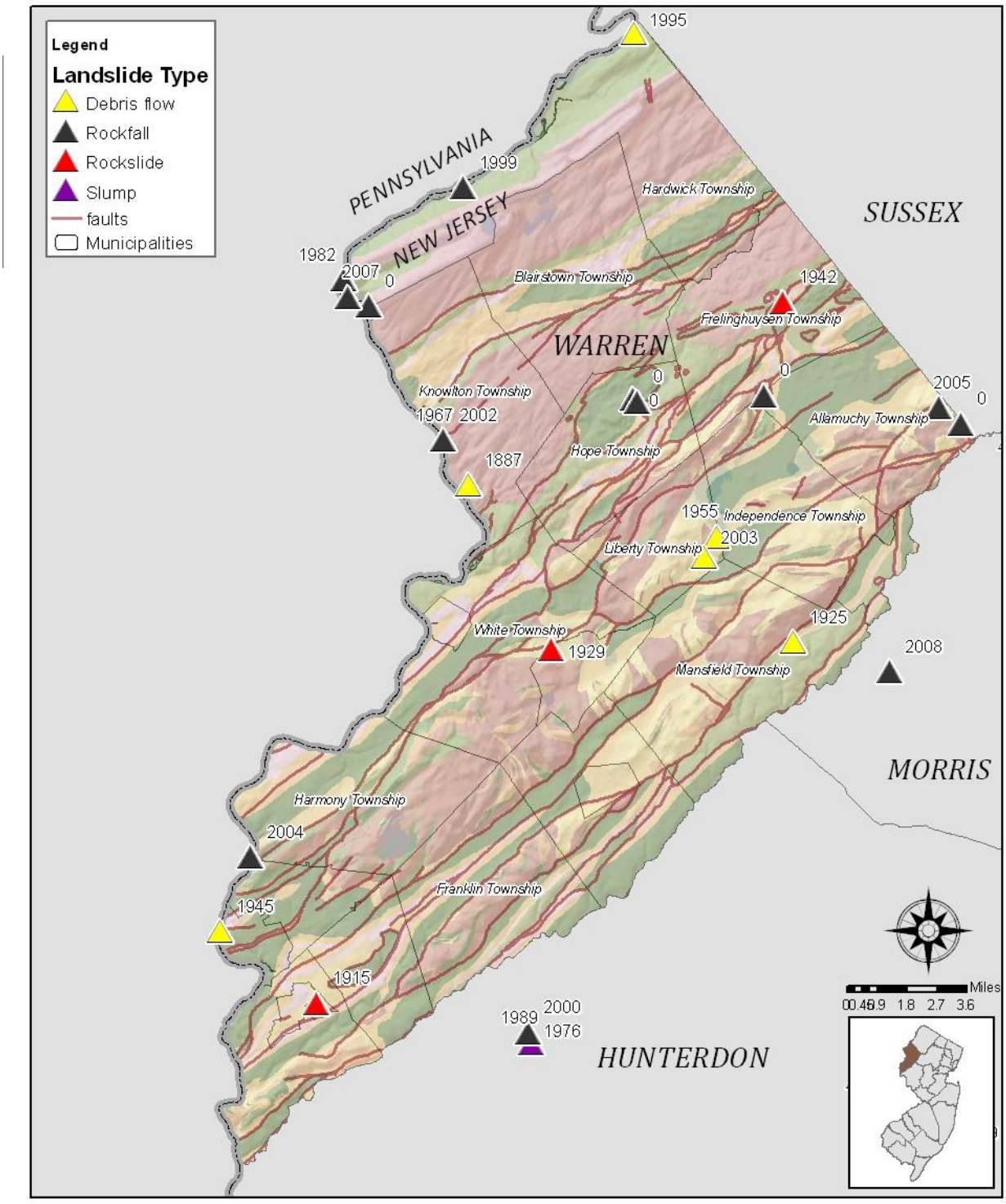
Location	Date	Type	Trigger	Description	Deaths	Injuries	Property Damage
Liberty Township	11/2003	Debris Flow	Heavy Rain	A 5' high by 75' wide wall of mud, debris and trees slid onto Rt. 46 after heavy rain, road closed for repairs, 20 yards of guardrail destroyed.	0	0	Yes
Knowlton Township	04/2007	Rockfall	Heavy Rain	A car was damaged when it ran into a landslide as it fell onto Rt. 80 westbound near the Delaware River after heavy rain, Rt. 80 westbound closed.	0	0	Yes

Source: NJDEP Landslide GIS Data retrieved from http://www.nj.gov/dep/njgs/geodata/dgs06-3.htm

Notes:

(1) There were nine other Warren County events in the database, but these reportedly caused no damage.

Figure 3.3.8-2: Reported Warren County Landslides



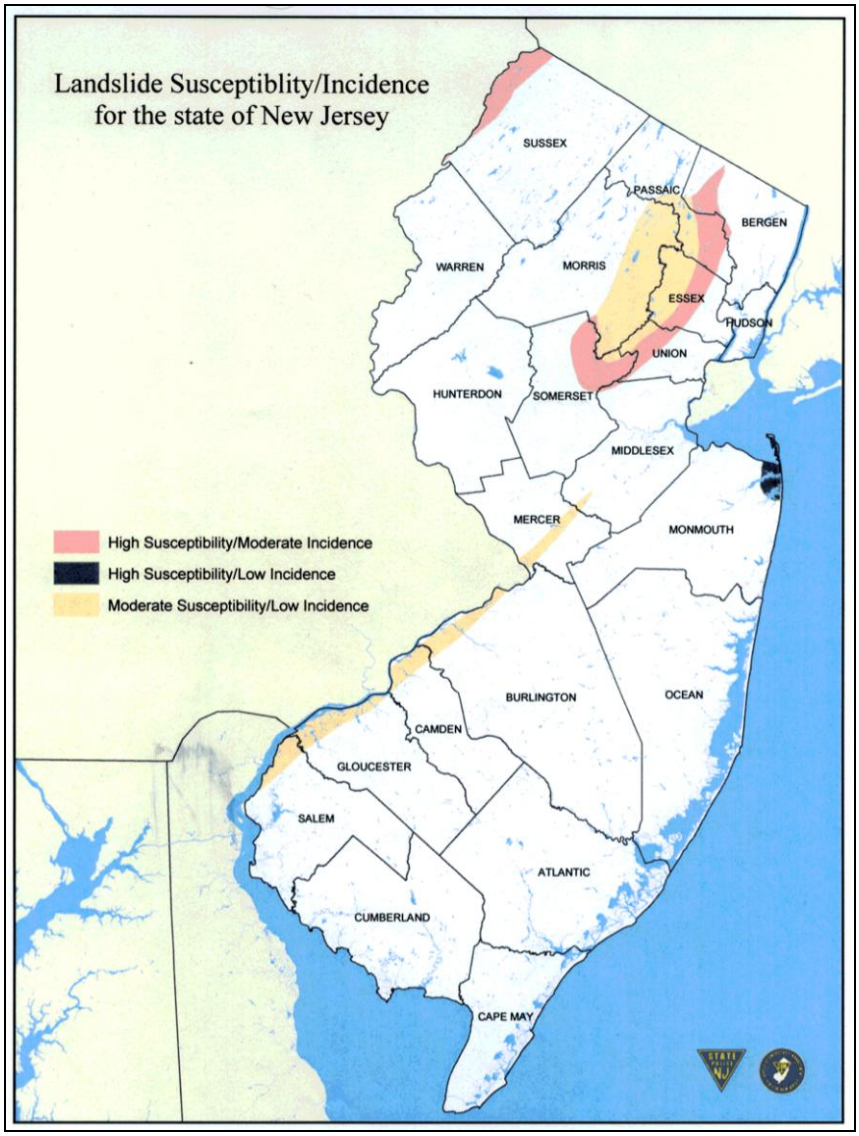
Source: NJDEP Landslide GIS Data retrieved from http://www.nj.gov/dep/njgs/geodata/dgs06-3.htm

Based on the occurrence of twelve landslide events that potentially caused damage in one-hundred twenty-three years, the probability of future landslide events Warren County is 10% likelihood per year.

Location and Extent of Landslide Hazard

According to USGS and NJGS, Warren County overall has a low susceptibility of landslide incidence. However, some areas may be more or less prone to landslides based on geology, man-made alterations of the area, and soil moisture. Detailed landslide susceptibility maps were created for northern New Jersey Counties as part of a NJDEP NJGS study, but Warren was not part of the study.

Figure 3.3.8-3: New Jersey Landslide Susceptibility/Incidence



Source: NJDEP NJGS

Impact on Life and Property of the Landslide Hazard

Landslides have caused a significant number of deaths in the past, a total of 58 and 43 injuries. However, most were due to landslides interfering with train tracks or due to quarrying triggered events, with the last deaths occurring in 1945. The event in 1945 killed four people in their apartment after a retaining wall collapsed due to heavy rains. Some New Jersey communities have made attempts to mitigate landslide hazards through building codes. The events since 1945 have involved damage to infrastructure, particularly roads. Estimates for damages are not available, but an example of the type of damage an event can cause is shown in Figure 3.3.8-4.

Figure 3.3.8-4: October 1995 Debris Flow in Hardwick Township After Heavy Rains

Source: NJDEP NJGS New Jersey Landslides Information Circular, pg3, photograph by R. Witte, NJGS. Retrieved from http://www.state.nj.us/dep/njgs/enviroed/infocirc/landslides.pdf

Prioritization and Rationale of the Landslide Hazard

Since the probability of future significant landslides in the county is 10%, this is considered 'unlikely' for an index value of 1. Due to the large number of deaths and injuries before 1945 that were caused by landslides in the county, the magnitude or severity for anticipated landslide hazard impacts can be considered 'catastrophic', for an index value of 4. The warning time for a landslide is usually "less than 6 hours" for an index value of 1; although USGS does have a list of landslide warning signs on their website, such as soil moving away from foundations, sunken or down-dropped road beds, sudden decrease in creek water levels, a faint rumbling sound that increases, and more at http://landslides.usgs.gov/learning/prepare/index.php Landslides generally last for "less than 6 hours", so the index value would be 1.

Table 3.3.8-2: CPRI for Degree of Risk for Landslide Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	4 x .30	+	4 x .15	+	1 x .10	=	2.35

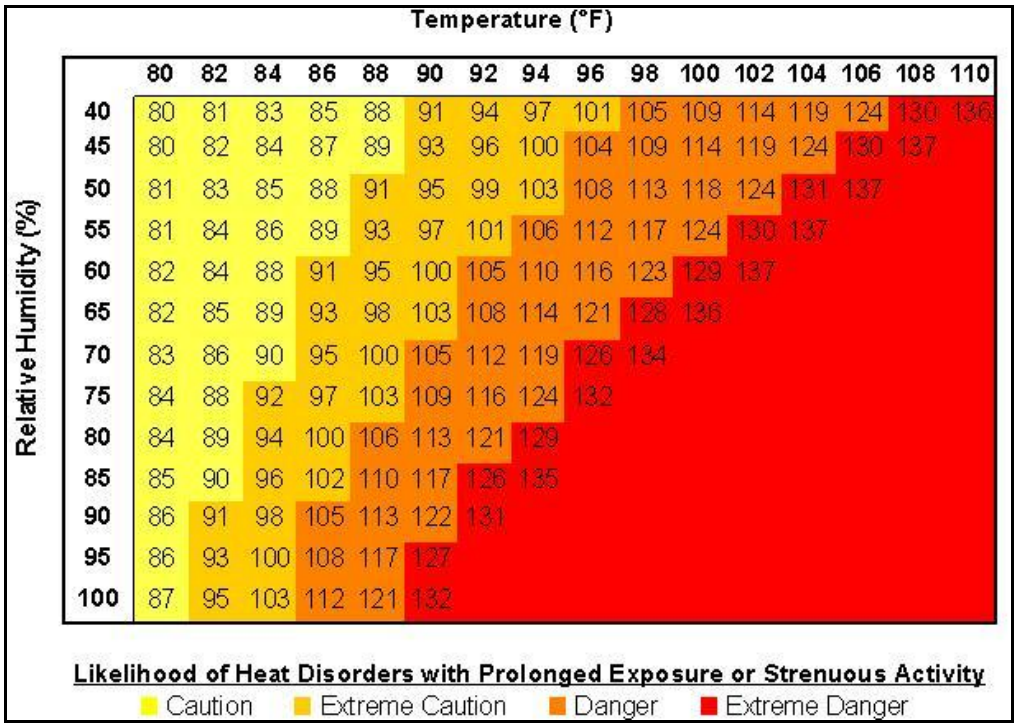
Although Warren County is in a Low Susceptibility/Incidence area for landslides, there have been many previous deaths, injuries, and property damages due to landslides in Warren County over the past 123 years. For these reasons, non-seismic landslides will be studied in further detail in this Plan.

3.3.9 Severe Weather – Summer

Description of the Severe Weather – Summer Hazard

In the northeastern United States, periods of hotter than normal temperatures, often with high levels of humidity, can occur in the summer. These extreme temperature events can last a day to a week or longer. It is usually considered a heat wave in this area when the temperature rises above 100 degrees Fahrenheit, accompanied by high humidity. NOAA's National Weather Service (NWS) has created the Heat Index (HI) that combines relative humidity and actual air temperature to try to accurately measure how hot the air feels to the human body, and then demonstrate the potential health effects.

Figure 3.3.9-1: NOAA's National Weather Heat Index



Source: NOAA. Retrieved from http://www.weather.gov/om/heat/heatindex.shtml

Occurrence and Future Probability of Severe Weather – Summer Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been five extreme heat events within Warren County that resulted in losses.

Table 3.3.9-1: Significant Severe Summer Weather Events, Warren County, 1960 - 2010

Location	Date	Type	Deaths	Injuries	Property Damage	Crop Damage
Warren	7/4/1993	Heat Wave	0	0.08	$0	$0
Warren	7/1/1995	Unseasonably Warm	0	0	$0	$0
Warren	8/1/1995	Unseasonably Warm	0	0	$0	$0
Warren	7/19/1997	Excessive Heat	1.56*	0	$0	$0
Warren	8/1/2006	Excessive Heat	2.73	0	$0	$0

Source: SHELDUS 7.0 and NCDC

Notes:

(1) All efforts were made to research the actual location of deaths and injuries associated with a specific event, however when a specific county could not be determined then the number of deaths or injuries were divided by the number of counties associated with that event according to NCDC. This is the methodology utilized by SHELDUS 7.0. This can cause fractions of deaths or injuries associated with a specific county for an event.

(2) The 1997 excessive heat wave was listed as 1.56 deaths for Warren County in SHELDUS, however this same event had zero deaths in NCDC (with 25 injuries), so the source of this number is unclear.

Based on the occurrence of five significant events in fifty years, the probability of future loss-causing heat events in Warren County is 10% likelihood per year.

Location and Extent of Severe Weather – Summer Hazard

The entire county has approximately the same risk for severe summer weather. Generally, heat waves are regional phenomena, but pockets of extreme heat can exist based on elevation and pressure system patterns. Climate change may or may not influence the severity of heat waves in the area in the future.

Impact on Life and Property of the Severe Weather – Summer Hazard

Heat waves can cause deaths, injuries, wide-spread power outages, and damage such as road buckling. According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been five extreme heat temperature events in Warren County that have resulted in losses. There have been approximately 2 to 4 deaths and 1 injury in the county. From July 4, 1999 to July 6, 1999 there was a serious heat wave in New Jersey that caused 17 deaths and 160 injuries in neighboring counties. According to NOAA's NWS, on average, heat kills more Americans than any other natural hazard except extreme cold temperatures.[33] NWS has increased its efforts to alert the public and authorities to the hazards of heat waves, and communities have implemented cooling centers during some events to reduce the loss of life.

[33] NOAA NWS. Retrieved from http://www.weather.gov/os/brochures/heat_wave.shtml

Prioritization and Rationale of the Severe Weather – Summer Hazard

Since the probability of future significant heat waves in the county is 10%, this is considered 'unlikely' for an index value of 1. The magnitude or severity for anticipated heat wave hazard impacts could be 'catastrophic' since multiple deaths have occurred in the past for an index value of 4. The warning time for severe summer weather is usually "at least 24 hours before an event occurs" for an index value of 1. Heat waves can usually last more than a day but less than a week, so the index value would be 3.

Table 3.3.9-2: CPRI for Degree of Risk for Severe Weather – Summer Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	4 x .30	+	1 x .15	+	3 x .10	=	2.1

Summer severe weather events can cause serious harm to people. However, it is unclear if the previous deaths and injuries occurred in Warren County or elsewhere in the state. Based on past events, the likelihood of a significant heat wave event occurring is unlikely in Warren County. For these reasons, the severe summer weather hazard will not be examined in further detail in this Plan.

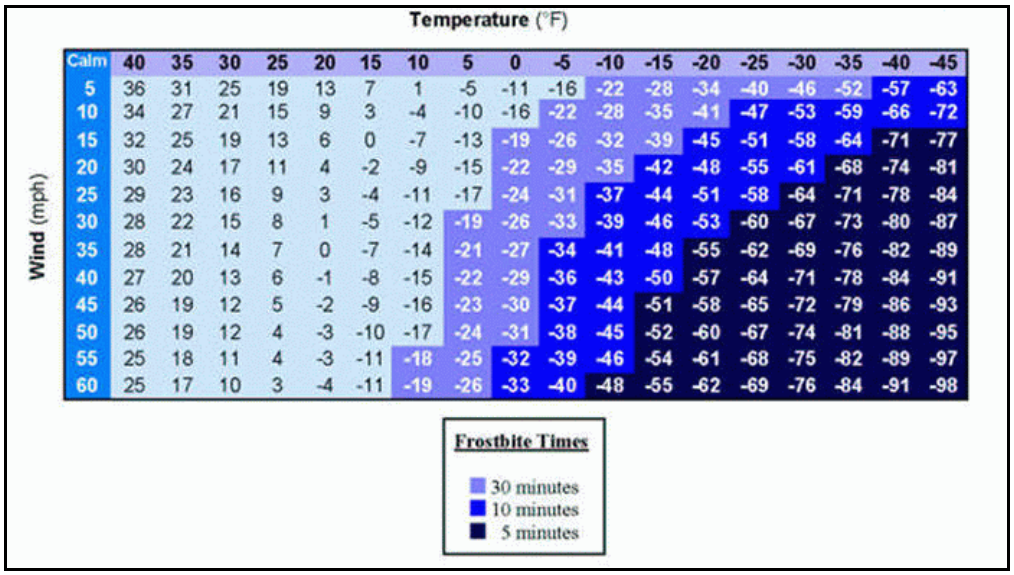
3.3.10 Severe Weather – Winter

Description of the Severe Weather – Winter Hazard

Severe winter weather may include one or more of the following: snowstorms, blizzards, sleet, freezing rain, ice storms, and extreme cold temperatures. Extreme cold temperatures are characterized by the ambient air temperature dropping to approximately 0 degrees Fahrenheit or below. Significant snowstorms are characterized by a rapid accumulation of snow, while a blizzard is categorized as a snowstorm with winds of 35 miles per hour or greater and/or visibility of less than ¼ mile for three or more hours. Many of these types of storms can immobilize a region, cause treacherous roadways, power usage spikes, and property damage or collapse. Although there is no widely used scale to classify snowstorms, the National Weather Service (NWS) developed the Northeast Snowfall Impact Scale (NESIS). NESIS classifies high impact Northeast snowstorms that have large areas of 10 inch snowfall accumulations or more. The index utilizes population information in addition to meteorological measurements for an indication of the storm's impacts on society. The five categories are: Extreme (5), Crippling (4), Major (3), Significant (2), and Notable (1). NOAA's National Weather Service (NWS) in cooperation with a team of universities and other agencies developed the current wind chill temperature index (WCT) formula in 2001.[34] WCT uses wind speed at 5 feet (the average height of a human's face), incorporates heat loss from the body, is based on a human face model, utilizes 3 miles per hour as the calm wind threshold, uses a consistent standard for skin tissue resistance and assumes a clear night sky for solar radiation.

[34] NOAA. Retrieved from http://www.crh.noaa.gov/lsx/?n=winterday

Figure 3.3.10-1: Wind Chill Temperature Index



Source: NOAA. Retrieved from http://www.crh.noaa.gov/lsx/?n=winterday

Occurrence and Future Probability of Severe Weather – Winter Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been forty-one severe winter weather events within Warren County that resulted in losses. Table 3.3.10-1 lists the eighteen winter weather events with reported bodily harm in Warren County.

Table 3.3.10-1: Severe Winter Weather Events with Reported Deaths and/or Injuries, Warren County, 1960 - 2010

Location	Date	Type	NESIS Category	Deaths	Injuries	Property Damage	Crop Damage
Warren	2/13/1960	Glaze, Sleet, Snow	-	2.38	0.33	$1,791	$0
Warren	2/19/1960	Snow, High Winds	-	0	0.1	$17,909	$0
Warren	3/3/1960	Snow	5	2.86	0.43	$1	$17,909
Warren	12/11/1960	Snow, Strong Winds	-	0	2.48	$17,909	$0
Warren	1/19/1961	Heavy Snow, Strong Winds	3	0	0.05	$17,909	$0
Warren	1/12/1964	Heavy Snowstorms	4	0	0.1	$16,715	$0
Warren	12/16/1973	Snow, Sleet, Freezing Rain	-	0.38	0.14	$119,398	$0
Warren	1/3/1974	Snow and Ice	-	0.1	0	$10	$0
Warren	1/9/1974	Snow and Ice	-	1.48	0	$10	$0
Warren	3/29/1974	Snow, Wind	-	1.5	0	$0	$0
Warren	4/10/1974	Snow and Ice	-	0.13	0.13	$0	$0
Warren	12/28/1976	Snow	-	0	0.05	$0	$0

Location	Date	Type	NESIS Category	Deaths	Injuries	Property Damage	Crop Damage
Warren	1/19/1978	Snow	4	0	0.1	$0	$0
Warren	1/7/1996	Blizzard (DR-1088)*	5	0	0.23	$2,003,817	$0
Warren	1/13/1999	Winter Storm	-	3.13	0	$0	$0
Warren	1/14/2003	Winter Weather	-	0.44	0	$0	$0
Warren	2/16/2003	Winter Weather (DR-3181)*	4	1	0.13	$1,183,225	$0
Warren	12/24/2008	Winter Weather	-	0.08	0	$0	$0

Source: SHELDUS 7.0, NCDC, and NWS's NESIS from http://www.ncdc.noaa.gov/snow-and-ice/nesis.php?sort=nesis_asc#rankings

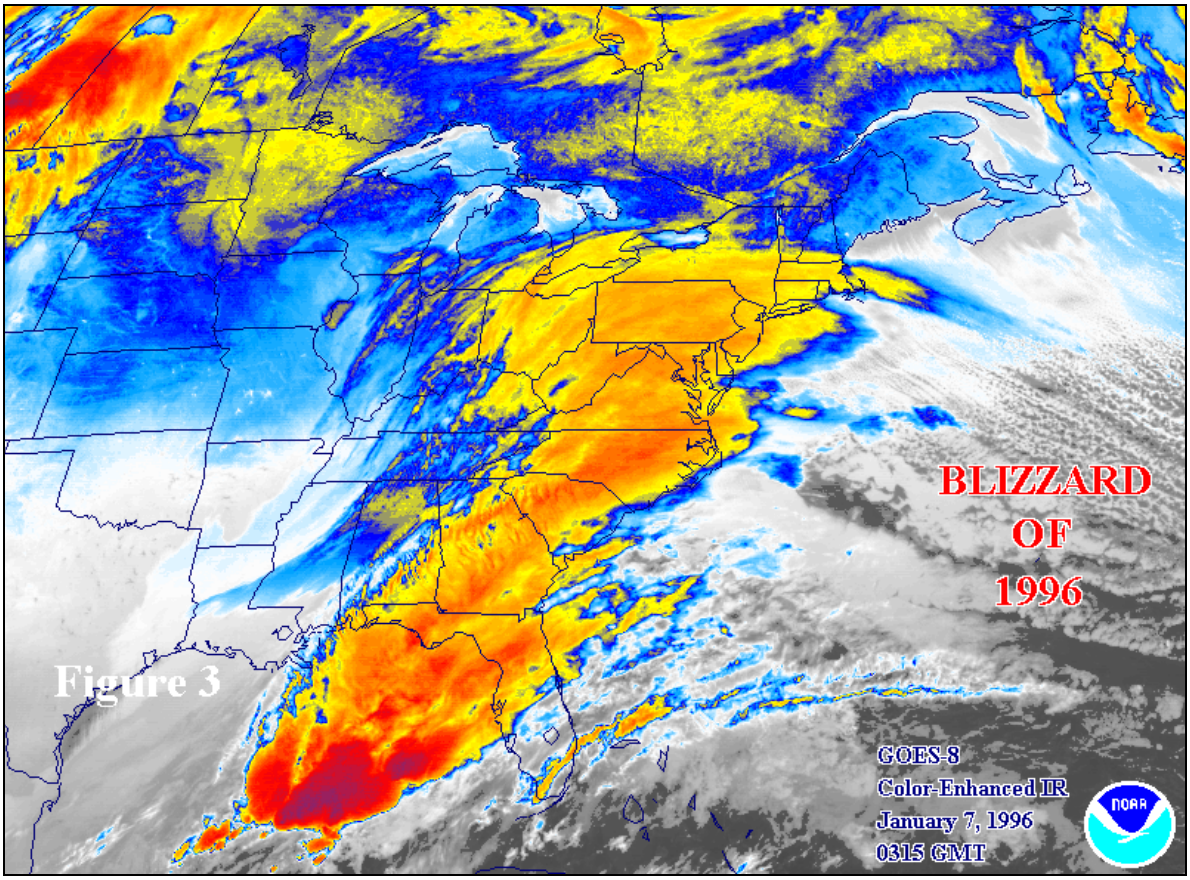
Notes:

(1) All efforts were made to research the actual location of deaths and injuries associated with a specific event, however when a specific county could not be determined then the number of deaths or injuries were divided by the number of counties associated with that event according to NCDC. This is the methodology utilized by SHELDUS 7.0. This can cause fractions of deaths or injuries associated with a specific county for an event.

(2) Events with an asterisk (DR)* denote Declared Emergencies. See Table 3.2.1-1.

The "Blizzard of 1996" was a severe nor'easter that paralyzed the eastern coast with up to 4 feet of snow. In many locations, the storm did not meet the technical definition of a blizzard, however on January 7, the Trenton-Mercer Airport recorded conditions to meet the true classification of a blizzard. A State of Emergency was declared for New Jersey and then a Presidential Disaster Declaration was issued.

Figure 3.3.10-2: Color Enhanced Infrared Satellite Image of the Blizzard on January 7, 1996



Source: NOAA. Retrieved from www.crh.noaa.gov

The winter storm that occurred from February 14-19, 2003 caused significant impacts in Warren County and received a Disaster Declaration because of the effects of heavy snow. Total snowfall in Warren County ranged from 17' to 25'.

Based on the occurrence of forty-one significant events in fifty years, the probability of future loss-causing severe winter weather events in Warren County is 82% likelihood per year.

Location and Extent of Severe Weather – Winter Hazard

The entire county has approximately the same risk for severe winter weather. However, different areas of the county may be more or less severely affected during a particular event due to elevation, terrain, precipitation levels, and weather and pressure system patterns. According to the Office of the New Jersey State Climatologist, Warren County is part of the North Climate Zone which averages 40 to 50 inches of annual snowfall.[35] These amounts can vary widely from year to year, with some winters consisting of multiple severe winter weather events, while others are very mild with little or no severe weather. The extent of winter storms varies in terms of storm location, temperature, and ice or snowfall. Extreme temperatures can also occur during the winter in Warren County, and it is difficult to predict long term patterns.

[35] Office of New Jersey State Climatologist. Retrieved from http://climate.rutgers.edu/

Climate change may or may not influence the severity of severe winter weather in the area in the future.

Impact on Life and Property of the Severe Weather – Winter Hazard

As seen in Table 3.3.10-1, severe winter weather events have potentially caused 13 to 14 deaths and 4 to 5 injuries in Warren County. The cause of death and injuries due to winter storms can be attributed to car accidents, hypothermia, exhaustion and heart attacks, frostbite, wind chill, fires, carbon monoxide poisoning, structure collapse, and electrocution. According to NOAA's NWS, on average, extreme cold temperatures kills more Americans than any other natural hazard.

During a winter storm, infrastructure can be severely impacted, including damaged roadways, utility lines and pipes, railroads, and bridges. The eighteen severe weather events that caused bodily harm also account for property damages totaling $3,378,694 in 2010 currency. According to SHELDUS and NCDC databases, in addition to these eighteen events, there have been twenty-three additional severe winter weather events that caused property damages since 1960. The most severe of the events in which no deaths or injuries occurred, was a heavy snow event on January 22, 2005 that caused the 2010 monetary equivalent of $1,760,446 in property damages. The remaining twenty-two storms with reported property damages total $1,697,488 in adjusted dollar figures for the year 2010. This puts property damage estimates at approximately $6.837 million and crop damage at $17,909 at 2010 inflation values, for all severe winter weather events since 1960 in Warren County.

Prioritization and Rationale of the Severe Weather – Winter Hazard

The probability of future significant winter weather in the county is 82%, or 'Highly Likely' for an index value of 4. The magnitude or severity for anticipated severe winter weather hazard impacts could be 'catastrophic' since multiple deaths, injuries, and hefty financial impacts have occurred in the past, for an index value of 4. The warning time for severe winter weather is usually "at least 24 hours before an event occurs" for an index value of 1. Severe winter weather usually lasts more than a day but less than a week, so the index value would be 3.

Table 3.3.10-2: CPRI for Degree of Risk for Severe Weather – Winter Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
4 x .45	+	4 x .30	+	1 x .15	+	3 x .10	=	3.45

Severe winter weather events can cause serious harm to people and property, as demonstrated by past events and impacts in Warren County. Based on past events, the likelihood of a significant winter weather event occurring in the future is very likely. For these reasons, this hazard will be examined in further detail in Section 4.

3.3.11 Wildfire

Description of the Wildfire Hazard

A wildfire is any fire that burns out of control and typically occurs in grasslands, forest, brush land, etc. Wildfire is a natural process that is important to ecosystems, and fire suppression can lead to more severe fires due to the buildup of vegetation, which creates more fuel. However, wildfires can also endanger the lives of people and destroy property when out of control. Wildfires can also cause secondary effects including erosion, landslides, introduction of invasive species, and changes in water quality. Wildfires can be caused by lightning strikes, but are most often the intentional or unintentional result of humans.

Occurrences and Probability of the Wildfire Hazard

According to the 2007 State Hazard Mitigation Plan for the State of New Jersey, Warren County had a total of 891 fire incidents that burned a total of 1,444 acres from 1996 to 2006, for an average of 81 fire incidents per year and an annual average of 131 acres.[36]

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been no wildfires that caused losses in Warren County.

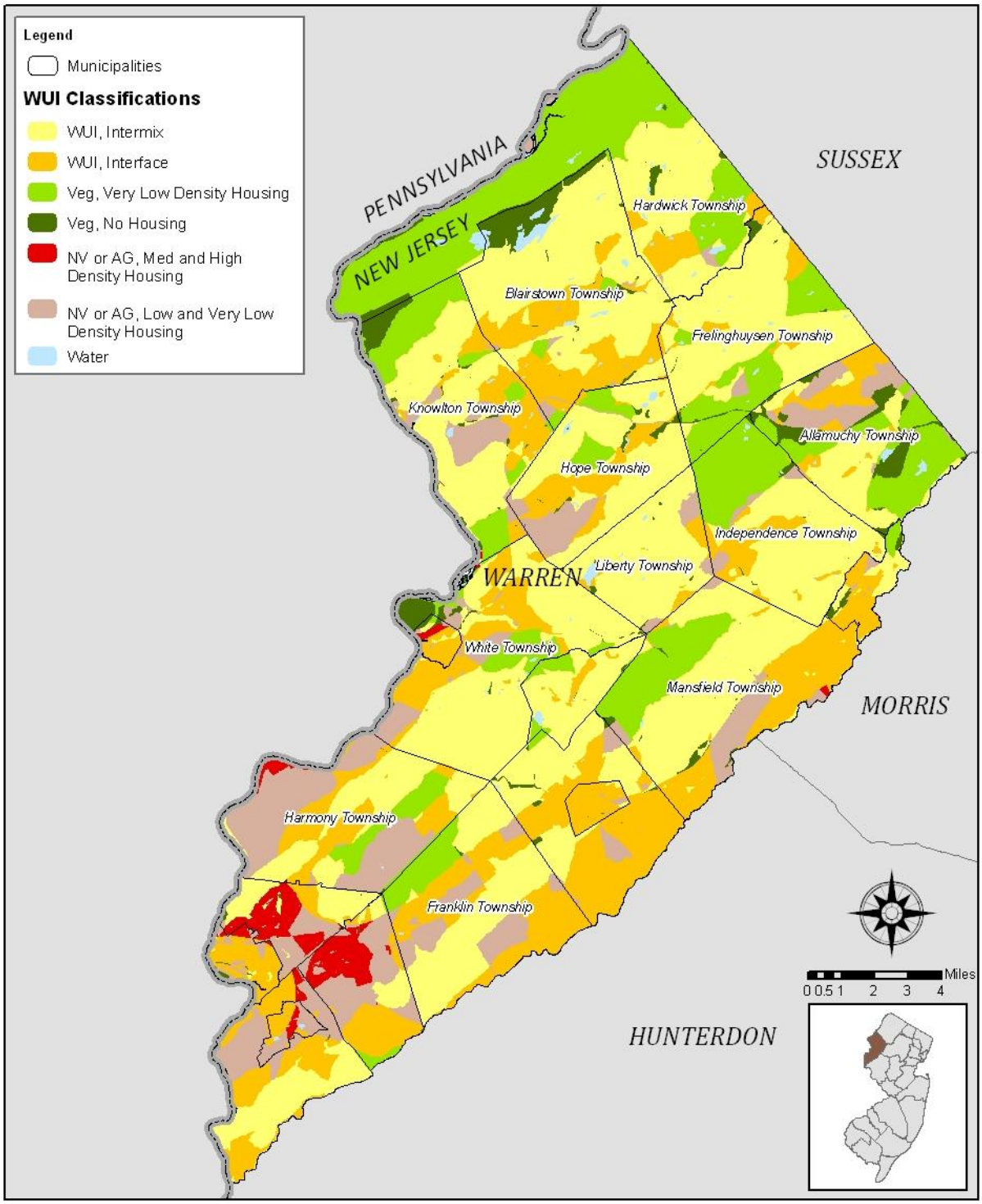
Based on the occurrence of no significant events in fifty years, the probability of future loss-causing wildfire events in Warren County is less than 1% likelihood per year.

Location and Extent of the Wildfire Hazard

When hot and dry conditions develop, forests and vegetation may become vulnerable to wildfires. Commercial and residential development near forested areas are at the highest risk of wildfire. The Wildland-Urban Interface (WUI) is where houses meet or intermingle with wildland vegetation. The WUI is where wildfires pose the greatest risk to human lives and structures. Figure 3.3.11-1 shows the extent of the WUI by census block, where the risk is the greatest in the yellow intermix and gold interface areas. Both areas must have a density of at least one structure per 40 acres. Intermix communities are places where housing and vegetation intermingle and wildland vegetation is continuous, with more than 50% vegetation. Interface communities are areas with housing in the vicinity of contiguous vegetation, within 1.5 miles of an area over 1,325 acres that is more than 75% vegetated.[37]

[36] 2007 NJ State Hazard Mitigation Plan pg 66-67.
[37] Radeloff, V. C., R. B. Hammer, S. I Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15:799-805. Retrieved from http://silvis.forest.wisc.edu/projects/WUI_Main.asp

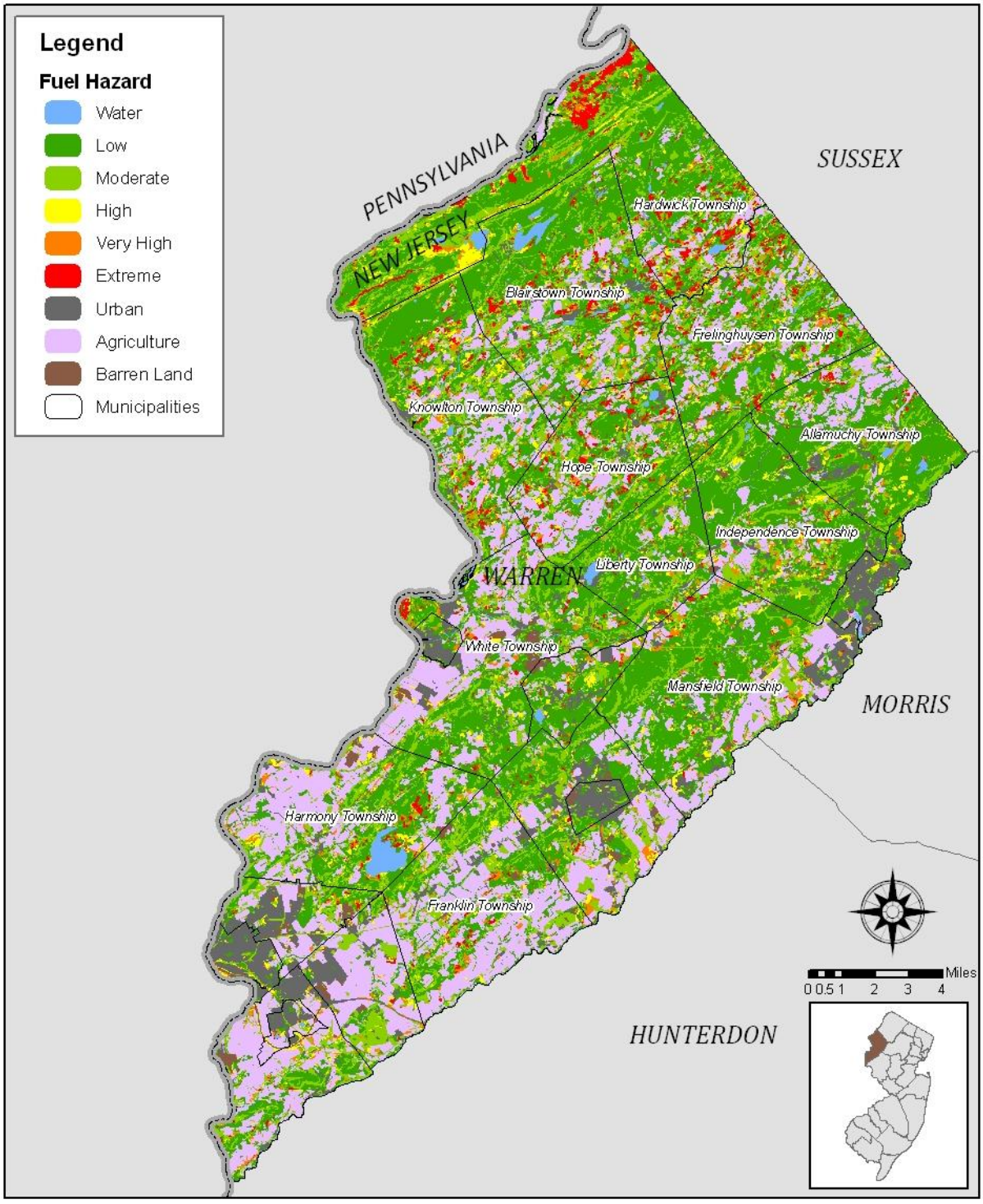
Figure 3.3.11-1: Warren County Wildland-Urban Interface 2000 Extent



Source: Radeloff, V. C., R. B. Hammer, S. I Stewart, J. S. Fried, S. S. Holcomb, and J. F. McKeefry. 2005. The Wildland Urban Interface in the United States. Ecological Applications 15:799-805. WUI 2000 GIS data retrieved from http://silvis.forest.wisc.edu/Library/WUIDefinitions.asp

Temperature, humidity, and wind affect the severity and duration of wildfires. The type and amount of fuel, in addition to its burning qualities and level of moisture, affect wildfire potential and behavior. Topography is also important because it affects the movement of air and fire over the ground. The slope and shape of terrain can change the rate of speed at which the fire travels. In May 2009, NJDEP's New Jersey Forest Fire Service released wildfire fuel hazard GIS data, shown in Figure 3.3.11-2. They incorporated land type and slope into the hazard ranking. The areas of highest wildfire fuel risk are shown in red (extreme risk), orange (very high risk), and yellow (high risk).

Figure 3.3.11-2: Warren County Wildfire Fuel Hazard Risk



Source: NJDEP's New Jersey Forest Fire Service. GIS Data retrieved from http://www.state.nj.us/dep/gis/njfh.html#HUN

Impact on Life and Property of the Wildfire Hazard

According to a comparison of the SHELDUS and NCDC databases, since 1960 there have been no wildfire events within Warren County that have resulted in losses.

Prioritization and Rationale of the Wildfire Hazard

Since the probability of future significant wildfires in the county is less than 1%, this is considered 'unlikely' for an index value of 1. Based on no previous occurrences of losses, the anticipated wildfire hazard impact is considered 'negligible' for an index value of 1. The warning time for a wildfire is "less than 6 hours warning time before an event occurs" for an index value of 4. Wildfires can last multiple days, but usually the "event lasts less than 1 week" for an index value of 3.

Table 3.3.11-1: CPRI for Degree of Risk for Wildfire Hazard in Warren County

Probability	+	Magnitude /Severity	+	Warning Time	+	Duration	=	CPRI
1 x .45	+	1 x .30	+	4 x .15	+	3 x .10	=	1.65

Although wildfires can occur in Warren County, as documented by historical reports, there have been no previously recorded deaths, injuries, or financial impacts over the past fifty years. Based on past events, the likelihood of a severe wildfire event occurring is unlikely. For these reasons, wildfires will not be studied in further detail in this Plan.

3.4 Hazard Priorities

Section 3.3 provided an overview and profiles for all of the hazards that have potential to impact Warren County in the future. However, in Section 4 the hazards of highest concern to the county will be further reviewed through detailed risk assessments.

A summary of all of the profiled hazards for Warren County is shown in Table 3.4-1. It includes the CPRI value that was compiled in the profiles, the probability of future loss-causing/significant events occurring in the county annually, overview of relevant background information, reasoning for why to include or exclude the hazard from further risk assessment in Section 4, and if it will or will not be reviewed further in this Plan. This is meant to be a brief overview of information from Section 3.3, and any further details regarding the hazards and associated information can be found there.

Table 3.4-1: Prioritization and Rationale for Further Risk Assessment for Warren County Hazards

Hazard	CPRI	Future Probability of Loss-Causing Events in County	Background	Rationale	Further Risk Assessment?
High Wind – Straight Line	3.5	100%	• 9-11 previous deaths and 1-2 injuries • At least $1.739 million in property damages	• Highly likely for loss-causing events to occur often in county • Past history of severe losses	Yes
Severe Weather - Winter	3.45	82%	• 41 severe events with 13-14 deaths and 4-5 injuries • @$3.379 million in property damages	• Previous multiple deaths and injuries and severe financial impacts • Highly likely loss-causing events will continue to occur	Yes
Flood	3	26%	• 1-2 previous deaths and 0-1 injury • @$75 million in previous property damages • Multiple severe events, three recent in 2004,2005, & 2006	• Significant event highly likely • Previous events have been significant • Will continue to severely impact county in the future	Yes
Earthquake /Geological	2.9	Possible	• 19 previous events, none significant • Studies that risk in area is higher than previously thought due to active network of faults	• Low frequency, however concerns raised based on Sykes 2007 study that lower frequency but high severity events possible in area • USGS and NJDEP possible risk with high magnitude • Event could be catastrophic with many older structures not seismically sound	Yes

Hazard	CPRI	Future Probability of Loss-Causing Events in County	Background	Rationale	Further Risk Assessment?
Landslide (non-seismic)	2.35	10%	• 12 previous events • 58 deaths, 43 injuries in past • Property damage amount unknown but significant	• All of county in Low Susceptibility/Incidence area, but multiple severe incidents over the years • 58 deaths and 43 injuries	Yes
Dam Failure	2.2	Possible	• 15 high, 7 significant, 62 low hazard dams • 0 reported dam incidents • County average dam age = 52 years old (many unknown age)	• No previously recorded events, deaths, injuries, or financial impacts • Increased inspection efforts • All high hazard dams have EAPs	Yes
Severe Weather - Summer	2.1	10%	• 5 events with possibly 2-4 deaths and 1 injury • No property damages	• Unclear if all deaths occurred in county or elsewhere in state • Likelihood is unlikely to possible	No
Wildfire	1.65	<1%	• No previous events with deaths, injuries, property, or crop damages	• No previous deaths, injuries, or damages • Very unlikely loss-causing event will occur	No
Hazardous Material Release	1.55	Unlikely	• Both transportation and on-site have occurred in past • All have been minor	• No previously reported deaths or injuries • Low previous financial impacts • Unlikely to occur	No
High Wind - Tornado	1.45	<2%	• 1 previous events • No deaths or injuries • @$1.916 million in property damages	• No deaths or injuries • Most severe previous tornado was F1 • Probability very low for future events	No
Drought	1.3	2%	• 1 previous significant event with @$6.58 million in crop damages	• No previously recorded deaths, injuries, or property damages • Unlikely for event with impacts to occur, and impacts have previously been only crop damages	No

Notes:

(2) Property Damage and Crop Damage amounts have been adjusted to 2010 inflation amounts using the average Consumer Price Index from the U.S. Department of Labor's Bureau of Labor Statistics.

(3) Sources for losses and basis for probabilities explained in Section 3.3.

As shown in Table 3.4-1, high wind – straight line, winter severe weather, floods, earthquake/geological hazards, and non-seismic landslides have been selected for further in-depth risk assessment in Section 4.

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Section 4
Risk Assessment

Contents of this Section

4.1 IFR Requirement for Risk Assessment

IFR §201.6(c)(2)(i): *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.*

IFR §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.*

IFR §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.*

IFR §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.*

IFR §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.*

IFR §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.*

4.2 Overview of Warren County's Assets and Development Trends

To better understand a community's risks, an evaluation of which assets are exposed to hazard events must be completed. The inventory of assets that should be considered includes the population, structures, and lifelines that could be impacted by hazard events. Section 3 provided brief descriptions of historical hazard impacts, the locations and extent of the hazards, and the impact on life and property due to each of the hazards. Section 4.3 goes into greater detail of the potential impacts due to dam failures, earthquake/geological, flood, high wind – straight-line winds, and severe winter weather. First, this Section will describe the county's overall inventory that could be injured, damaged, or destroyed during the occurrence of a hazard and possible future development trends. FEMA's spatial loss estimation software, HAZUS-MH, includes data for a number of inventory categories and was used as the foundation for the inventory data for this Plan. HAZUS-MH utilizes a number of data sources, including Census 2000 data, 2006 Dun & Bradstreet data, and Homeland Security Infrastructure Protection data to create the inventory database. Since this is a national inventory database, the accuracy of HAZUS-MH outputs can be improved by refining the inventory data based on local data. A significant improvement that can be made is to review and update the essential facilities data, which includes police stations, fire stations, medical facilities, emergency operation centers, and schools.

4.2.1 Population and Demographics

According to Census Bureau statistics, there was a population of 63,220 in 1960 in Warren County. This increased by 16.99% by 1970, again by 14.15% in the following decade, and by 8.50% from 1980 to 1990. According to the 2000 Census data, Warren saw an increase from 1990 to 2000 of 11.82%, for a total population of 102,437. Table 4.2.1-1 shows the population growth from 1980 to 2000 in individual municipalities. Figure 4.2.1-1 shows the population levels by municipality based on 2000 Census data.

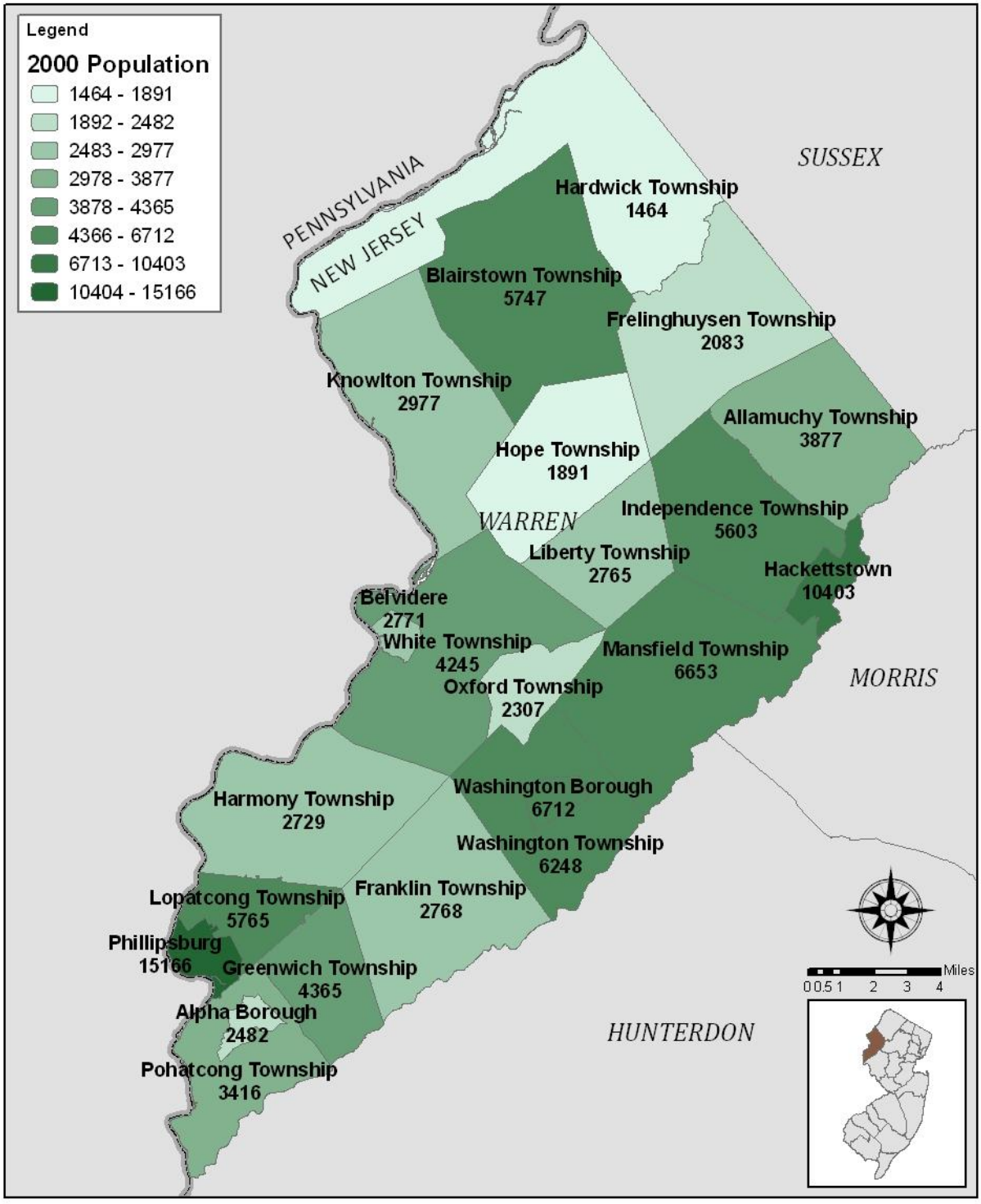
Table 4.2.1-1: Population Growth from 1980 to 2000 by Municipality in Warren County

Municipality	1980 Population	1990 Population	2000 Population	% Change from 1980 to 2000
Allamuchy Township	2,560	3,484	3,877	51.45%
Alpha Borough	2,644	2,530	2,482	-6.13%
Belvidere Town	2,475	2,669	2,771	11.96%
Blairstown Township	4,360	5,331	5,747	31.81%
Franklin Township	2,341	2,404	2,768	18.24%
Frelinghuysen Township	1,435	1,779	2,083	45.16%
Greenwich Township	1,738	1,899	4,365	151.15%
Hackettstown Town	8,850	8,120	10,403	17.55%
Hardwick Township	947	1,255	1,464	54.59%
Harmony Township	2,592	2,653	2,729	5.29%
Hope Township	1,468	1,719	1,891	28.81%
Independence Township	2,829	3,940	5,603	98.06%
Knowlton Township	2,074	2,543	2,977	43.54%

Municipality	1980 Population	1990 Population	2000 Population	% Change from 1980 to 2000
Liberty Township	1,730	2,493	2,765	59.83%
Lopatcong Township	4,998	5,052	5,765	15.35%
Mansfield Township	5,780	7,154	6,653	15.10%
Oxford Township	1,659	1,790	2,307	39.06%
Phillipsburg Town	16,647	15,757	15,166	-8.90%
Pohatcong Township	3,856	3,591	3,416	-11.41%
Washington Borough	6,429	6,474	6,712	4.40%
Washington Township	4,243	5,367	6,248	47.25%
White Township	2,748	3,603	4,245	54.48%
Total	**84,403**	**91,607**	**102,437**	**21.37%**

Source: NJOIT, OGIS January 2009. GIS data retrieved from http://www.state.nj.us/dep/gis/.

Figure 4.2.1-1: 2000 Population in Warren County by Municipality



Source: NJOIT, OGIS January 2009. GIS data retrieved from http://www.state.nj.us/dep/gis/.

4.2.2 General Building Stock

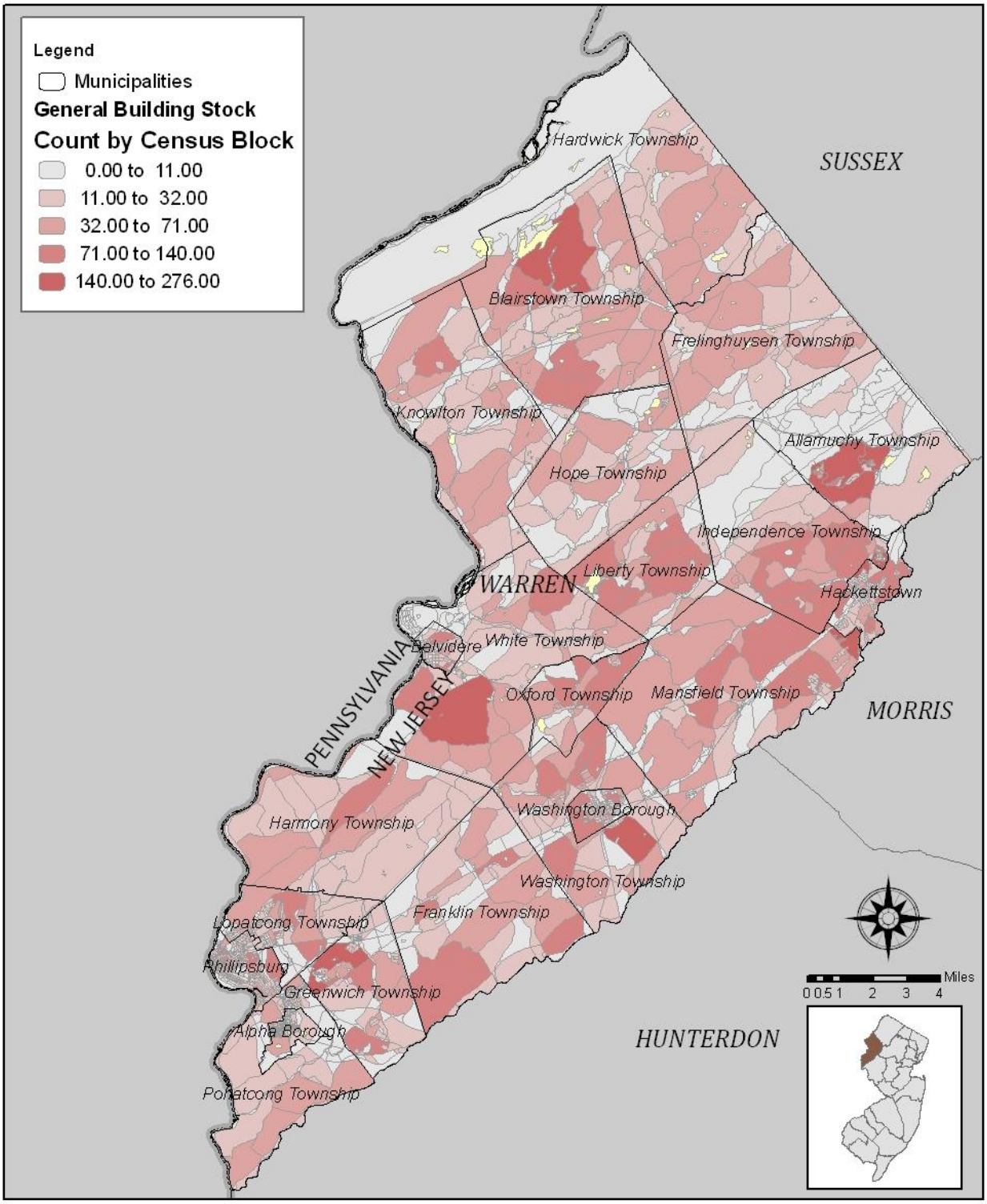
Warren County is 362.20 square miles, contains 23 census tracts, and 2,964 census blocks with over 38,000 households. There are an estimated 42,000 buildings in the region with a total building replacement value (excluding contents) of $8,662,000,000. Approximately 91% of the county's structures and 73% of the building value are associated with residential housing. Wood frame construction makes up 79% of the building inventory, with the other 21% constructed of steel, concrete, precast, reinforced masonry, unreinforced masonry, or manufactured housing. In HAZUS-MH analysis, the general building stock is grouped and evenly distributed at the census block or tract level.

Table 4.2.2-1: Building Exposure by Occupancy in Warren County

Occupancy	Exposure	% of Total Building Inventory
Residential	$6,343,325,000	73.2%
Commercial	$1,411,429,000	16.3%
Industrial	$447,575,000	5.2%
Agricultural	$60,778,000	0.7%
Religious	$143,159.000	1.7%
Government	$59,017,000	0.7%
Education	$196,718,000	2.3%
Total	**$8,662,001,000**	**100.0%**

Source: HAZUS-MH MR4, Patch 2 Analysis completed June 2010.

Figure 4.2.2-1: Building Count by Census Block Based on 2000 Census Data



Source: HAZUS-MH MR4, Patch 2 Analysis completed June 2010.

4.2.3 Critical Facilities

For this Plan, a focus on the accuracy of the essential facilities and some of the lifeline data was a priority. The lifeline data that was updated for this Plan included potable water system facilities and waste water treatment plants. The Delaware River Basin Commission (DRBC) shared the HAZUS-MH data that was updated based on their partnerships with certain communities, which they compiled in 2007 for the *Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey Section of the Delaware River Basin*. This update did not include the entire county, only those municipalities within the designated watershed who chose to participate (see Figure 3.3.4-1 in Section 3 for a map of the participating communities in Warren County). During this Plan's process, the DRBC updated data was provided to the county, and updates were received from the municipalities to varying degrees. Warren County GIS Department also provided data for essential facilities updates. All of the relevant data was then compiled and reloaded into HAZUS-MH for use in the analysis and loss estimations.

Table 4.2.3-1 provides the facility class codes for essential facilities and utilities that are included in Tables 4.2.3-2 through 4.2.3-8.

Table 4.2.3-1: Facility Class Code Definitions

Facility Class	Type of Facility	Occupancy Class	Description
EFEO	ESF: Emergency Response	Emergency Operation Centers	-
EFFS	ESF: Emergency Response	Fire Station	-
EFPS	ESF: Emergency Response	Police Station	-
EFHS	ESF: Medical Care	Small Hospital	Hospital with less than 50 beds
EFHM	ESF: Medical Care	Medium Hospital	Hospital with beds between 50-150
EFHL	ESF: Medical Care	Large Hospital	Hospital with greater than 150 beds
EFMC	ESF: Medical Care	Medical Clinic	Clinics, Labs, Blood Banks
MDFLT	ESF: Medical Care	Default for Medical	
EFS1	ESF: School	School	Primary and High School, K-12
EFS2	ESF: School	College/University	Community and State Colleges, State and Private Universities
PDFLT	Utility	Default for Potable Water	-
WDFLT	Utility	Default for Waste Water Facility	-

Source: HAZUS-MH MR4 Technical and User Manuals.

There are 15 Emergency Operations Centers in the Warren County essential facility inventory that were used for analysis, as listed in Table 4.2.3-2.

Table 4.2.3-2: Essential Facilities – Emergency Operation Centers in Warren County

Facility Name	City	Facility Class
Belvidere Ambulance Corps	Belvidere Town	EFEO
Blairstown Ambulance Corps	Blairstown Township	EFEO
Emergency Operations Center	Oxford	EFEO
Emergency Squad	Independence	EFEO
Emergency Squad	Oxford	EFEO
Hackettstown Civil Defense	Hackettstown	EFEO
Hackettstown First Aid	Hackettstown	EFEO
Hardwick Emergency Management	Blairstown	EFEO
Harmony Twp Emergency Mgmt	Phillipsburg	EFEO
Lopatcong Emergency Management	Lopatcong	EFEO
Lopatcong Emergency Squad	Lopatcong	EFEO
Mansfield Rescue Squad	Mansfield Township	EFEO
Phillipsburg Civil Defense	Phillipsburg	EFEO
Phillipsburg Emergency Squad	Phillipsburg	EFEO
Warren County Emergency Mngmnt	Franklin Township	EFEO

Source: HAZUS-MH, DRBC, and local data sources.

There are 38 fire station facilities in the Warren County essential facility inventory that were used for analysis, as listed in Table 4.2.3-3.

Table 4.2.3-3: Essential Facilities – Fire Station Facilities in Warren County

Facility Name	City	Facility Class
Allamuchy Township Volunteer Fire Department	Allamuchy	EFFS
Alpha Volunteer Fire Department	Alpha	EFFS
Asbury Fire Company #1 Inc.	Asbury	EFFS
Blairstown Fire Hall	Blairstown Township	EFFS
Blairstown Hose Co #1	Blairstown	EFFS
Butlers Park Fire Department	Mansfield Township	EFFS
Delaware Park Engine Co. No. 1	Lopatcong	EFFS
DSM Industrial Fire and Rescue Brigade	Belvidere	EFFS
Franklin Township Fire Department	Franklin Township	EFFS
Franklin Township Fire Department	Franklin Township	EFFS
Franklin Township Fire Department	Franklin Township	EFFS
Good Will Fire Company	Belvidere	EFFS
Hackettstown Fire Department	Hackettstown	EFFS
Hackettstown Fire Department	Hackettstown	EFFS
Harmony Township Volunteer Fire Company	PHILLIPSBURG	EFFS
Hope Volunteer Fire Department	Hope	EFFS
Huntington Fire Company	Pohatcong Township	EFFS
Independence Township Volunteer Fire Department	Great Meadows	EFFS
Lopatcong Fire Company No. 2	Lopatcong	EFFS
Lopatcong Fire Department	Phillipsburg	EFFS
Mansfield Township Fire Company 1	Port Murray	EFFS
Mountain Lake Fire Company	Belvidere	EFFS

Facility Name	City	Facility Class
Mansfield Volunteer Fire Department	Oxford	EFFS
Oxford Volunteer Fire Department	Oxford	EFFS
Phillipsburg Fire Department	Phillipsburg	EFFS
Phillipsburg Fire Department 94-2, 6	Phillipsburg	EFFS
Phillipsburg Fire Department 94-3	Phillipsburg	EFFS
Phillipsburg Fire Department 94-4	Phillipsburg	EFFS
Phillipsburg Fire Department 94-5	Phillipsburg	EFFS
Phillipsburg Fire Department 94-7	Phillipsburg	EFFS
Pohatcong Fire House	Pohatcong Township	EFFS
Stewartsville Volunteer Fire Company	Stewartsville	EFFS
Mansfield Fire Company	Hackettstown	EFFS
Washington Boro Fire Dept	Washington	EFFS
Washington Township Fire Department	Washington Township	EFFS
Washington Township Fire Department	Washington Township	EFFS

Source: HAZUS-MH, DRBC, and local data sources.

There are 13 police station facilities in the Warren County essential facility inventory that were used for analysis, as listed in Table 4.2.3-4.

Table 4.2.3-4: Essential Facilities – Police Station Facilities in Warren County

Facility Name	City	Facility Class
Belvidere Police Department	Belvidere	EFPS
Blairstown Police Department	Blairstown	EFPS
Greenwich Police Department	Stewartsville	EFPS
Hackettstown Police Department	Hackettstown	EFPS
Independence Police Department	Independence	EFPS
Lopatcong Township Police Department	Phillipsburg	EFPS
Mansfield Township Police Department	Port Murray	EFPS
NJ State Police Station	Mansfield	EFPS
NJ State Police Station	Hope	EFPS
Phillipsburg Police Department	Phillipsburg	EFPS
Pohatcong Township Police Department	Phillipsburg	EFPS
Warren County Sheriff	Belvidere	EFPS
Washington Police Department	Washington	EFPS
Washington Township Police Department	Washington	EFPS

Source: HAZUS-MH, DRBC, and local data sources.

There are 11 medical care facilities in the Warren County essential facility inventory that were used for analysis, as listed in Table 4.2.3-5.

Table 4.2.3-5: Essential Facilities – Medical Care Facilities in Warren County

Facility Name	City	Facility Class
Brakeley Park Center	Lopatcong Township	EFHM
Clover Rest Home	Knowlton Township	EFMC
Forest Manor Nursing Home	Frelinghuysen TWP	EFMC
Hackettstown Community Hospital	Hackettstown	EFHM
House of the Good Shepherd	Hackettstown	EFHM
Hulses' Rest Home	Liberty Township	EFMC
Lopatcong Care Center	Lopatcong Township	EFHL
Phillipsburg Care Center	Phillipsburg Town	EFHM
Radiant Star Nursing Home	Harmony	
Warren Haven	Mansfield Township	EFHL
Warren Hospital	Phillipsburg	EFHL

Source: HAZUS-MH, DRBC, and local data sources.

There are 62 school facilities in the Warren County essential facility inventory that were used for analysis, as listed in Table 4.2.3-6.

Table 4.2.3-6: Essential Facilities – School Facilities in Warren County

Facility Name	City	Facility Class
Allamuchy Township	Allamuchy	EFS1
Alpha School	Alpha	EFS1
Andover Morris	Phillipsburg	EFS1
Barber Elementary	Phillipsburg	EFS1
Belvidere High	Belvidere	EFS1
Blair Academy	Blairstown	EFS1
Blair Academy	Blairstown Township	EFS1
Blairstown Elementary	Blairstown	EFS1
Brass Castle	Washington	EFS1
Centenary College	Hackettstown	EFS2
Children's Center Pre-School	Blairstown	EFS1
Delaware Park School	Lopatcong	EFS1
Early Childhood Center	Phillipsburg	EFS1
Franklin Township	Washington	EFS1
Freeman	Phillipsburg	EFS1
Frelinghuysen Township	Johnsonburg	EFS1
Good Shepherd Christian Academy	Washington	EFS1
Great Meadows Middle School	Great meadows	EFS1
Green Street	Phillipsburg	EFS1
Hackettstown High	Hackettstown	EFS1
Hackettstown Middle	Hackettstown	EFS1
Harmony Township School	Phillipsburg	EFS1
Hatchery Hill	Hackettstown	EFS1
Hope Elementary School	Hope township	EFS1
Hope Township	Hope	EFS1
Howell School	Phillipsburg	EFS1
Independence Township Central	Great meadows	EFS1

Facility Name	City	Facility Class
Knowlton Township Elementary School	Delaware	EFS1
Liberty Township Elementary School	Great Meadows	EFS1
Lopatcong Elementary School	Phillipsburg	EFS1
Lopatcong Township Middle School	Phillipsburg	EFS1
Mansfield Township Elementary School	Port Murray	EFS1
Middle	Phillipsburg	EFS1
Mike's Tykes	White	EFS1
N Warren Reg High School	Blairstown	EFS1
Oxford Central	Oxford	EFS1
Oxford Street	Belvidere	EFS1
Phillipsburg Christian Academy	Phillipsburg	EFS1
Phillipsburg High School	Phillipsburg	EFS1
Phillipsburg Middle School	Phillipsburg	EFS1
Pohatcong Township Elementary School	Phillipsburg	EFS1
Port Colden	Washington	EFS1
Regional Middle School	Independence	EFS1
Ridge and Valley Charter School	Blairstown	EFS1
Saints Philip and James School	Phillipsburg	EFS1
St Joseph Catholic Academy	Washington	EFS1
St Mary of the Assumption School	Hackettstown	EFS1
Stepping Stone School	Bloomsburg	EFS1
Stewartsville School	Stewartsville	EFS1
Sunrise School	Hackettstown	EFS1
Taylor Street Elementary School	Washington	EFS1
The Greenwich School	Stewartsville	EFS1
Third Street Elementary School	Belvidere	EFS1
Vail Preschool (Blairstown Elem)	Blairstown Township	EFS1
Warren County Special Services School	Washington	EFS1
Warren County Community college	Washington Township	EFS2
Warren County Vocational & Technical Institute	Washington	EFS1
Warren Hills Regional High School	Washington	EFS1
Warren Hills Middle School	Washington	EFS1
Washington Memorial Elementary School	Washington	EFS1
White Township	Belvidere	EFS1
Willow Grove Street	Hackettstown	EFS1

Source: HAZUS-MH, DRBC, and local data sources.

There are 4 potable water facilities in the Warren County utilities inventory that were used for analysis, as listed in Table 4.2.3-7.

Table 4.2.3-7: Utilities – Potable Water Facilities in Warren County

Facility Name	City	Facility Class
Aqua Water Company	Lopatcong	PDFLT
Baltimore Street Pump Station	Lopatcong	PDFLT
Blairstown Water Company	Blairstown Town	PDFLT
Stonehenge Pump Station	Lopatcong	PDFLT

Source: HAZUS-MH, DRBC, and local data sources.

There are 12 waste water system facilities in the Warren County utilities inventory that were used for analysis, as listed in Table 4.2.3-8.

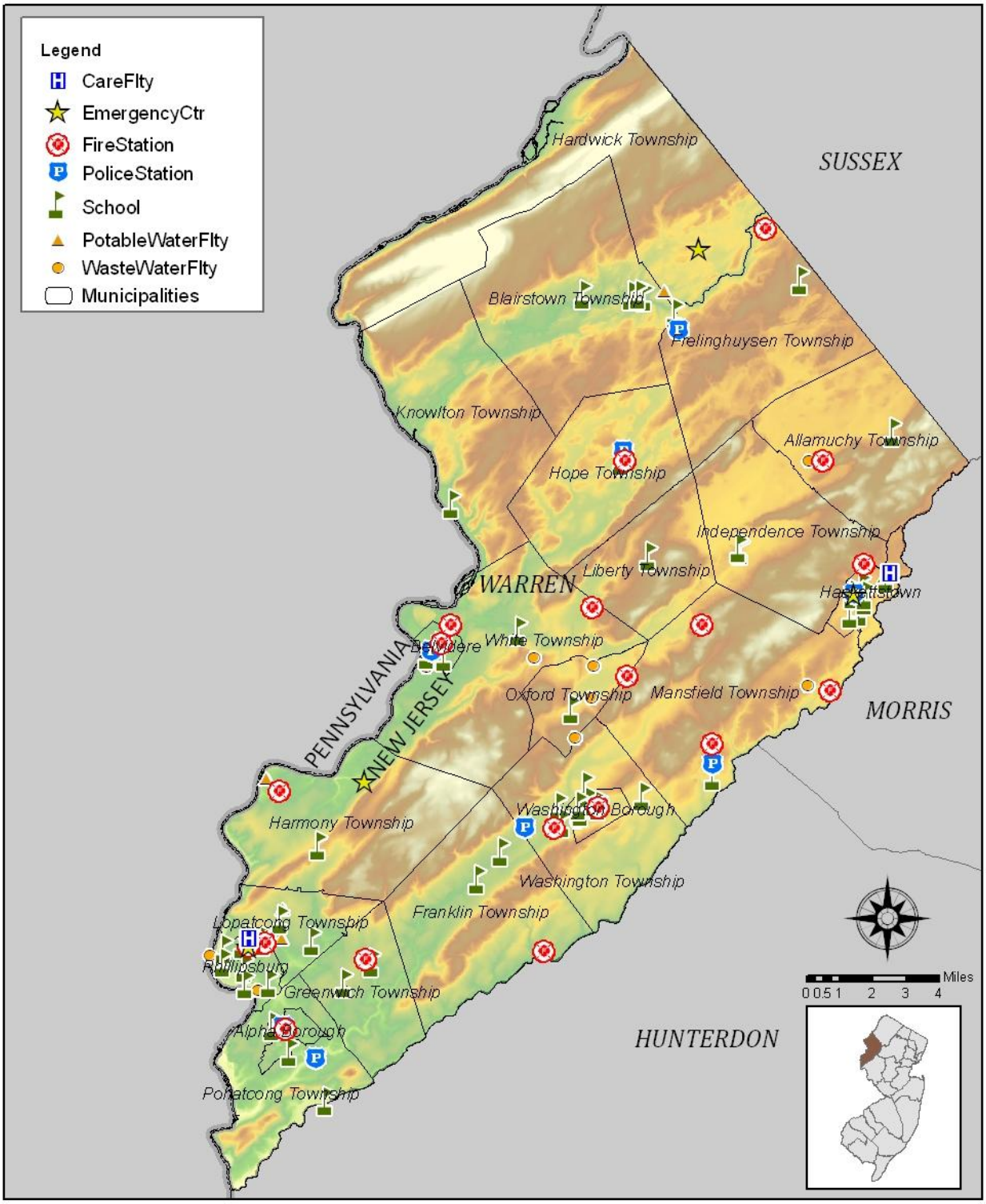
Table 4.2.3-8: Utilities – Waste Water System Facilities in Warren County

Facility Name	City	Facility Class
Allamuchy Township Sewage Treatment Plant	Allamuchy	WDFLT
Allamuchy Township Water & Sewer Department	Allamuchy Township	WDFLT
Belvidere Area Wastewater Treatment Plant	White Township	WDFLT
Cliffside Park Borough	Cliffside Park	WDFLT
Diamond Hill Estates Sewage Co	Hackettstown	WDFLT
Hmua Wastewater Treatment Plant	Hackettstown	WDFLT
Oxford area Water Treatment Plant	Oxford	WDFLT
Phillipsburg town Sewage Treatment Plant	Phillipsburg	WDFLT
Riverside Way Lift Station	Phillipsburg	WDFLT
Warren County District Landfill	Oxford	WDFLT
Washington Borough Water Treatment Plant	Washington	WDFLT
Woodcliff Sewerage Treatment Plant	North Bergen	WDFLT

Source: HAZUS-MH, DRBC, and local data sources.

Figure 4.2.3-1 shows the locations of the essential facilities, potable water facilities, and waste water system facilities throughout Warren County that were used in this analysis.

Figure 4.2.3-1: Essential Facilities, Potable Water Facilities, and Waste Water System Facilities in Warren County



Source: HAZUS-MH, DRBC, and local data sources.

In Warren County, the replacement value of the transportation systems is estimated to be approximately $2,630,800,000 and the utility lifeline systems to be about $1,181,900,000 for a total of over $3,712,000,000. This inventory includes approximately 182 kilometers of highways, 235 bridges, and 4,978 kilometers of pipes.

4.2.4 Future Land Use and Development

As shown in Table 4.2.1-1 and Figure 4.2.1-1, various municipalities in Warren County have experienced varying degrees of increases and decreases in population over the past few decades. The majority of the municipalities have seen an increase since 1980, with the exceptions of Alpha Borough, Philipsburg Town, and Pohatcong Township that have had decreases in population. This may be reflective of some future population and related development trends, however it is difficult to predict future development due to the variety of factors that can affect it, such as zoning and land use restrictions, economic changes, and real estate market variability.

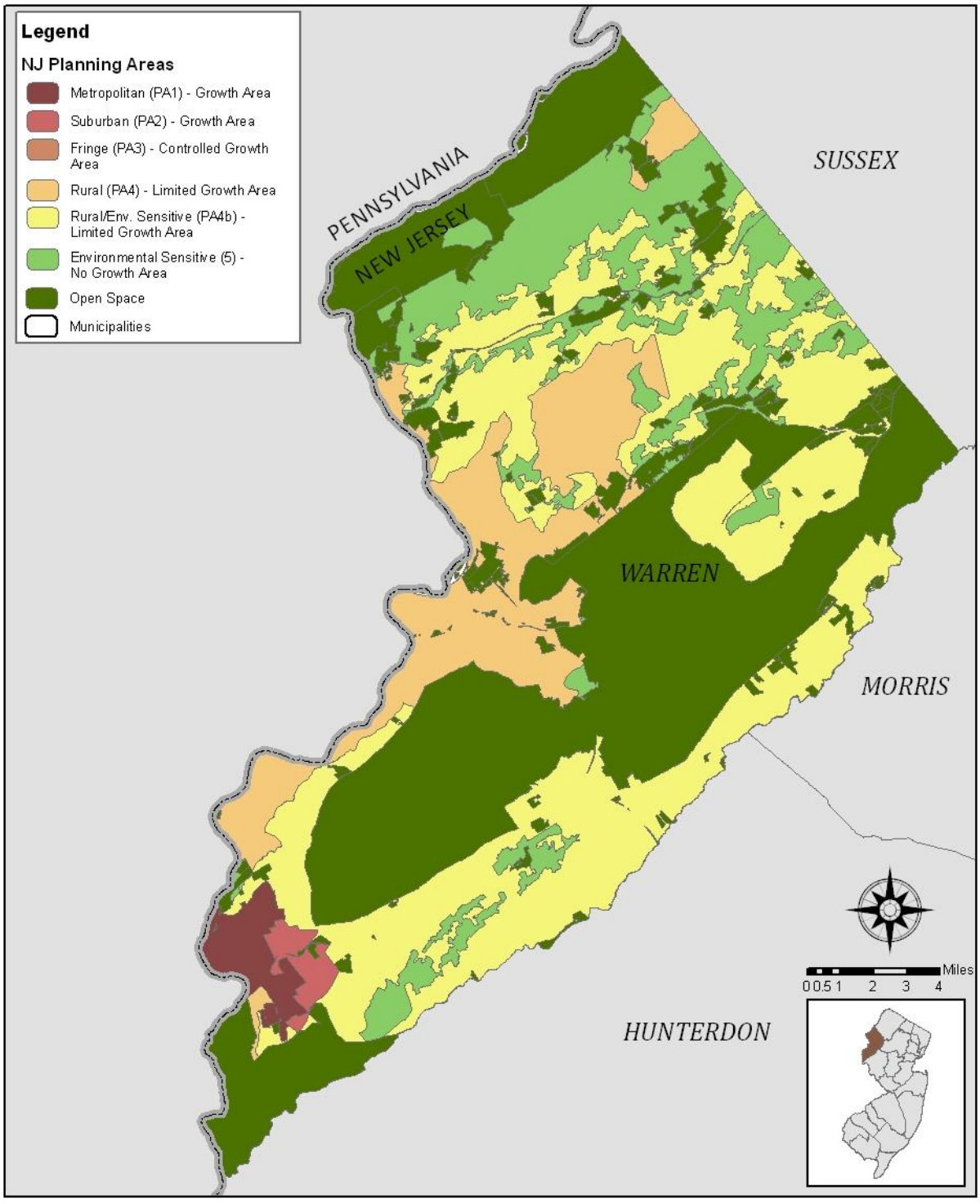
Figure 4.2.4-1 shows the five Planning Area designations as designated by the final draft of New Jersey's 2010 State Development and Redevelopment Plan (NJDRP). The five Planning Areas (PA) are as follows:

- **PA1 - The Metropolitan PA, (Growth Area):** A variety of municipalities that have strong ties to major metropolitan areas. Includes mature settlement patterns, infrastructure systems that are approaching their reasonable life expectancy, aging housing stock in need of rehabilitation, recognition that redevelopment will be the predominant form of growth, and a growing need to regionalize services and systems. Intended to provide for much of the State's future development and redevelopment.
- **PA2 – The Suburban PA, (Growth Area):**: Located adjacent to PA1, but has a lack of high intensity centers, available developable land, and more dispersed and fragmented pattern of predominantly low-density development. Served by regional infrastructure and often designated for growth in municipal master plans. Intended to provide for much of the state's future development.
- **PA3 – The Fringe PA, (Controlled Growth Area):**: Predominantly still a rural landscape that is not prime agricultural or environmentally sensitive land, with scattered small communities and free-standing residential, commercial, and industrial development. Large investments in water and sewer and local road networks have not yet occurred. Intended to direct growth into and revitalize cities and towns, where future growth does occur accommodate it through more compact, center-based developments, and protect the existing environs primarily as open space and farmlands.
- **PA4 – The Rural Planning Area, (Limited Growth Area)**: Comprises much of NJ's countryside, where large masses of cultivated or open land surround rural regional centers, towns, villages, and hamlets. Relatively isolated residential, commercial, and industrial sites are clearly distinguishable from typical suburban development. Includes most of NJ's prime farmland. Intended to maintain the environs as large contiguous tracts of farmland and open space , promote a viable agricultural industry and compatible off-the-farm economic opportunities for farmers, and revitalize existing rural centers.
    - **PA4B – The Rural/Environmentally Sensitive PA**: A sub-PA with similar characteristics of PA4 but intended to support continued agricultural development on lands with environmentally sensitive features.

- **PA5 – The Environmentally Sensitive PA, (No Growth Area):** Contains large contiguous land areas with valuable eco-systems, geological features and wildlife habitats. NJ's future environmental integrity and a substantial portion of its economy depends on the protection of these irreplaceable resources. Existing centers within PA5 are the focus of residential and commercial growth and public facilities and services for their region. Intended to protect environmental resources through the protection of large contiguous tracts of open space, accommodate growth in exiting cities and towns and new center-based developments, and revitalize existing cities and towns.[1]

[1] January 2010 Final Draft of NJ State Development and Redevelopment Plan, p31-38. Plan retrieved from http://www.nj.gov/dca/divisions/osg/plan/df.html

Figure 4.2.4-1: NJDRP 2010 Planning Areas and Expected Areas of Development



Source: GIS data from NJ Office of Smart Growth, 2010 NJDRP. Retrieved from http://www.nj.gov/dca/divisions/osg/plan/df.html#gis.

4.3 Estimate of Potential Losses

Following the hazard profiling in Section 3, Warren County chose to include a more detailed risk assessment for the five highest impact hazards to the county; which include dam failure, earthquake/geological, flood, high wind – straight-line winds, and winter severe weather. Understanding vulnerable assets and quantifying risk for specific hazards can help guide mitigation strategies and efforts. Each estimate of potential losses section contains at a minimum the following subsections for each of the chosen hazards:

Methodology

Explanation of the approach used in the loss estimations. FEMA's HAZUS-MH MR4 Patch 2 software is utilized for flood, hurricane winds, and earthquake scenarios to predict potential losses. Although considered one of the best available models, there are inaccuracies associated with HAZUS-MH and the results should be utilized for planning purposes only. As mentioned in Section 4.2.3, some of the site-specific data inventory was updated in HAZUS-MH prior to the running the risk assessments, including essential facilities, potable water system facilities, and waste water treatment plants. (Note that the Hurricane Wind HAZUS-MH module will not model damages to potable water system facilities and waste water treatment plants.) The analysis is restricted to the county boundaries, so damage assessments do not contain information regarding adjacent counties. Note that HAZUS-MH provides the following disclaimer with all result reports: *The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific [event]. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.*

The dam failure risk assessment is based on a few specific examples, using GIS analysis with inundation boundaries, county parcel data, and HAZUS-MH data references. For the severe winter weather hazard, a traditional 100-year planning approach was utilized based on historical information.

Potential Losses

Display and explanation of data assessing the potential losses in the county for future hazard events.

Critical Facilities Risk

Summary of critical facilities at risk due to specific hazards per available information. See Section 4.2.3 for a list of critical facilities that could be impacted in Warren County. Essential facilities, potable water facilities, and waste water system facilities were updated based on DRBC and local data. Replacement costs for updated essential facilities are not known, but are necessary to provide accurate loss estimations based on damages in HAZUS. Instead of

providing potentially inaccurate loss estimates, the number of facilities damaged and the severity will be provided.

Results for Specific Scenarios

If there are multiple scenarios used in a risk assessment, the losses (general building stock and critical facilities) will be broken into separate results sub-sections.

Risk Assessment Next Steps

Includes any relevant information or suggestions for future loss estimation improvements or necessary actions.

4.3.1 Dam Failure

Methodology for Dam Failure

As discussed in Section 3.3.1-2, Warren County is home to 15 high hazard dams, 7 significant dams, and 62 low hazard dams. In order to conduct a loss estimation, four dam sites were chosen by the county: Merrill Creek Dam, Yards Creek Dam Complex, Lake Wallenpaupack, and Mongaup River Dam Complex. All are considered 'High' hazard dams and have existing Emergency Action Plans (EAPs). Part of these EAPs are inundation maps that show the areas that would become inundated under various scenarios.

For the Mongaup River and Yards Creek Dam complexes, the original hardcopy inundation maps were scanned and digitally mosaicked together. This was then georeferenced in ESRI ArcGIS using orthoimagery and roadways as references. The inundation boundaries were then digitized. For Merrill Creek Dam, shapefiles of the inundation boundaries were obtained from NJDEP's Dam Safety & Flood Control Bureau, and Lake Wallenpaupack's EAP included GIS files. Once the spatial inundation boundary file was obtained or created, it was overlaid in GIS with Warren County parcel data and parcels that intersected with the inundation boundary were selected. These were compiled based on occupancy/zoning type for parcel counts. Depth of flooding was not a consideration in this analysis, therefore true loss estimations cannot be provided. However, the potentially affected areas are shown.

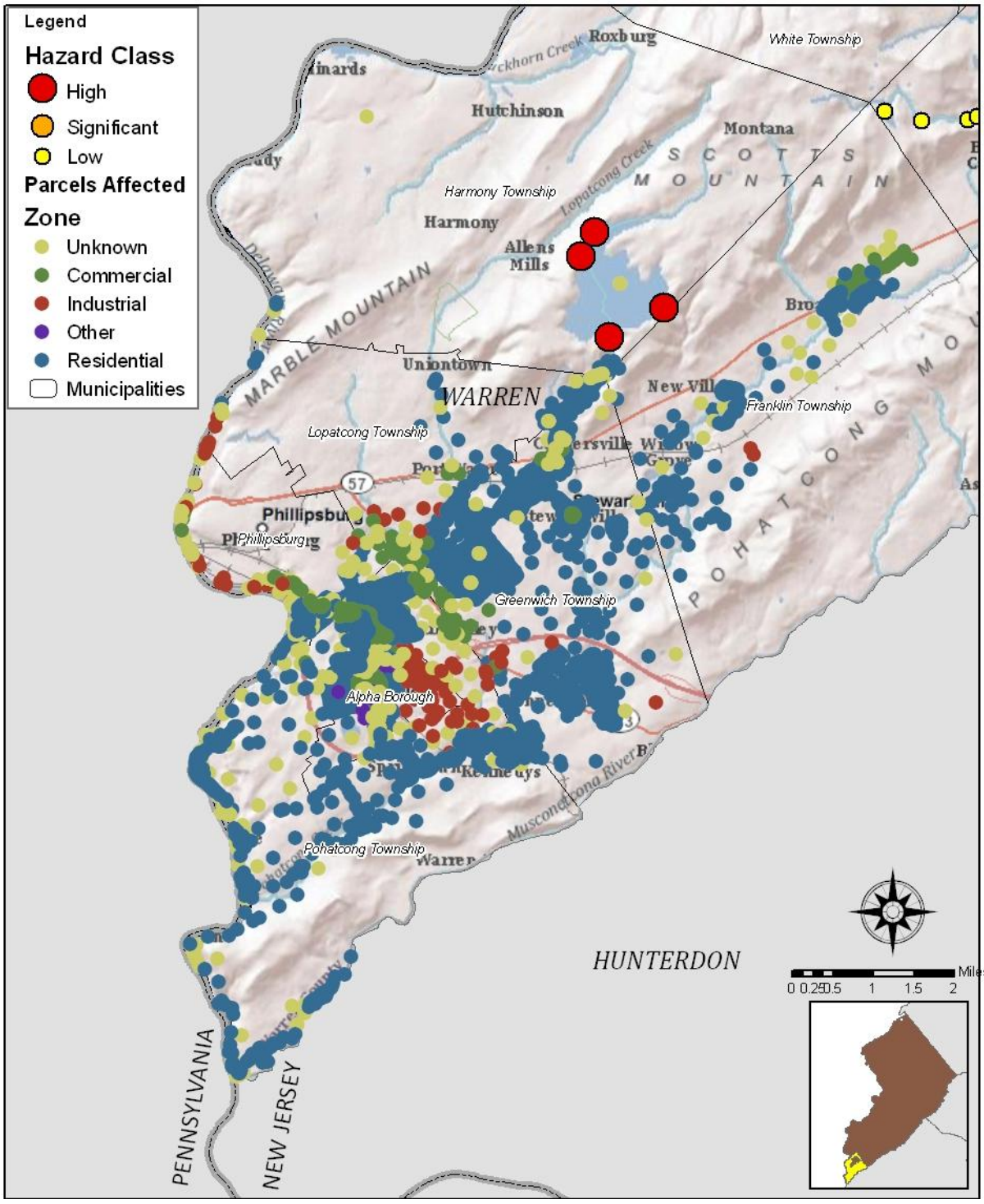
Although a dam failure may affect surrounding areas and counties, this analysis focuses on the impacts in Warren County only. Note that this is not an indication that there is any known likelihood that these dams will fail, this is only a risk assessment for planning purposes.

Potential Losses, Results for Dam Failure Scenario #1- Merrill Creek Dam

Merrill Creek Dam is located in Harmony Township and is owned and operated by Merrill Creek Owners Group. The dam's EAP includes three inundation scenarios: probable maximum flood with no breach, probable maximum precipitation flood with breach, and a sunny day breach. The probable maximum precipitation flood with breach will be used for this assessment, as it represents the worst-case scenario.

A dam breach would affect areas of Greenwich Township, Alpha Borough, Pohatcong Township, Franklin Township, Phillpsburg, Harmony Township and Lopatcong Township. According to this scenario, if the dam was to fail, it would impact 389 unknown zone type parcels, 397 commercial, 103 industrial parcels, 13 other, and 3,946 residential parcels in Warren County. Each parcel may have multiple structures built on it or none.

Figure 4.3.1-1: Affected Parcels if Merrill Creek Dam Failed



Critical Facilities, Results for Dam Failure Scenario #1- Merrill Creek Dam

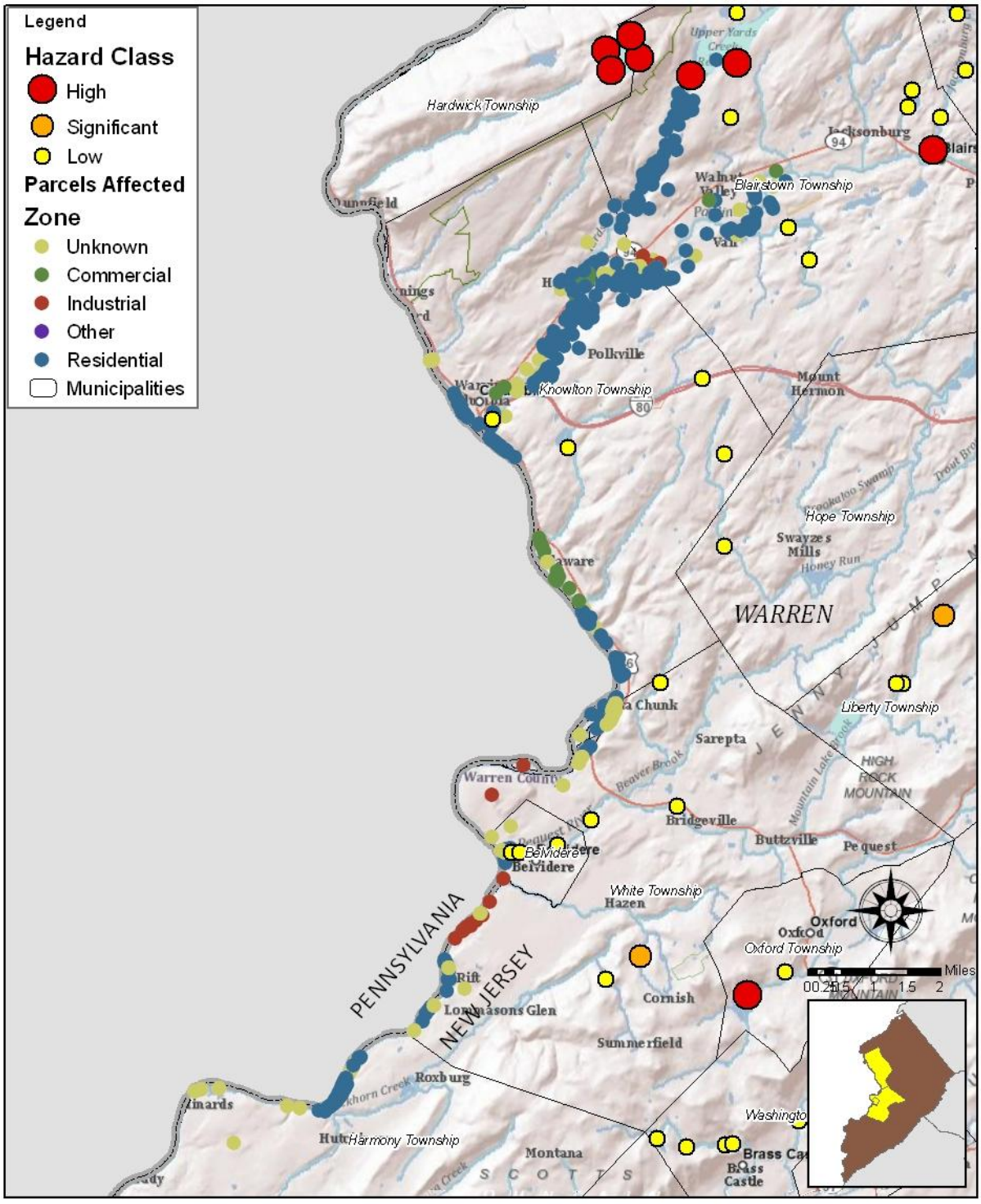
If this dam were to fail, there would be no care facilities, no EOCs, 1 fire station, no police stations, 2 schools, no potable water facilities, and 1 waste water system facilities impacted in Warren County.

Potential Losses, Results for Dam Failure Scenario #2- Yards Creek Dam

Yards Creek Station is a hydroelectric plant located in Blairstown and Hardwick Townships with three reservoirs and multiple dams and dikes. It is jointly owned by Jersey Central Power & Light Company and PSEG Fossil LLC and operated by Jersey Central Power & Light Company. The dam's EAP includes eight inundation scenarios: Lower Reservoir Main Dam failure, Lower Reservoir Saddle Dam failure, Penstock failure, Upper Reservoir East Dike failure southern portion, Upper Reservoir East Dike failure northern portion, Upper Reservoir North Dike failure, Upper Reservoir West Dike failure northern portion, Upper Reservoir West Dike failure southern portion, Upper Reservoir Southwest Dike, and Auxiliary Reservoir Dam failure. Each of the eight scenarios includes a probable maximum flood condition and sunny day condition. The Lower Reservoir Main Dam failure with probable maximum flood condition will be used for this assessment, as it appears to represent the worst-case scenario.

A dam breach would affect areas of Blairstown Township, Knowlton Township, White Township, Belvidere, and Harmony Township. According to this scenario, if the dam was to fail, it would impact 80 unknown zone type parcels, 39 commercial, 17 industrial, and 356 residential parcels in Warren County. Each parcel may have multiple structures built on it or none.

Figure 4.3.1-2: Affected Parcels if Yards Creek Dam Failed



Critical Facilities, Results for Dam Failure Scenario #2- Yards Creek Dam

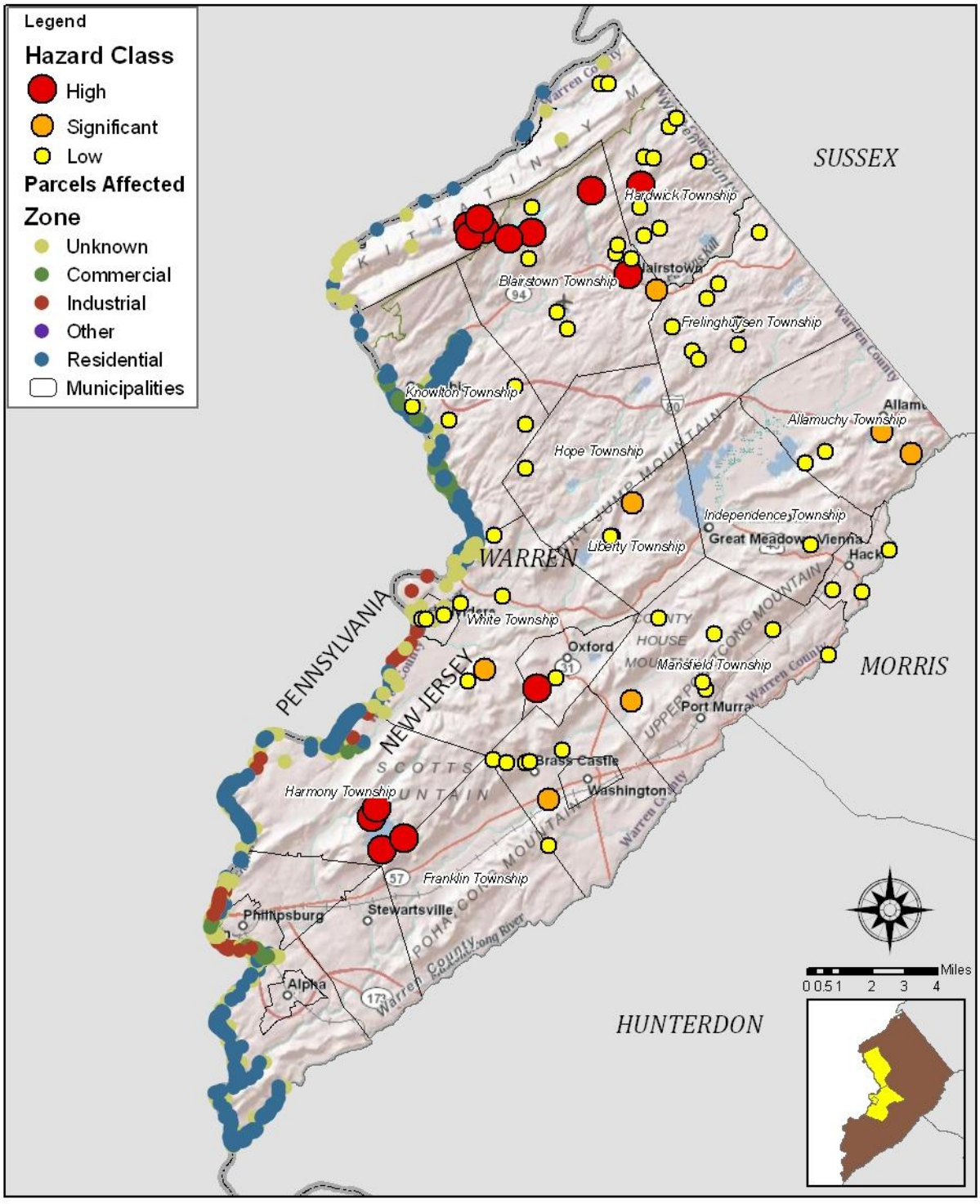
If this dam were to fail, there would be no care facilities, no EOCs, no fire stations, no police stations, no schools, no potable water facilities, and no waste water system facilities impacted in Warren County.

Potential Losses, Results for Dam Failure Scenario #3- Lake Wallenpaupack Dam

The Wallenpaupack hydroelectric station in Wilsonville, Pennsylvania is owned and operated by PPL Generation, LLC. Wallenpaupack's EAP includes two inundation scenarios: a fair weather breach and a probable maximum failure. The probable maximum precipitation flood with breach will be used for this assessment, as it represents the worst-case scenario.

A dam breach would affect all municipalities along the Delaware River. According to this scenario, if the dam was to fail, it would impact 335 unknown zone type parcels, 215 commercial, 84 industrial, 3 other, and 850 residential parcels in Warren County. Each parcel may have multiple structures built on it or none.

Figure 4.3.1-3: Affected Parcels if Lake Wallenpaupack Dam Failed



Critical Facilities, Results for Dam Failure Scenario #3- Lake Wallenpaupack Dam

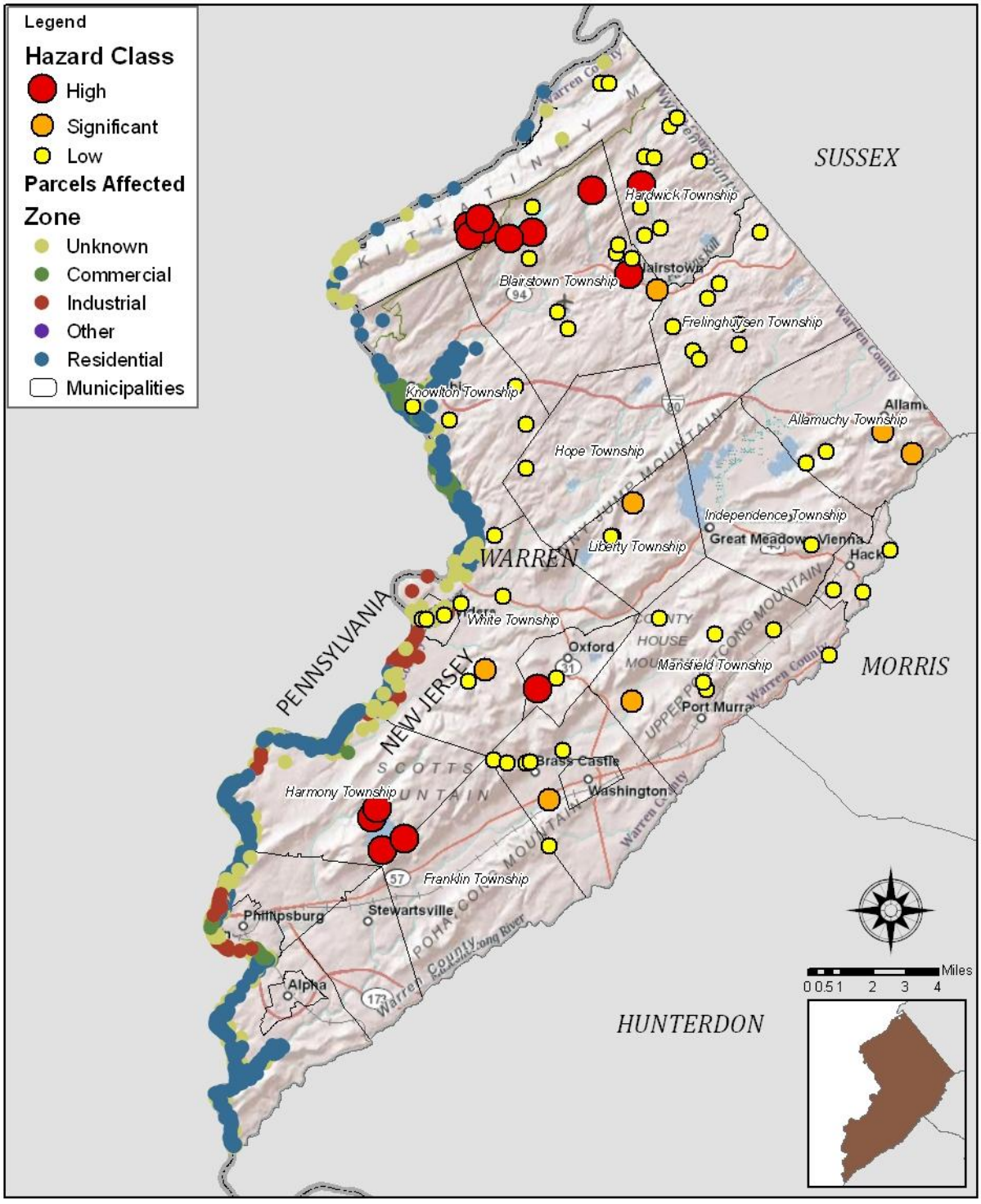
If this dam were to fail, there would be no care facilities, no EOCs, no fire stations, no police stations, 2 schools, no potable water facilities, and 2 waste water system facilities impacted in Warren County.

Potential Losses, Results for Dam Failure Scenario #4- Mongaup River Hydro System

The Mongaup River Hydro System consists of Swinging Bridge, Mongaup, and Rio dam systems. It is located in Sullivan County, New York and owned and operated by AER-NY Gen, LLC. Mongaup's EAP includes two inundation scenarios: a sunny day breach and a flood breach. The flood with breach will be used for this assessment, as it represents the worst-case scenario.

A dam breach would affect all of the municipalities along the Delaware River and vicinity. According to this scenario, if the dam was to fail, it would impact 353 unknown zone type parcels, 255 commercial, 129 industrial, 5 other, and 1,059 residential parcels in Warren County. Each parcel may have multiple structures built on it or none.

Figure 4.3.1-4: Affected Parcels if Mongaup River Hydro System Failed



Critical Facilities, Results for Dam Failure Scenario #4- Mongaup River Hydro System

If this dam were to fail, there would be no care facilities, no EOCs, 1 fire station, 1 police station, 1 school, no potable water facilities, and 2 waste water system facilities impacted in Warren County.

Risk Assessment Next Steps for Dam Failure

There are nearly eighty additional dams in Warren County that were not analyzed and pose some risk to the surrounding communities. Those that were assessed do not take the depth of flooding into consideration and therefore the potential cost of a dam failure. This analysis could be completed in the future utilizing HAZUS-MH and inundation boundaries, cross-sections, and base flood elevation information. On-site inspections and regular maintenance are important to the health of the county's dams to reduce the risk of dam failure.

4.3.2 Earthquake/Geological

Methodology for Earthquake/Geological

Three different earthquake scenarios were chosen for analysis in HAZUS-MH MR4 Patch 2 after discussion with the New Jersey Geological Survey. One was a deterministic scenario based on a Moment Magnitude of 5.5, earthquake depth of 10 kilometers, Central Eastern United States attenuation function, and epicenter location in the center of Warren County. Although it is unlikely that an earthquake's epicenter will occur in the exact center of the county, this provides a good planning scenario for losses.

The other two scenarios are probabilistic (statistical) scenarios that are based on ground shaking parameters derived from U.S. Geological Survey probabilistic seismic hazard curves. The first was a 500-year return period scenario also based on a Moment Magnitude of 5.5. The second probabilistic scenario allowed for calculation of Annualized Earthquake Loss (AEL). AEL is the estimated long-term value of earthquake losses to the general building stock in any single year in a specified geographic area, such as a county.[2] The annualized loss analysis in HAZUS-MH averages potential losses from future scenarios while considering their probabilities of occurrence. This is based on eight different return periods, including the 100-, 250-, 500-, 750-, 1000-, 1500-, 2000-, and 2500-year return period earthquake events. In this way, AEL incorporates historic patterns of smaller frequent earthquakes with larger, infrequent events to create a balanced assessment of earthquake risk.[1] See the HAZUS-MH MR4 Technical Manual, Chapter 17 for a more detailed description of the Annualized Losses methodology the model utilizes. AEL does not offer as many results as the other types of scenarios, but provides estimated average annualized losses for general building stock and casualties.

[2] FEMA, *FEMA 366: Estimated Annualized Earthquake Losses for the United States* (April 2008). Retrieved from http://www.fema.gov/library/viewRecord.do?id=3265

NEHRP soil classifications can be updated using local data in HAZUS-MH for more accurate results. Unfortunately, a National Earthquake Hazards Reduction Program (NEHRP) soil classification map or data was not available for Warren County. The default soil type classification in HAZUS-MH is Class D, which is acceptable for most areas, but may not be the best choice in glaciated rock areas.

Potential Losses for Earthquake/Geological

Building losses are separated into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage to the building and its contents. Direct building damages are categorized based on the structure's building occupancy or use; such as residential, commercial, industrial, and others. The business interruption losses are the losses associated with the inability to operate a business and includes the temporary living expenses for people displaced from their homes due to damages from the earthquake.

For the earthquake model, estimates of casualties are provided by HAZUS-MH based on four severity levels that describe the extent of the injuries: Severity Level 1 – injuries require medical attention but no hospitalization, Severity Level 2 – injuries require hospitalization but are not life-threatening, Severity Level 3 – injuries require hospitalization and can become life-threatening if not treated promptly, and Severity Level 4 – victims are killed by the earthquake. Casualty estimates are provided for three different times of day, at 2:00 AM, 2:00PM, and 5:00PM.

HAZUS-MH also provides estimates for the number of households that might be displaced from their homes due to the earthquake and the number of displaced people that may seek accommodations in temporary public shelters.

HAZUS-MH estimates the amount of debris that will be generated due to the earthquake event and separates debris into two types; brick/wood and reinforced concrete/steel. This distinction is made because there are different types of material handling equipment needed to handle the two types of debris.

Critical Facilities Risk for Earthquake/Geological

All critical facilities are vulnerable to earthquakes. A critical facility would encounter many of the same impacts as any other building within the county, depending on the level of building code used to construct the structure. These impacts include structural failure and loss of facility functionality. In other words, a damaged police station may not be able to serve the community.

The HAZUS-MH earthquake module also provides loss estimates for some transportation and utility lifeline losses. As previously mentioned, essential facilities, potable water facilities, and waste water facilities were updated before analysis based on DRBC and local updates.

Potential Losses, Results for Earthquake Scenario #1- Deterministic: 5.5 Moment Magnitude with Epicenter Centrally Located in Warren County

In this scenario, HAZUS-MH estimates that about 4,774 buildings will be at least moderately damaged, which is over 11% of the total number of buildings in the county. Approximately 142 buildings will be damaged beyond repair. Table 4.3.2-1 shows the approximate expected building damage by occupancy. As shown, single family housing suffered the most damage, with other residential occupancy structures with second-most damage. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.2-1: Approximate Expected Building Damage by Occupancy Based on a Centrally Located 5.5 Moment Magnitude Event in Warren County

Occupancy	No Damage		Slight Damage		Moderate Damage		Extensive Damage		Complete Damage	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	166	0.57	53	0.59	33	0.85	9	1.07	1	0.9
Commercial	1,514	5.17	416	4.68	310	8.08	90	11.22	15	10.79
Education	61	0.21	16	0.18	12	0.32	3	0.42	1	0.43
Government	57	0.19	16	0.18	14	0.36	4	0.5	1	0.46
Industrial	551	1.88	142	1.59	116	3.03	33	4.14	5	3.54
Other Residential	4,757	16.25	1,389	15.64	786	20.51	198	24.72	33	23.38
Religion	111	0.38	34	0.38	22	0.58	7	0.86	1	0.98
Single Family	22,062	75.35	6,817	76.75	2,540	66.28	456	57.08	85	59.52
Total	**29,278**		**8,881**		**3,833**		**799**		**142**	

Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $524,650,000, with 13% of the total related to the business interruption of the County.

Casualties are also estimated for three different times of day in HAZUS-MH earthquake modeling as shown in Table 4.3.2-2.

Table 4.3.2-2: Approximate Expected Casualties Based on a Centrally Located 5.5 Moment Magnitude Event in Warren County

Time of Day	Level 1 (Injuries without Hospitalization)	Level 2 (Injuries with Hospitalization)	Level 3 (Life-threatening if not Treated)	Level 4 (Death)
2:00 AM (Highest Residential Load)	97	18	2	4
2:00 PM (Highest Educational, Commercial, and Industrial Load)	79	16	2	4
5:00 PM (Highest Commute Time)	81	17	4	4

Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

HAZUS-MH estimates that approximately 310 households will be displaced due to this earthquake event. Of these displaced households, the model estimates that about 175 people will seek temporary shelter in public shelters.

For this earthquake scenario, HAZUS-MH predicts that approximately 110,000 tons of debris may be generated or approximately 4,480 truckloads (at 25 tons per truck). Of the total, 60% will consist of brick/wood and 40% of reinforced concrete/steel.

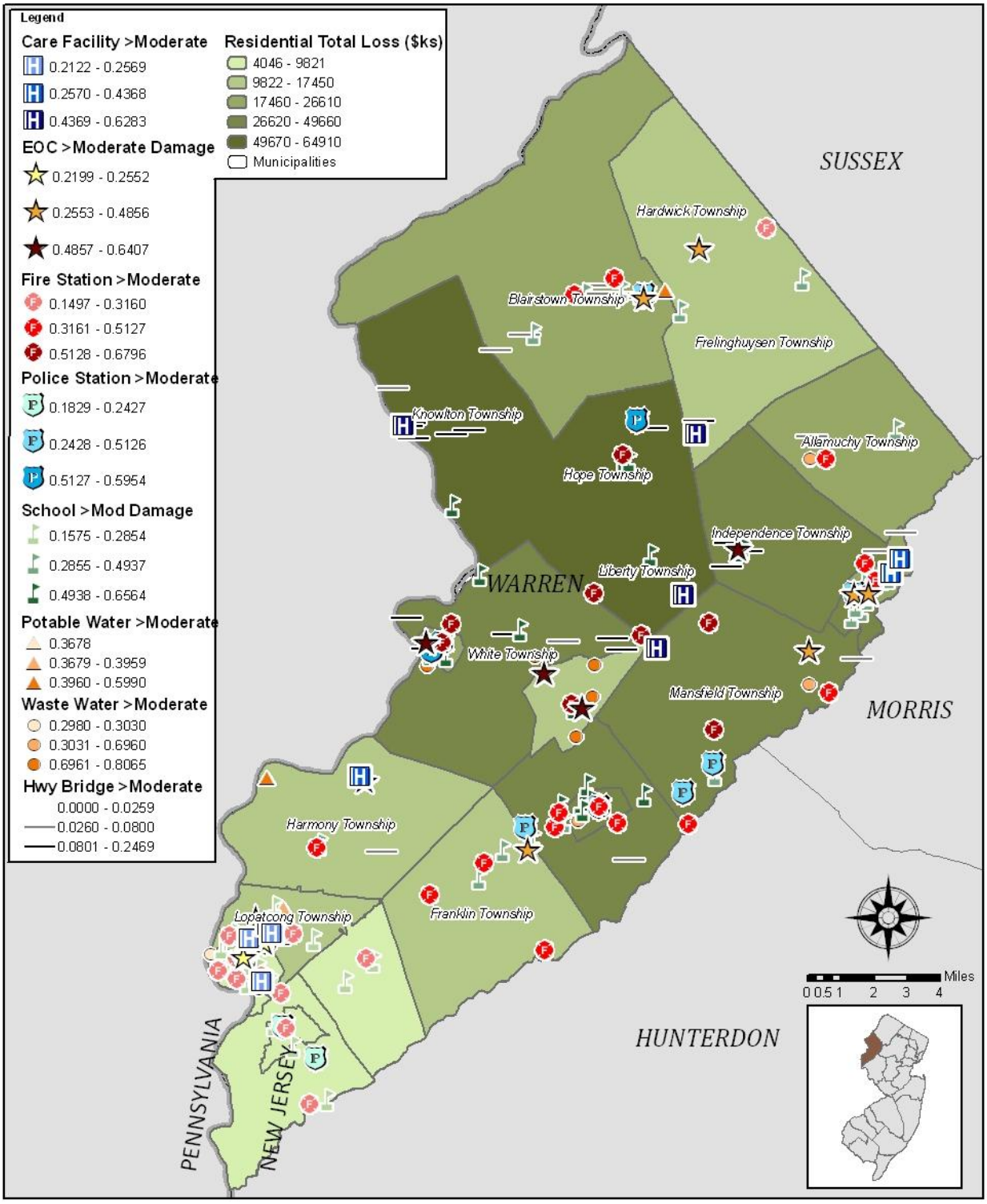
Critical Facilities at Risk, Results for Earthquake Scenario #1- Deterministic: 5.5 Moment Magnitude with Epicenter Centrally Located in Warren County

HAZUS-MH estimates that 4 of the county's 11 medical facilities will experience at least moderate damage due to this earthquake. On the day of the earthquake, only 5% of the county's hospital beds will be available for use by patients already in the hospital and those injured by the earthquake. After one week, 58% of the beds will be back in service, and 83% after 30 days.

The model predicts that 20 of the 62 schools, 4 of the 15 emergency operations centers, 6 of the 13 police stations, and 10 of the 38 fire stations may expect at least moderate damage due to this event.

Figure 4.3.2-1 shows the various critical facilities and the degree of damage; the darker the symbol, the more damage it sustained. The background shows the total losses for residential structures in each census tract in thousands of dollars based on this scenario.

Figure 4.3.2-1: At Least Moderately Damaged Critical Facilities Based on a Centrally Located 5.5 Moment Magnitude Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

In terms of transportation systems, HAZUS-MH predicts that one bus facility will be at least moderately damaged, but will have at least 50% functionality after a day.

For utility lifelines, the model estimates that 2 of 4 potable water systems, 10 of 12 waste water systems, 1 of 1 oil system, 1 of 1 electrical power system, and 1 of 2 communication systems will incur at least moderate damage. All are expected to be at least 50% functional after one week. It is estimated that out of 38,660 households, all will have potable water and 20,546 will not have electrical power at day one. By day three, 11,883 are still without electricity. This decreases to about 4,062 households without electricity at one week, 613 after one month, and 27 after three months.

Potential Losses, Results for Earthquake Scenario #2- 500-year Probabilistic: 5.5 Moment Magnitude in Warren County

In this scenario, HAZUS-MH estimates that about 326 buildings will be at least moderately damaged, which is over 1% of the total number of buildings in the county. Approximately 3 buildings will be damaged beyond repair. As shown, single family housing suffered the most damage, with other residential occupancy structures with second-most damage. Table 4.3.2-3 shows the approximate expected building damage by occupancy. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.2-3: Approximate Expected Building Damage by Occupancy Based on a 500-year Probabilistic, 5.5 Moment Magnitude Event in Warren County

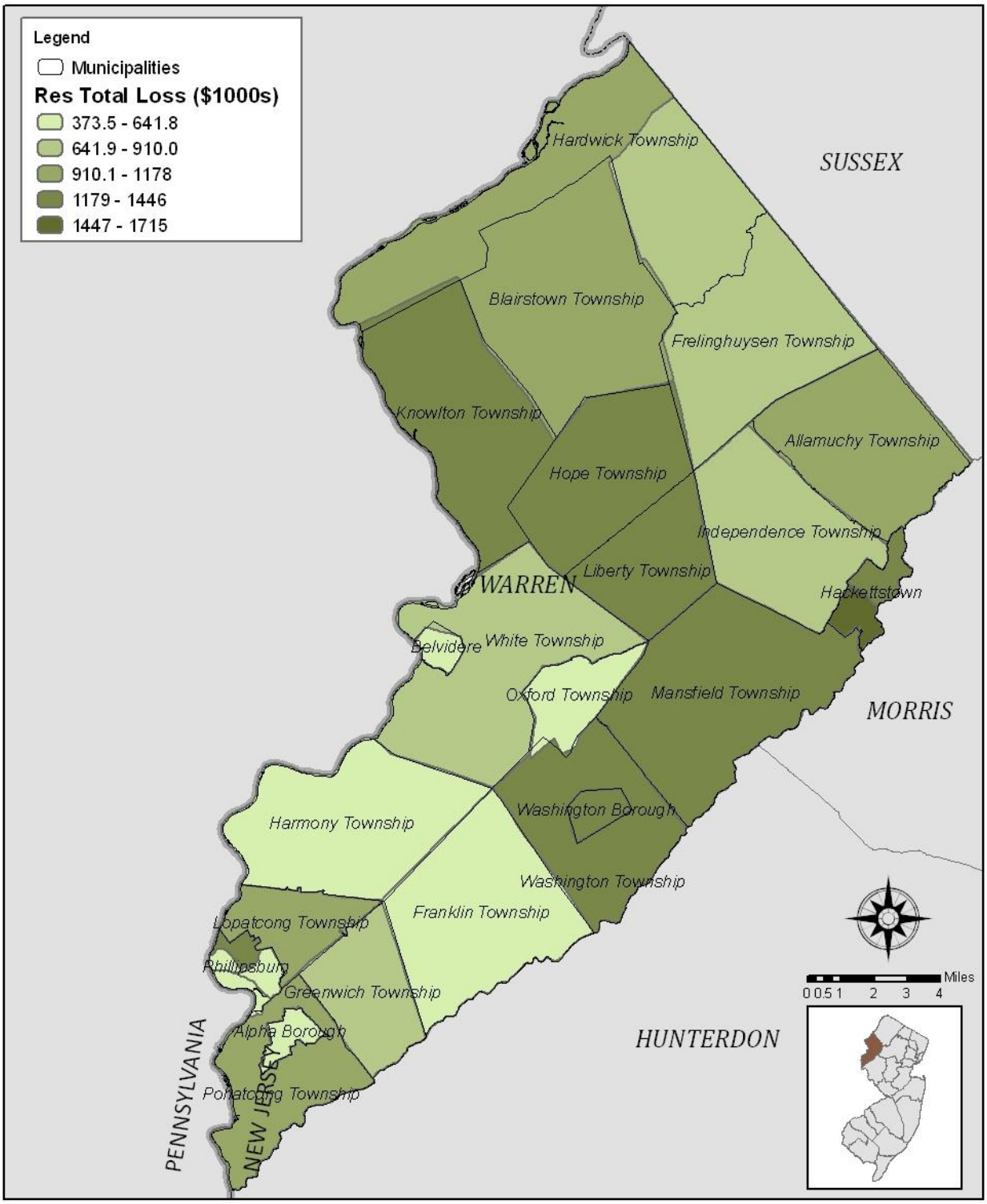
Occupancy	No Damage		Slight Damage		Moderate Damage		Extensive Damage		Complete Damage	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	246	0.59	11	1	3	1.14	0	1.11	0	0.61
Commercial	2,198	5.3	104	9.41	37	12.89	5	12.72	0	9.79
Education	88	0.21	4	0.35	1	0.46	0	0.42	0	0.4
Government	86	0.21	4	0.34	1	0.45	0	0.38	0	0.28
Industrial	798	1.92	35	3.19	13	4.41	2	3.95	0	2.62
Other Residential	6,840	16.48	236	21.36	77	27.15	9	24.39	1	23.12
Religion	165	0.4	7	0.64	3	0.95	0	1.06	0	1.05
Single Family	31,084	74.89	703	63.7	150	52.55	22	55.97	2	62.13
Total	**41,503**		**1,104**		**285**		**39**		**3**	

Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

Figure 4.3.2-2: Total Residential Losses by Census Tract Based on 500-year Probabilistic, 5.5 Moment Magnitude Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $20,570,000, with 26% of the total related to the business interruption of the county.

Casualties are also estimated for three different times of day in HAZUS-MH earthquake modeling as shown in Table 4.3.2-2.

Table 4.3.2-4: Approximate Expected Casualties Based on a 500-year Probabilistic, 5.5 Moment Magnitude Event in Warren County

Time of Day	Level 1 (Injuries without Hospitalization)	Level 2 (Injuries with Hospitalization)	Level 3 (Life-threatening if not Treated)	Level 4 (Death)
2:00 AM (Highest Residential Load)	5	1	0	0
2:00 PM (Highest Educational, Commercial, and Industrial Load)	5	1	0	0
5:00 PM (Highest Commute Time)	5	1	0	0

Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

HAZUS-MH estimates that approximately 15 households will be displaced due to this type of earthquake event. Of these displaced households, the model estimates that about 7 people will seek temporary shelter in public shelters.

For this earthquake scenario, HAZUS-MH predicts that approximately 10,000 tons of debris may be generated or approximately 360 truckloads (at 25 tons per truck). Of the total, 74% will consist of brick/wood and 26% of reinforced concrete/steel.

Critical Facilities at Risk, Results for Earthquake Scenario #2- 500-year Probabilistic: 5.5 Moment Magnitude in Warren County

HAZUS-MH estimates that none of the county's medical facilities will experiences at least moderate damage due to this earthquake. On the day of the earthquake, 54% of the county's hospital beds will be available for use by patients already in the hospital and those injured by the earthquake. After one week, 97% of the beds will be back in service, and 100% after 30 days.

The model predicts that none of the schools, emergency operations centers, police stations, and fire stations will expect at least moderate damage due to this type of event.

In terms of transportation systems, HAZUS-MH predicts that none of the railway facilities, light rail facilities, and airport facilities will have at least moderate damage due to this type of event.

For utility lifelines, the model estimates that none of the potable water systems, waste water systems, oil systems, electrical power systems, and communication systems will incur at least moderate damage.

Potential Losses, Results for Earthquake Scenario #3- Annualized Earthquake Losses for Warren County

In this scenario, HAZUS-MH estimates that about 144 buildings will be at least moderately damaged, which is over 0% of the total number of buildings in the county. It is estimated that zero buildings will be damaged beyond repair. Table 4.3.2-5 shows the approximate expected building damage by occupancy. As shown, single family housing had the most damage. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.2-5: Approximate Expected Building Damage by Occupancy Based on Annualized Earthquake Losses for Warren County

Occupancy	No Damage		Slight Damage		Moderate Damage		Extensive Damage		Complete Damage	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	135	0.35	0	0	0	0	0	0	0	0
Commercial	1,065	2.74	0	0	0	0	0	0	0	0
Education	4	0.01	0	0	0	0	0	0	0	0
Government	4	0.01	0	0	0	0	0	0	0	0
Industrial	316	0.81	0	0	0	0	0	0	0	0
Other Residential	6,180	15.91	65	8.74	10	7.3	0	0	0	0
Religion	78	0.2	0	0	0	0	0	0	0	0
Single Family	31,062	79.97	679	91.26	127	92.7	7	100	0	0
Total	**38,844**		**744**		**137**		**7**		**0**	

Source: HAZUS-MH MR4, Patch 2 Earthquake Analysis completed June 2010.

Notes:

(2) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $33,000, with 25% of the total related to the business interruption of the county.

There are estimated to be no casualties for estimated average losses.

HAZUS-MH estimates that approximately 15 households will be displaced due to this type of earthquake event. Of these displaced households, the model estimates that about 7 people will seek temporary shelter in public shelters.

As previously mentioned, AEL does not offer the full range of results that the other HAZUS-MH scenarios offer, and as such, critical facilities are not estimated by the AEL model.

Risk Assessment Next Steps for Earthquake / Geological Hazards

The population, demographics, and aggregated building stock in HAZUS-MH could be updated using 2010 Census data once available, or if local data is available to increase the accuracy of the results and produce a Level II analysis. The creation of a NEHRP soils class dataset for input into HAZUS-MH would also improve the results of the analysis, similar to the earthquake loss estimation studies that were conducted by the NJDEP's NJGS available at http://www.state.nj.us/dep/njgs/enviroed/hazus.htm. Documentation of any changes to zoning or building codes or any other mitigation actions may alter future risk assessments.

4.3.3 Flood

Methodology for Flood Hazard

Three different flood scenarios were chosen for analysis in HAZUS-MH MR4 Patch 2, a 100-year return period (1% annual chance), 500-year return period (.2% annual chance), and annualized losses. Annualized loss calculates five return periods, including the 10-, 50-, 100-, 200-, and 500-year, and estimates the maximum potential annual loss based on a sum of losses over all return periods multiplied by the probability of those floods occurring. Annualized losses only returns limited results, such as direct economic annualized losses for buildings.

The topographic data used in this analysis was the USGS's National Elevation Dataset at the 1/3 arc-second resolution, which is often referred to as the approximate 10 meter data. This data is publicly accessible, and can be downloaded from http://seamless.usgs.gov/. HAZUS-MH defaults to the 1 arc-second resolution dataset, however taking the extra time to download and process the 1/3 arc-second dataset can provide improved results in the model.

A simplified explanation of the process HAZUS-MH utilizes in the flood model is:

- Utilize topography (in this case, USGS NED data) to generate a stream network
- Choose the reaches to be included in the analysis
- Run hydrology to create discharge values
- Run hydraulics and create flood elevations, flood depth grids, and delineate floodplains
- Run analysis to generate results based on data created in previous steps, inventory, and damage curves (degree of damage to a structure is based on depth of flooding)

Again, this is an extremely simplified description of the modeling process, for a more detailed description; see the HAZUS-MH MR4 Technical and User Manuals available online from FEMA.

It should be noted for all Warren County flood assessments that a three small segments of a reach of the Delaware River between Martin's Creek and Allegheny Creek on the western border of the County were considered 'problem reaches' and could not be processed by HAZUS-MH. Although not a large area, the inclusion of this reach would increase any estimated damages. The problem reaches are visible on Figure 4.3.3-1.

Potential Losses for Flood

Building losses are separated into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage to the building and its contents. Direct building damages are categorized based on the structure's building occupancy or use; such as residential, commercial, industrial, and others. The business interruption losses are the losses associated with the inability to operate a business and includes the temporary living expenses for people displaced from their homes due to damages from flooding.

Estimates of casualties are not provided by the HAZUS-MH flood model.

HAZUS-MH provides estimates for the number of households that might be displaced from their homes due to flooding and the number of displaced people that may seek accommodations in temporary public shelters. In the flood model, displacement includes households evacuated from within or very near to the inundated area.

HAZUS-MH estimates the amount of debris that will be generated due to the flood event and separates debris into three types: finishes (dry wall, insulation, etc), structural (wood, brick, etc), and foundations (concrete slab, concrete block, rebar, etc). This distinction is made because there are different types of material handling equipment needed to handle the three types of debris.

Critical Facilities Risk for Flood

The risk to critical facilities is dependent on their proximity to flood areas. Although flooding can occur anywhere, it is best to choose critical facility locations that are outside the floodplain.

A critical facility would encounter many of the same impacts as any other building within the county, depending on the level of building code used to construct the structure. These impacts include structural failure and loss of facility functionality. In other words, a damaged police station may not be able to serve the community.

The HAZUS-MH flood model also estimates losses for some transportation and utility lifeline categories, including highway bridges, waste water facilities, and potable water facilities.

As previously mentioned, essential facilities, potable water facilities, and waste water facilities were updated before analysis based on DRBC and local updates.

Potential Losses, Results for Flood Scenario #1- 100-year Return Period Event in Warren County

In a 100-year return period event, HAZUS-MH estimates that about 155 buildings will be at least moderately damaged, which is over 5% of the total number of buildings in the county. Approximately 60 buildings will be damaged beyond repair. As shown, residential housing suffered the most damage. Table 4.3.3-1 shows the approximate expected building damage by occupancy. In Table 4.3.3.-1, the "damage states" are 1-10% is considered slight, 11-20%, 21-30%, 31-40%, 41-50%, and any structures damaged more than 50% are considered substantially damaged. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.3-1: Approximate Expected Building Damage by Occupancy Based on 100-year Event in Warren County

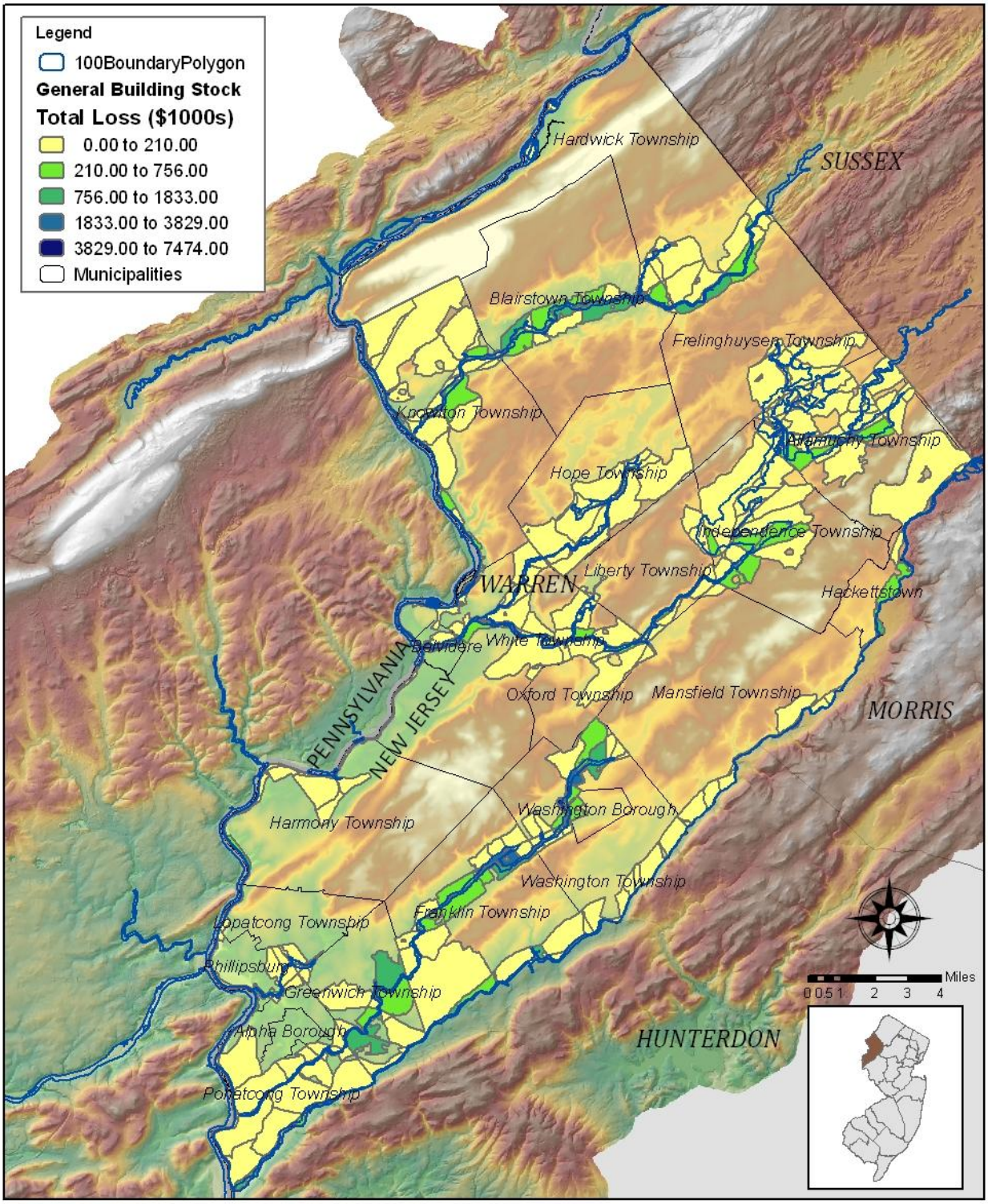
Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	2	1.28	12	7.69	34	21.79	47	30.13	61	39.10
Total	**0**		**2**		**12**		**34**		**47**		**61**	

Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

Figure 4.3.3-1: General Building Stock Damaged Based on 100-year Flood Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

The total economic loss estimated for the flood is about $133,210,000 which represents 8.28% of the total replacement value of the scenario buildings. HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $131,100,000, with 1% of the total related to the business interruption of the county.

HAZUS-MH estimates that approximately 760 households will be displaced due to this flooding event. Of these displaced households, the model estimates that about 1,040 people will seek temporary shelter in public shelters.

For this flooding scenario, HAZUS-MH predicts that approximately 11,925 tons of debris may be generated or approximately 480 truckloads (at 25 tons per truck). Of the total, finishes consist of 38%, structure comprises 35%, and foundations about 27%.

Critical Facilities at Risk, Results for Flood Scenario #1- 100-year Return Period Event in Warren County

HAZUS-MH estimates that none of the county's 2 medical facilities, none of the 4 EOCs, 1 of the 19 fire stations, 1 of the 12 police stations, and 4 of the 51 schools will experiences at least moderate damage and loss of use due to the flooding event, as shown in Table 4.3.3-2.

Table 4.3.3-2: Expected Damaged Essential Facilities Based on 100-year Event in Warren County

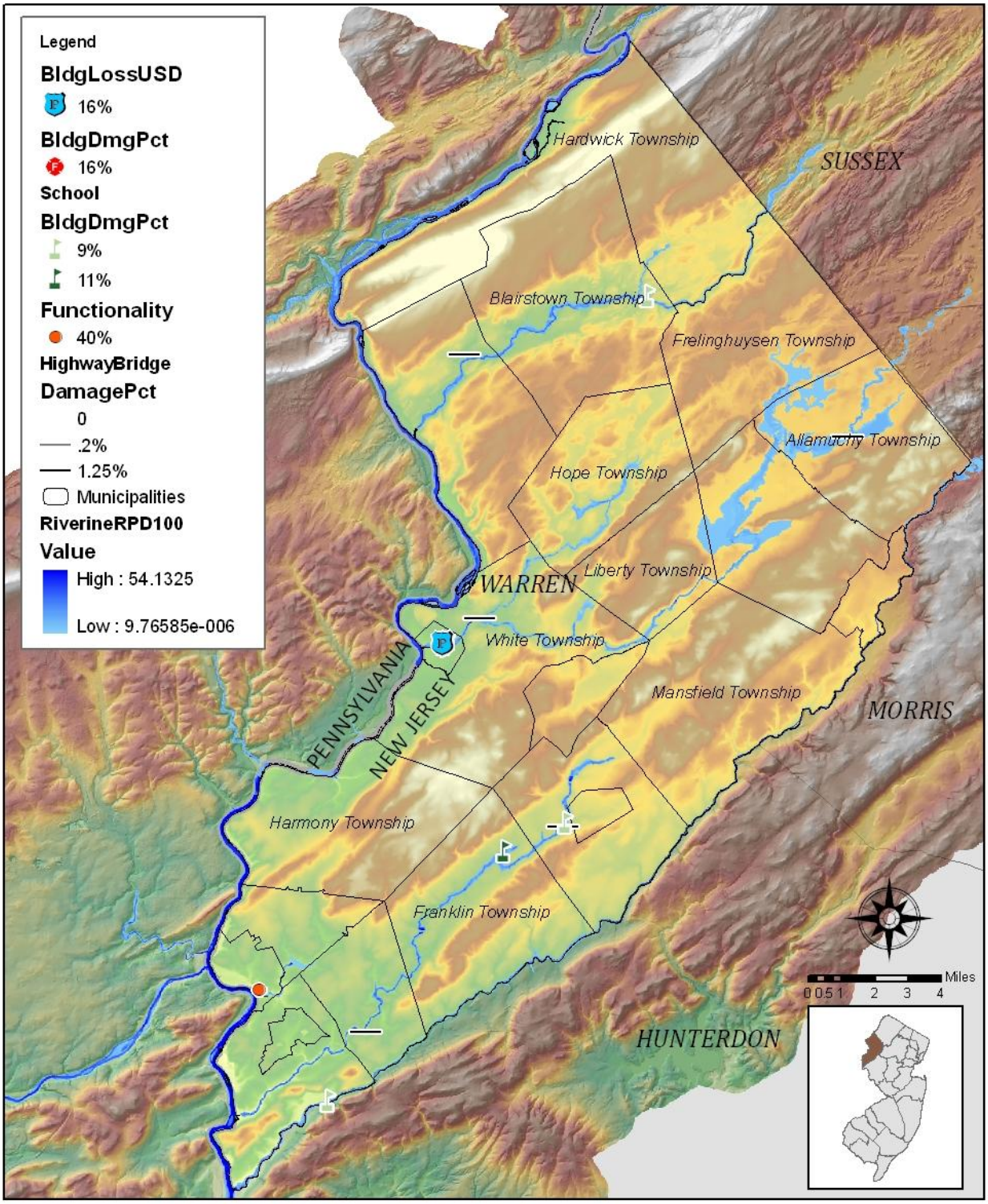
Facility Name	Facility Type	Total Building Damage %	Total Content Damage %	Non-Functional Facility?	Average Restoration Time
Good Will Fire Company	Fire Station	15.60%	73.29%	Yes	630 Days
Belvidere Police Department	Police Station	15.60%	73.29%	Yes	630 Days
Blairstown Elementary	School	9.60%	66.40%	Yes	630 Days
Warren County Voc & Tech Ins	School	10.65%	69.31%	Yes	630 Days
Good Shepherd Christian Academy	School	9.53%	66.12%	Yes	630 Days
Stepping Stone School	School	9.00%	60.01%	Yes	480 Days

Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing a combination of default HAZUS-MH data and updated local data. These results should be used for planning purposes only.

Figure 4.3.3-2: Damaged Critical Facilities Based on 100-year Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

In terms of transportation systems, HAZUS-MH predicts that none of the railway facilities, light rail facilities, and airport facilities will have damage due to this type of event. However, ten highway bridges will sustain less than 2% damage.

For utility lifelines, the model estimates that none of the potable water facilities, oil systems, electrical power systems, and communication systems will incur any damage. The Phillipsburg Town of STP waste water system facility will sustain about 40% damage and will not be functional.

Potential Losses, Results for Flood Scenario #2- 500-year Return Period Event in Warren County

In a 500-year return period event, HAZUS-MH estimates that about 195 buildings will be at least moderately damaged, which is over 3% of the total number of buildings in the County. Approximately 92 buildings will be damaged beyond repair. As shown, residential housing suffered the most damage. Table 4.3.3-3 shows the approximate expected building damage by occupancy. In Table 4.3.3.-3, the "damage states" are 1-10% is considered slight, 11-20%, 21-30%, 31-40%, 41-50%, and any structures damaged more than 50% are considered substantially damaged. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.3-3: Approximate Expected Building Damage by Occupancy Based on 500-year Event in Warren County

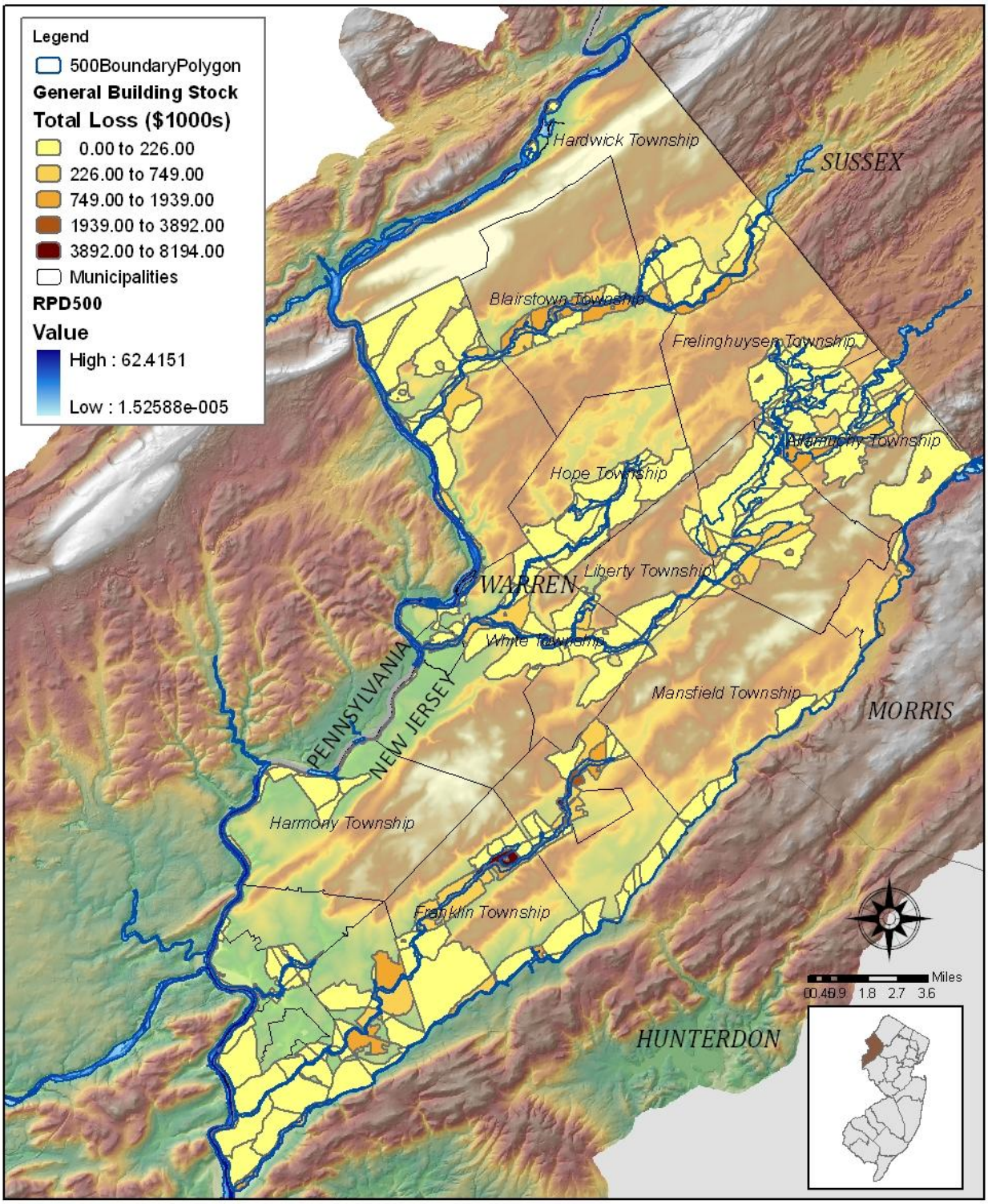
Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%	Damaged Structures	%
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	1	100
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	0	0	2	1.04	10	5.21	33	17.19	56	29.17	91	47.40
Total	**0**		**2**		**10**		**33**		**56**		**92**	

Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

Notes:

(2) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

Figure 4.3.3-3: General Building Stock Damaged Based on 500-year Flood Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

The total economic loss estimated for the flood is about $162,450,000 which represents 10.10% of the total replacement value of the scenario buildings. HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $159,850,000 with 1% of the total related to the business interruption of the county.

HAZUS-MH estimates that approximately 865 households may be displaced due to this flooding event. Of these displaced households, the model estimates that about 1,220 people will seek temporary shelter in public shelters.

For this flooding scenario, HAZUS-MH predicts that approximately 16,320 tons of debris may be generated or approximately 650 truckloads (at 25 tons per truck). Of the total, finishes consist of 34%, structure comprises 38%, and foundations about 26%.

Critical Facilities at Risk, Results for Flood Scenario #2- 500-year Return Period Event in Warren County

HAZUS-MH estimates that none of the county's 2 medical facilities, none of the 4 EOCs, 2 of the 19 fire stations, 1 of the 12 police stations, and 4 of the 51 schools will experiences at least moderate damage and loss of use due to the flooding event, as shown in Table 4.3.3-4.

Table 4.3.3-4: Expected Damaged Essential Facilities Based on 500-year Event in Warren County

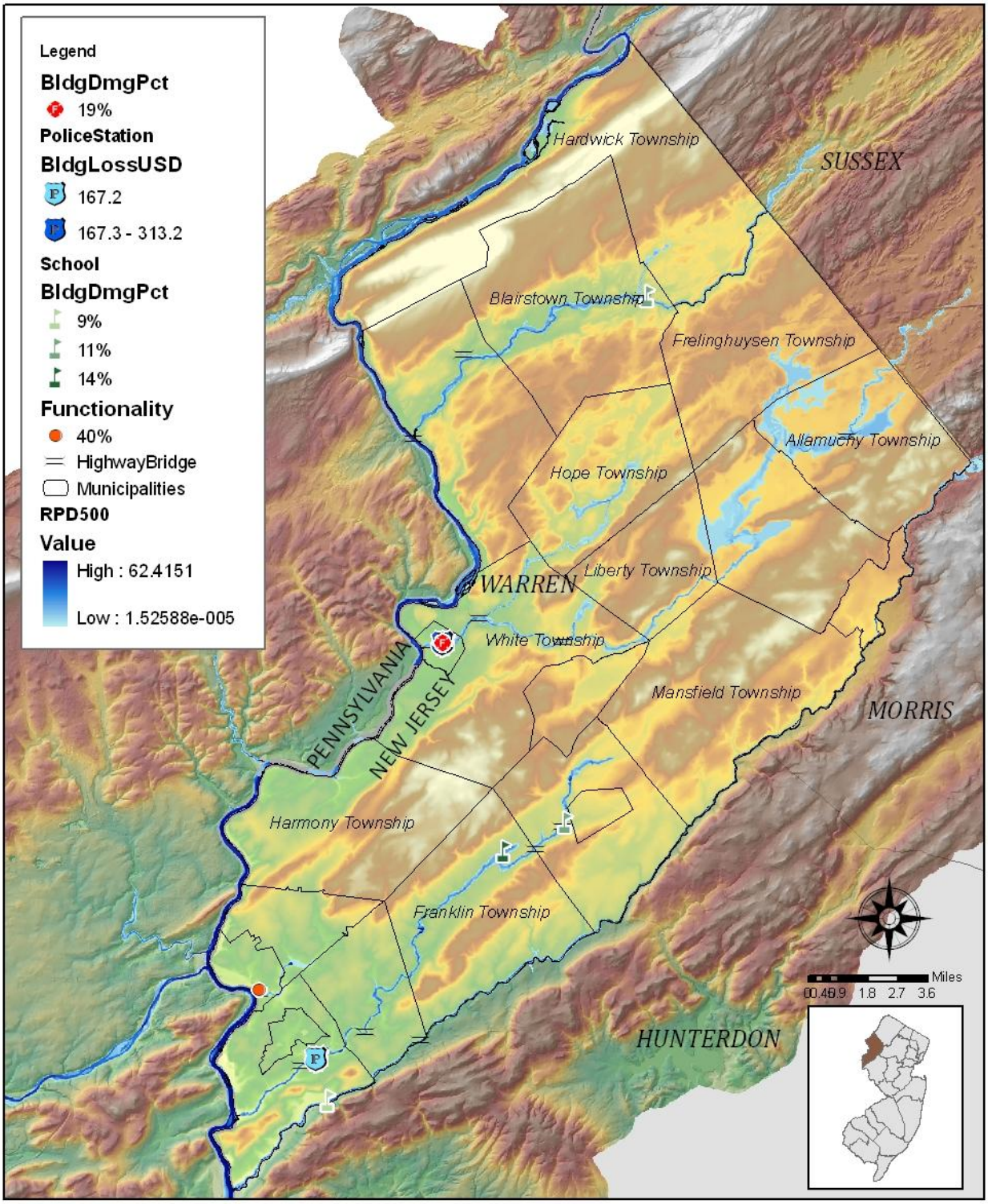
Facility Name	Facility Type	Total Building Damage %	Total Content Damage %	Non-Functional Facility?	Average Restoration Time
Good Will Fire Company	Fire Station	18.80%	85.79%	Yes	630 Days
Belvidere Police Department	Police Station	18.80%	85.79%	Yes	630 Days
Pohatcong Township Police Department	Police Station	10.04%	20.65%	Yes	480 Days
Blairstown Elementary	School	11.00%	70.00%	Yes	630 Days
Warren County Voc & Tech Ins	School	13.73%	73.10%	Yes	630 Days
Good Sheperd Christian Academy	School	10.67%	69.34%	Yes	630 Days
Stepping Stone School	School	9.00%	60.01%	Yes	480 Days

Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

Notes:

(2) These results are based on a default, Level I analysis utilizing a combination of default HAZUS-MH data and updated local data. These results should be used for planning purposes only.

Figure 4.3.3-4: Damaged Critical Facilities Based on 500-year Flood Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Flood Analysis completed June 2010.

In terms of transportation systems, HAZUS-MH predicts that none of the railway facilities, light rail facilities, and airport facilities will have damage due to this type of event. However, eleven highway bridges will sustain less than 3% damage.

For utility lifelines, the model estimates that none of the potable water facilities, oil systems, electrical power systems, and communication systems will incur any damage. The Phillipsburg Town of STP waste water system facility will sustain about 40% damage and will not be functional.

Potential Losses, Results for Flood Scenario #3- Annualized Flood Losses in Warren County

HAZUS-MH estimates that the maximum potential annualized loss in Warren County totals approximately $29,110,000 for building damages, $15,022,000 for contents damages, and $487,000 for inventory losses. This is a building loss ratio of %1. Income losses include $2,000 for relocation losses, $91,000 for lost wages, and $0 in rental income losses. The total annualized loss is approximately $29,218,000.

As previously mentioned, annualized losses does not offer the full range of results that the other HAZUS-MH scenarios offer, and as such, critical facilities are not estimated.

Risk Assessment Next Steps for Flood Hazard

The population, demographics, and aggregated building stock in HAZUS-MH could be updated using 2010 Census data once available, or if local data is available to increase the accuracy of the results and produce a Level II analysis. The DFIRM data or DFIRM-generated depth grids could be input directly into HAZUS-MH for a more accurate depiction of the hazard and loss results for a Level II analysis. Documentation of any changes to zoning or building codes or any other mitigation actions that may alter future risk assessments.

4.3.4 High Wind – Straight-line Winds

Methodology for High Wind – Straight-line Winds

As discussed in Section 3.3.6, straight line high wind hazards include a variety of different types of wind events, however HAZUS-MH offers a tested methodology in its hurricane wind model that is representative of straight line wind events. HAZUS-MH will be used to simulate a historic event using current inventory and a probabilistic scenario. The first scenario is as if Hurricane Floyd was to occur today, and the second is a 100 year probabilistic event, with some annualized results provided.

Potential Losses for High Wind – Straight-line Winds

The hurricane wind model is the least comprehensive of the three HAZUS-MH models, but provides a number of useful results. Building losses are separated into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage to the building and its contents. Direct building damages are categorized based on the structure's building occupancy or use; such as residential, commercial, industrial, and others. The business interruption losses are the losses associated with the inability to operate a business and includes the temporary living expenses for people displaced from their homes due to damages from hurricane winds.

HAZUS-MH also provides estimates for the number of displaced households that might be displaced from their homes due to the earthquake and the number of displaced people that may seek accommodations in temporary public shelters.

HAZUS-MH estimates the amount of debris that will be generated due to the earthquake event and separates debris into three types; brick/wood, reinforced concrete/steel, and tree debris. This distinction is made because there are different types of material handling equipment needed to handle the three types of debris.

Critical Facilities Risk for High Wind – Straight-line Winds

All critical facilities are vulnerable to wind events. A critical facility would encounter many of the same impacts as any other building within the County, depending on the level of building code used to construct the structure. These impacts include structural failure and loss of facility functionality. In other words, a damaged police station may not be able to serve the community.

The HAZUS-MH hurricane wind model does not provide transportation and utility system losses at this time.

As previously mentioned, essential facilities were updated before analysis based on DRBC and local updates.

Potential Losses, Results for Hurricane Winds Scenario #1- Hurricane Floyd Wind Event in Warren County

In this scenario, HAZUS-MH estimates that the peak wind gust will be 68 mph, which will cause about 2 buildings to sustain at least moderate damage, which is less than 1% of the total number of buildings in the county. Zero buildings will be damaged beyond repair. Table 4.3.4-1 shows the approximate expected building damage by occupancy. As shown, residential housing suffered the most damage. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.4-1: Approximate Expected Building Damage by Occupancy Based on Hurricane Floyd Wind Event in Warren County

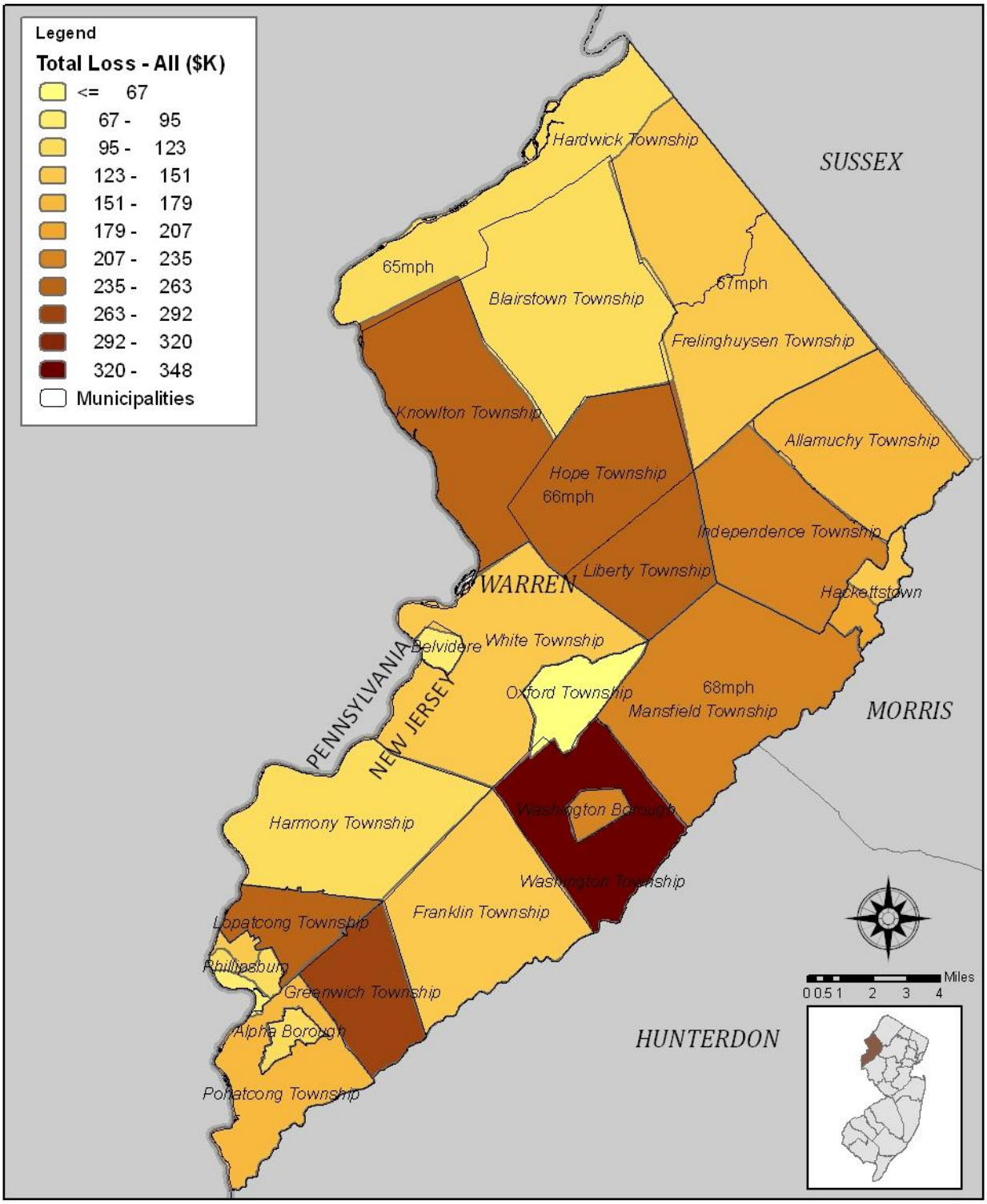
Occupancy	None		Minor Damage		Moderate Damage		Severe Damage		Complete Damage	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	260	99.68	1	0.31	0	0	0	0	0	0
Commercial	2,335	99.6	9	0.39	0	0	0	0	0	0
Education	93	99.58	0	0.42	0	0	0	0	0	0
Government	91	99.56	0	0.44	0	0	0	0	0	0
Industrial	843	99.55	4	0.45	0	0	0	0	0	0
Religion	174	99.69	1	0.31	0	0	0	0	0	0
Residential	39,054	99.82	67	0.17	2	0.01	0	0	0	0
Total	**42,849**		**83**		**2**		**0**		**0**	

Source: HAZUS-MH MR4, Patch 2 Hurricane Wind Analysis completed June 2010.

Notes:

(2) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

Figure 4.3.4-1: Total Losses by Census Tract and Wind Speeds Based on Hurricane Floyd Wind Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Hurricane Wind Analysis completed June 2010.

HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $4,000,000, with 1% of the total related to the business interruption of the county.

HAZUS-MH estimates that no households will be displaced due to this wind event, and therefore no one will seek temporary shelter in public shelters.

For this hurricane wind scenario, HAZUS-MH predicts that approximately 2,350 tons of debris may be generated or approximately 11 truckloads (at 25 tons per truck). Of the total, 12% will consist of brick/wood, 0% of reinforced concrete/steel, and 88% tree debris.

Critical Facilities at Risk, Results for Hurricane Winds Scenario #1- Hurricane Floyd Wind Event in Warren County

HAZUS-MH estimates that none of the county's medical facilities, emergency operations centers, police stations, fire stations, or schools should expect any damage due to this wind event.

Potential Losses, Results for Hurricane Winds Scenario #2- 100-year Wind Event in Warren County

In this scenario, HAZUS-MH estimates that the peak wind gust will be 70 mph, which will cause about 2 buildings to sustain at least moderate damage, which is less than 1% of the total number of buildings in the county. Zero buildings will be damaged beyond repair. One building will be damaged beyond repair. Table 4.3.4-2 shows the approximate expected building damage by occupancy. As shown, residential housing suffered the most damage. Note that some of the inventory includes data that is also included in the critical facilities data and should not be double-counted when losses are determined, for example education and schools.

Table 4.3.4-2: Approximate Expected Building Damage by Occupancy Based on 100-year Wind Event in Warren County

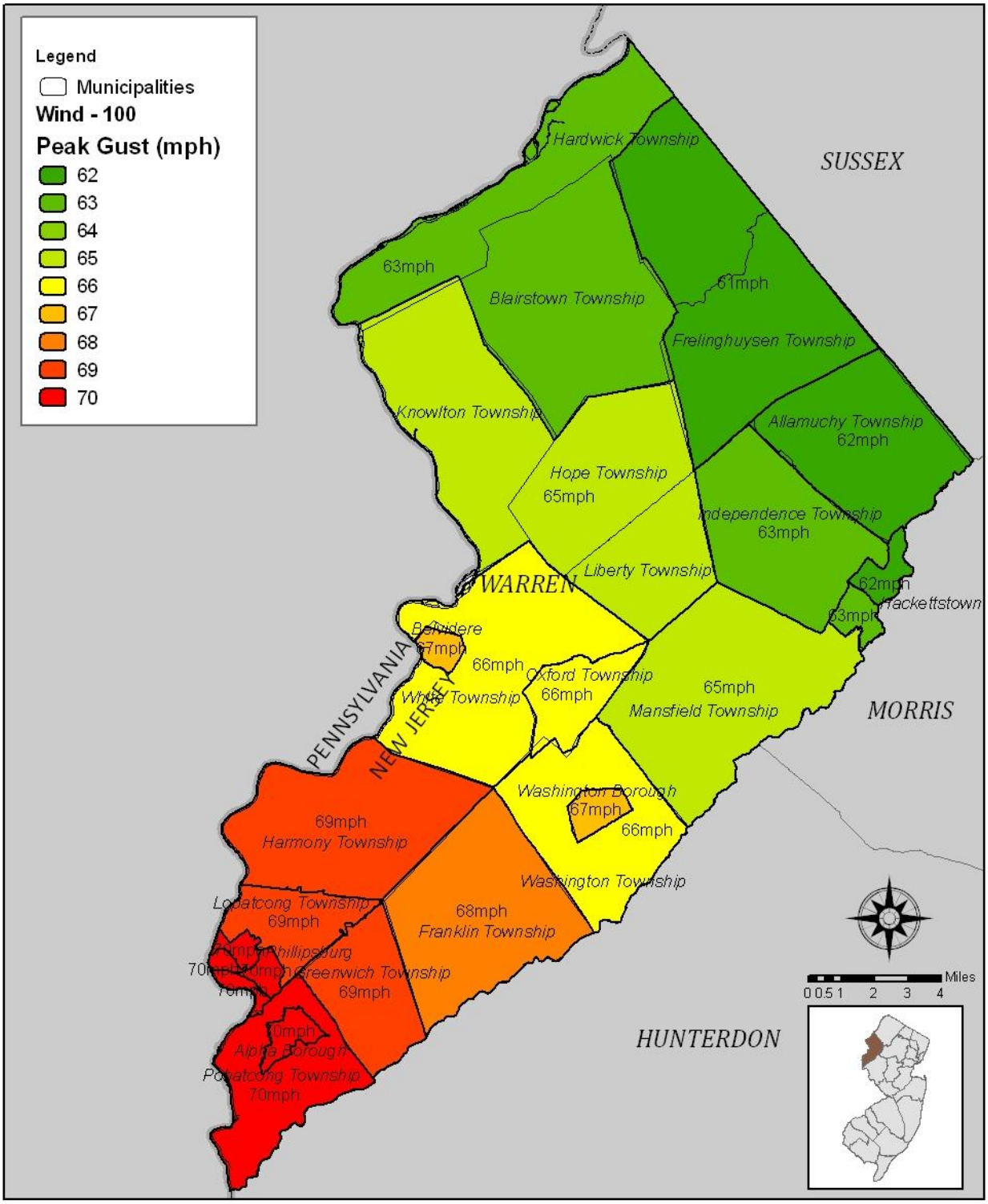
Occupancy	None		Minor Damage		Moderate Damage		Severe Damage		Complete Damage	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	260	99.69	1	0.31	0	0	0	0	0	0
Commercial	2,335	99.6	9	0.39	0	0	0	0	0	0
Education	93	99.58	0	0.42	0	0	0	0	0	0
Government	91	99.56	0	0.44	0	0	0	0	0	0
Industrial	843	99.55	4	0.45	0	0	0	0	0	0
Religion	174	99.68	1	0.32	0	0	0	0	0	0
Residential	39,049	99.81	72	0.18	2	0.01	0	0	0	0
Total	**42,845**		**87**		**2**		**0**		**0**	

Source: HAZUS-MH MR4, Patch 2 Hurricane Wind Analysis completed June 2010.

Notes:

(1) These results are based on a default, Level I analysis utilizing aggregated 2000 Census Bureau data. These results should be used for planning purposes only.

Figure 4.3.4-2: Peak Gust Wind Speeds Based on 100-year Wind Event in Warren County



Source: HAZUS-MH MR4, Patch 2 Hurricane Wind Analysis completed June 2010.

HAZUS-MH also estimated total building-related losses for this scenario, which total approximately $4,000,000, with 1% of the total related to the business interruption of the county.

The hurricane wind model provides annualized economic losses for a hurricane wind event. The residential property damage annualized losses are approximately $324,000 and total property damage (all occupancy types) around $372,000. Annualized business interruption (income) losses are estimated at $37,000.

HAZUS-MH estimates that no households will be displaced due to this wind event, and therefore no one will seek temporary shelter in public shelters.

For this hurricane wind scenario, HAZUS-MH predicts that approximately 19,920 tons of debris may be generated or approximately 225 truckloads (at 25 tons per truck). Of the total, 28% may consist of brick/wood, 0% of reinforced concrete/steel, and 72% tree debris.

Critical Facilities at Risk, Results for Hurricane Winds Scenario #2 – 100-year Wind Event in Warren County

HAZUS-MH estimates that none of the county's medical facilities, emergency operations centers, police stations, fire stations, or schools should expect any damage due to this wind event.

Risk Assessment Next Steps for High Wind – Straight-line Wind Hazard

The population, demographics, and aggregated building stock in HAZUS-MH could be updated using 2010 Census data once available, or if local data is available to increase the accuracy of the results and produce a Level II analysis in the Hurricane Wind model. Attention could be paid to the scientific community and the news of any new or significant improvements for high wind risk assessment methodologies that could be implemented in future analysis. Documentation could be made of any changes to zoning or building codes or any other mitigation actions that may alter future risk assessments.

4.3.5 Severe Weather – Winter

Methodology for Severe Weather – Winter

Unlike flood, earthquake, or hurricane wind hazards, there are no standard loss estimation models or methodologies for the winter storm hazard. In most cases, potential losses from winter storms are difficult to quantify. The SHELDUS 7.0 and NCDC database compiled in Section 3.3.10 is used to project future expected damages for Warren County utilizing a 100-year planning horizon and the OMB required 7% discount rate.

Potential Losses Due to Severe Weather – Winter

Table 4.3.5-1 shows the basic data that is utilized for the risk assessment and lists the data source.

Table 4.3.5-1: Severe Winter Weather Risk Assessment Parameters for Warren County for 1960 – 2010

Data	Source	Value
Loss-Causing Winter Storm Events	SHELDUS and NCDC	41
Time Extent in Years	SHELDUS and NCDC go back to 1960	50 years
Average Annual Number of Significant Winter Storm Events	# events/# years =	.82 average events per year
Total Reported Damages Due to Winter Storms (Adjusted for 2010 Inflation)	SHELDUS and NCDC	$6,854,536 in 2010 dollars
Estimated Annual Damages	Total $/# years =	$137,091
Reported Death	# deaths/# years =	13.48 deaths
Average Annual Deaths	SHELDUS and NCDC	.2696 average deaths per year
Value of Single Death	FEMA's *BCA Reference Guide*, Final June 2009	$5,800,000
Estimated Annual Cost of Deaths Due to Winter Storms	Average annual deaths * Value =	$1,563,680
Reported Injuries	SHELDUS and NCDC	4.27 injuries
Average Annual Injuries	# injuries/# years =	.0854 average injuries per year
Value of Single Injury	FEMA's *BCA Reference Guide*, Final June 2009 (see Note (3))	$396,667
Estimated Annual Cost of Injuries Due to Winter Storms	Average annual injuries * Value =	$33,875

Source: SHELDUS 7.0 and NCDC

Notes:

(1) For further information regarding specific significant winter weather events, see Table 3.3.10-1.
(2) Valuations for a single death obtained from FEMA's *BCA Reference Guide*, Final June 2009, p94.
(3) Valuation for a single injury is an average of the three severity categories of injury from FEMA's *BCA Reference Guide*, Final June 2009, p94. Since it is unknown whether these injuries are considered 'Hospitalized', 'Treat & Release', or 'Self-Treatment'.

The calculated annual damages, estimated annual cost of deaths, and annual cost of injuries data from Table 4.3.5-1 can be used for a simplified projection of future expected damages based on a standard present value coefficient of 14.27. This represents the 100-year planning horizon with the calculated 7% discount rate that is required by OMB.

Table 4.3.5-2: Estimated Risk for Warren County Due to Severe Winter Storms

Data	Value
Estimated Annual Damages	$137,091
Projected 100-year Risk Due to Winter Storm Damages	$1,956,285
Estimated Annual Cost of Deaths	$1,563,680
Projected 100-year Risk Due to Winter Storm Deaths	$22,313,714
Estimated Annual Cost of Injuries	$33,875
Projected 100-year Risk Due to Winter Storm Injuries	$483,396
Estimated Average Annual Risk Due to Winter Storms	**$1,734,646**
Estimated 100-year Total Risk Due to Severe Winter Storms	**$24,753,395**

The total estimated 100-year risk from severe winter storm events for Warren County is $24,753,395, as shown in Table 4.3.5-2. Unfortunately, municipality specific data is not available from SHELDUS 7.0 or NCDC regarding winter weather hazards. However, 2000 Census Bureau data can be used to calculate the percentage of the population in each municipality, and then multiply the percentage of the county's population in that municipality by the estimated 100 year total risk. This is a rough estimate, and should be utilized for planning purposes only.

Table 4.3.5-3: Estimated 100-year Projected Risk from Winter Weather Events in Warren County Municipalities

Municipality	2000 Census Bureau Population	Percentage of County Population	Estimated Average Annual Risk	Estimated 100-year Total Risk
Allamuchy Township	3,877	3.78%	$65,652	$936,858
Alpha Borough	2,482	2.42%	$42,030	$599,763
Belvidere Town	2,771	2.71%	$46,924	$669,598
Blairstown Township	5,747	5.61%	$97,318	$1,388,734
Franklin Township	2,768	2.70%	$46,873	$668,874
Frelinghuysen Township	2,083	2.03%	$35,273	$503,347
Greenwich Township	4,365	4.26%	$73,916	$1,054,781
Hackettstown Town	10,403	10.16%	$176,162	$2,513,834
Hardwick Township	1,464	1.43%	$24,791	$353,768
Harmony Township	2,729	2.66%	$46,212	$659,449
Hope Township	1,891	1.85%	$32,022	$456,951
Independence Township	5,603	5.47%	$94,880	$1,353,937
Knowlton Township	2,977	2.91%	$50,412	$719,377
Liberty Township	2,765	2.70%	$46,822	$668,149
Lopatcong Township	5,765	5.63%	$97,623	$1,393,084
Mansfield Township	6,653	6.49%	$112,660	$1,607,665

Municipality	2000 Census Bureau Population	Percentage of County Population	Estimated Average Annual Risk	Estimated 100-year Total Risk
Oxford Township	2,307	2.25%	$39,066	$557,475
Phillipsburg Town	15,166	14.81%	$256,818	$3,664,789
Pohatcong Township	3,416	3.33%	$57,846	$825,460
Washington Borough	6,712	6.55%	$113,660	$1,621,922
Washington Township	6,248	6.10%	$105,802	$1,509,798
White Township	4,245	4.14%	$71,884	$1,025,783
County Totals	**102,437**	**100%**	**$1,734,646**	**$24,753,395**

As shown in Table 4.3.5-3, Phillipsburg Town, Hackettstown Town, Washington Borough, Mansfield Township, and Washington Township have the highest estimated risk. However, this is simply due to the fact that there is equal risk for a significant winter weather event throughout the county and these were the largest populated municipalities according to the 2000 Census Bureau Data.

Critical Facilities Risk Due to Severe Weather – Winter

All of the critical facilities throughout Warren County are at equal risk of damage from a significant winter weather event. Critical facilities include the following essential facilities: police stations, fire stations, medical facilities, emergency operation centers, and schools. See Section 4.2.3 for a summary of the inventory of the critical facilities that could be impacted in Warren County.

4.4 Summary of Risk Assessment

The purpose of conducting risk assessments for potential hazards in Warren County is to provide a basis to make informed decisions and prioritizations for mitigation actions and efforts. Section 3 identifies and profiles hazards, while Section 4 goes into greater detail to evaluate where the most significant risks are and to quantify potential losses. Earthquake, flood, and hurricane winds have an established methodology for assessing losses, embodied in the HAZUS-MH software, whereas dam failure can be assessed building off of existing engineered data, and severe winter weather does not have a hazard-specific methodology to follow. Severe winter weather and straight-line high winds, have a more uniform exposure to risk across the county, while flood and dam failure have more specific locations where the risk is highest. Earthquake hazards may have a higher risk in certain areas of the county due to soil type, proximity to faults, and landslide factors, these areas are difficult to identify at the present time based on current science and therefore the entire county is currently considered to be at equal risk to earthquakes.

Table 4.4-1 compares annualized losses by hazard for Warren County. As shown, flood has the highest potential losses per year, then earthquake, straight line high winds, and finally winter severe weather. Placing these costs in a context of the percentage of building stock provides a way to quantify the risk and an indicator for prioritization. Keep in mind that all of the methodologies are not equal and that each hazard has its own characteristics, including geographic extent, which must be taken into consideration when planning mitigation actions.

Table 4.4-1: Summary of Potential Annualized Losses by Hazard for Warren County

Hazard	Annualized Losses	Represents	Source / Methodology	% of Building Stock ($8,662,001,000)
Dam Failure	N/A	-	-	-
Earthquake / Geological	$410,000	Economic - Total Property Damage (Capital Stock Losses) & Business Interruption Losses	HAZUS-MH MR4, Patch 2 – Earthquake Model	.004733%
Flood	$29,218,000	Economic – Property, Contents, & Inventory (Capital Stock Losses) & Business Interruption Losses	HAZUS-MH MR 4, Patch 2 – Flood Model	.337312%
High Wind – Straight Line	$409,000	Economic - Total Property Damage (Capital Stock Losses) & Business Interruption Losses	HAZUS-MH MR 4, Patch 2 - Hurricane Wind Model	.004722%
Severe Weather – Winter	$137,091 ($1,734,646)	Estimated Average Annual Damages (includes deaths and injuries)	100-year planning horizon methodology	.001583% (.020026%)

Notes:

(1) When conducting comparisons, be sure to use the same type of losses; for example do not use severe winter weather's value that includes deaths and injuries in comparison to flood's total property damage or you will not get an accurate portrayal.

(2) For planning purposes only.

(3) Unable to provide annualized losses for dam failure based on current information.

Dam Failure

The infrastructure throughout our nation is aging, and inspections and maintenance by trained professionals such as engineers on-site is imperative. The analysis provided in Section 4 is a first step towards understanding the risks associated with dam failure. There are many other dams within the county that have inherent risk that are not studied in this Plan. There is not enough available information to make specific conclusions regarding the risks of dam failure as a whole throughout the county.

Earthquake/Geological

As discussed in Section 3.3.3, there is a moderate degree of earthquake risk in the county. The analysis provided in Section 4 provides three different scenarios, one being arbitrary utilizing a 5.5M event with a centrally-located epicenter, and the other two exploring probabilistic losses. All three are based on default soil, landslide data, and building codes. Although earthquake science is not fully developed for the east coast, stricter building codes and construction methods can go a long way in reducing the risk for those structures. Retrofitting critical facilities, such as hospitals, is also an important consideration. HAZUS-MH can also be utilized to evaluate these specific mitigation actions, however a Level II analysis should be utilized for this type of study.

Flood

The HAZUS-MH Level I analysis provided here includes updates to the essential facilities, potable water facilities, and waste water facilities based on local data and is based on a higher resolution 1/3 arc-second Digital Elevation Model. In conjunction with the Repetitive Loss and Severe Repetitive Loss information provided in Section 3.3.4 and the new FEMA DFIRM maps and data, this analysis is a good basis for prioritizing efforts based on losses and geographic areas of risk. There are also a number of other excellent studies including; the *Delaware River Basin Flood Analysis Model Project* which evaluates effects of reservoir voids and release operations on downstream flood crests for the September 2004, April 2005, and June 2006 storm events, Delaware River Basin Commission's *A Multi-Jurisdictional Flood Mitigation Plan for Municipalities in the Non-tidal, New Jersey portion of the Delaware River Basin* discussed in Section 3.3.4 provides detailed flood mitigation actions for specific municipalities, *Updated Hydrologic Information for the Main Stem of the Delaware River* lead by USGS, NJ & NY Water Science Centers, and USACE Philadelphia District, and the very relevant upcoming *Delaware River Basin Interim Feasibility Study for New Jersey* led by USACE Philadelphia District expected 2013 to evaluate possible flood mitigation options.

High Wind – Straight-Line

As discussed in Section 3.3.3, there is a variety of different types of hazards that can affect the county and impact its communities. The analysis provided in this Plan utilizes HAZUS-MH's Hurricane Wind model to create a historical event based on Hurricane Floyd's characteristics and a second scenario utilizing probabilistic statistics. HAZUS-MH can also be utilized to evaluate specific mitigation actions, such as adding shutters to a certain number of structures. Before these types of analysis are undertaken, the inventory data should be updated further based on more recent and local information.

Severe Weather – Winter

As mentioned in Section 4, severe winter weather is difficult to evaluate as a risk, both geographically and by losses. In this Plan, a traditional 100-year planning horizon methodology that uses historic events was utilized to provide some basis for comparison. However, it is difficult to support specific conclusions or prioritizations based on this approach.

Relative Risks by Municipality in Warren County

Table 4.4-2 provides a general comparison of hazard vulnerabilities among the Warren County municipalities. All hazards that are included in Section 4 and have in-depth risk assessments are included in the matrix. They are ranked high, medium, or low and are relative rankings based on a composite review of the risk data presented in this Plan and other aforementioned sources. Even if overall risks for a municipality are deemed medium or low, there may be specific sites or areas with populations that may still be at increased risk from certain hazards. This matrix should be utilized for planning purposes only as an indication of where future evaluations and efforts may be based.

Table 4.4-2: Warren County Municipality-Level Risk Matrix

Municipality	Dam Failure	Earthquake / Geological	Flood	High Wind - Straight-Line	Severe Weather - Winter
Allamuchy Township	M	M(3)	M	M(1)	M(1)
Alpha Borough	L	M(3)	L	M(1)	M(1)
Belvidere Town	M	M(3)	H	M(1)	M(1)
Blairstown Township	H	M(3)	H	M(1)	M(1)
Franklin Township	M	M(3)	M	M(1)	M(1)
Frelinghuysen Township	M	M(3)	L	M(1)	M(1)
Greenwich Township	L	M(3)	L	M(1)	M(1)
Hackettstown Town	L	M(3)	M	M(1)	M(1)
Hardwick Township	H	M(3)	L	M(1)	M(1)
Harmony Township	H	M(3)	H	M(1)	M(1)
Hope Township	L	M(3)	H	M(1)	M(1)
Independence Township	L	M(3)	L	M(1)	M(1)
Knowlton Township	L	M(3)	H	M(1)	M(1)
Liberty Township	M	M(3)	L	M(1)	M(1)
Lopatcong Township	M	M(3)	M	M(1)	M(1)
Mansfield Township	M	M(3)	L	M(1)	M(1)
Oxford Township	H	M(3)	M	M(1)	M(1)
Phillipsburg Town	L	M(3)	H	M(1)	M(1)
Pohatcong Township	L	M(3)	H	M(1)	M(1)

Municipality	Dam Failure	Earthquake / Geological	Flood	High Wind – Straight-Line	Severe Weather - Winter
Washington Borough	L	M(3)	L	M(1)	M(1)
Washington Township	M	M(3)	H	M(1)	M(1)
White Township	M	M(3)	H	M(1)	M(1)

Notes:

(1) Some hazards have equal risk throughout the county. The risk is not determined by the amount of potential damage; otherwise the municipalities with the highest building stock and population would always be at highest risk even if the hazard is equivalent.

(2) Flood risk determined based on RLs and SRLs, as summarized in Section 3.3.4, on DFIRM flood zones, and HAZUS-MH analysis.

(3) Although earthquake risk may not be equivalent throughout the county, there is no scientific basis to prioritize one area over another.

(4) Dam failure risk is not based on the condition of the dam, but on the consequences if a dam were to fail. Therefore prioritization based on number and proximity of high, significant, and low dams

County and Municipal Mitigation Actions

The following are examples of mitigation actions included in the Section 6 as part of the Mitigation Action Plan that are intended to mitigate hazards included in the detailed risk assessment as well as all hazards identified in Section 3 as relevant for Warren County.

Dam Failure

- The analysis in Section 4.3.1 indicates that more than 10 different municipalities could be impacted by failures of the NJDEP-designated high hazard dams that were analyzed as part of the Plan. In some cases, municipalities could be affected by more than one of the analyzed dams. However, few specific mitigation actions were identified in this Plan at the municipal level due to the complexity of the issues involved and the lack of clear mitigation action alternatives. Instead, Warren County Action Items 2.A.21, 2.A.22 and 2.A.23 were included for follow-up investigations and actions by WCOEM with NJDEP.
- In addition, Warren County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include dam failure.
- Blairstown Township 6 is one example of a municipality level action item that specifically included dam failure

Earthquake/Geological

- The analysis is Section 4.3.2 indicates that numerous critical facilities could be impacted by earthquakes in Warren County. However, no specific mitigation actions were identified in this Plan at the municipal level due to the need to verify site-specific conditions and vulnerabilities and the lack of specific mitigation action alternatives. Instead, Warren County Action Items 2.A.5, 2.A.6, and 2.A.7 were included for follow-up investigations and actions by WCOEM with the New Jersey Geological Survey (NJGS).
- In addition, Warren County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include earthquake and other geological hazards.

Flood

- The analysis in Section 4.3.3 indicates that seven specific critical facilities are located in the 100-year and/or 500-year floodplains in Warren County. Of these, the Stepping Stone School was determined to be located outside of Warren County and the Warren County Vocational and Technical Institute was incorrectly identified as being located in the floodplain. The remaining five critical facilities have been addressed in Section 6 – Mitigation Strategy as follows:
  - Good Will Fire Company – see action item Belvidere Town #15.
  - Belvidere Police Department – see action item Belvidere Town #16.
  - Pohatcong Township Police Department – see action item Pohatcong Township #10.
  - Blairstown Elementary – see action item Blairstown Township #15.
  - Good Shepherd Christian Academy – see action item Washington Township #9.
- In addition, the following county and municipal actions have been developed in response to the results of Section 4.3.3:
  - Warren County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include flood.
  - Warren County Action Item 3.A.1 and other county-level mitigation actions address issues related to repetitive flood losses in the county and participation in the NFIP and/or CRS.
  - Allamuchy Township 1 is one example of several municipal level action items included that specifically address flood risk.

High Wind – Straight-Line

- Warren County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness.
- Warren County Action Item 2.A.10
- Frelinghuysen Township 1

Severe Weather – Winter

- Warren County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness.
- Warren County Action Item 2.A.18
- Franklin Township 1

In addition, a few municipalities identified wildfire mitigation projects including Allamuchy Township 2.

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Section 5
Capability Assessment

Contents of this Section

5.1 Overview

5.1.1 Purpose

Although not required by the Disaster Mitigation Act of 2000 or the Interim Final Rule, a capability assessment adds context to a hazard mitigation plan by providing an inventory of a jurisdiction's hazard mitigation-related programs and policies and an analysis of its capacity to carry them out. Understanding these capabilities is essential for developing mitigation strategies and actions.

The capability assessment is a review of Warren County's resources to identify, review, and analyze the framework in place to support implementation of mitigation actions identified in the Plan (see Section 6). This local capability is extremely important because 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.

5.1.2 Methodology

This capability assessment results from research, interviews, and surveys. Relevant documents were reviewed related to hazard mitigation, including the New Jersey State Hazard Mitigation Plan Update (2008), as well as state and federal sources related to funding, planning, and regulatory capability.

A web-based survey tool was designed and administered. The questions were vetted by the Warren County Office of Emergency Management, and the survey was live from April 26, 2010 until June 30, 2010. The survey was targeted at the primary municipal contacts for this planning process. For the most part, these were 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:

- Floodplain management
- Land use planning and regulation
- Capital improvement planning
- Land conservation programs
- Intra-and inter-jurisdictional coordination

5.2 Capability Assessment for Municipalities within Warren County

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 Plan in each municipality. 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 Warren County, 17 out of 22 primary contacts participated including one municipal official. However, respondents did not answer all of the survey questions, creating variations in the response rate.

5.2.1 Staffing and Personnel Capability for Hazard Mitigation

Sixty-five percent of municipal respondents in Warren County have a hazard mitigation or flood mitigation plan in their municipality and have implemented hazard mitigation projects, mostly relating to mitigation of flooding. When questioned if documentation of implemented hazard mitigation projects were available, two out of six responders (33%) stated that grant applications, cost-benefit analysis, project records, and/or close out documentation among others forms of documentation were available.

Of the 13 individuals that responded, 77% reported working for their municipality's office of emergency management and another 23% in a variety of township departments.

Almost all respondents reported working with other offices/agencies within their municipalities to plan and/or implement hazard mitigation, including the departments of public works, engineering, fire departments, planning, and the office of emergency management.

One of the respondents reported having staff trained or with expertise relevant to hazard mitigation. Additionally, only 13% of the respondents reported having staff with experience in hazard mitigation grant writing and 25% with staff with hazard mitigation grant administration experience.

Respondents reported little use of a Geographic Information System (GIS)–only 13% reported having a GIS department or unit using the technology with only two staff members among the respondents devoted to operating, updating, and maintaining GIS.

As shown in Figure 5.2.1-1, respondents had a relatively strong familiarity with FEMA mitigation grant programs. Seventy-one percent of the respondents were familiar with the Pre-Disaster Mitigation Program. Additionally, 57% were familiar with the Flood Mitigation Assistance Program and Hazard Mitigation Program. Forty-three of the respondents were equally familiar with the Public Assistance Program, Repetitive Flood Claim Loss Program, and the Severe Repetitive Flood Claim Program. As Figure 5.2.1-2 shows, participation in FEMA grant programs has been low in Warren County.

Figure 5.2.1-1: Respondent Familiarity with FEMA Mitigation Funding Sources (Answering 7 of 17)
(Source: NDRR Municipal Capability Assessment Survey, 2010)

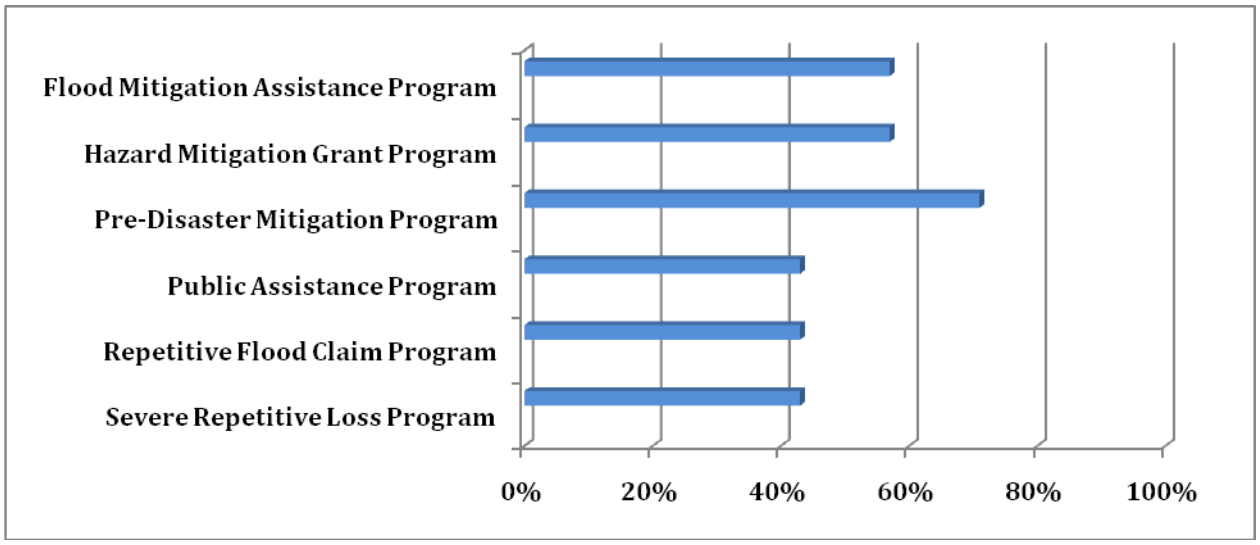
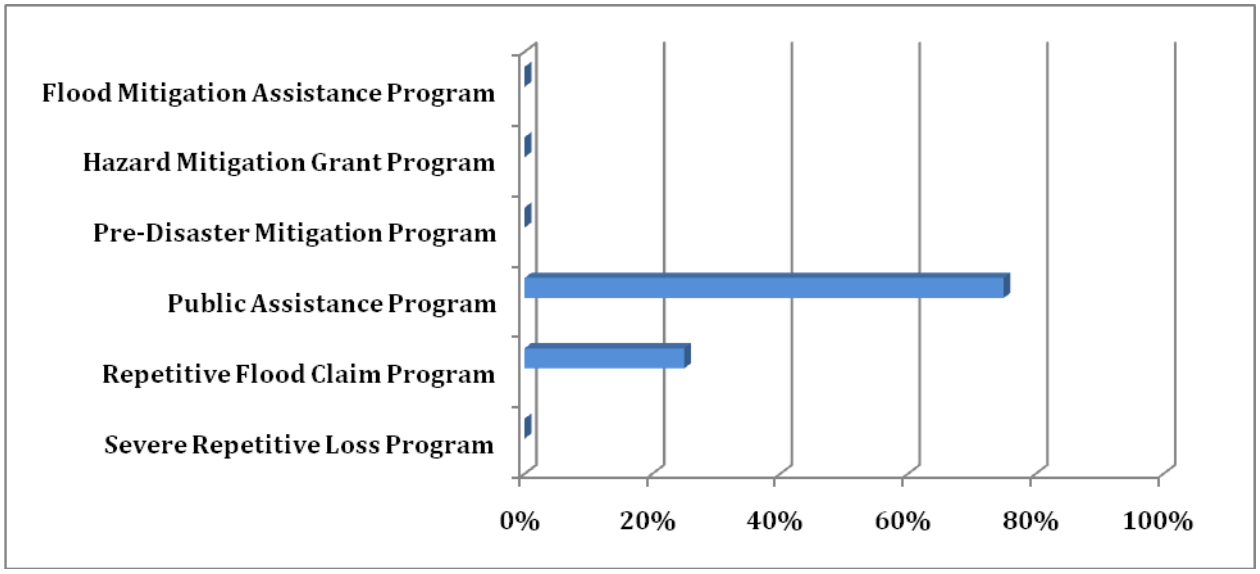


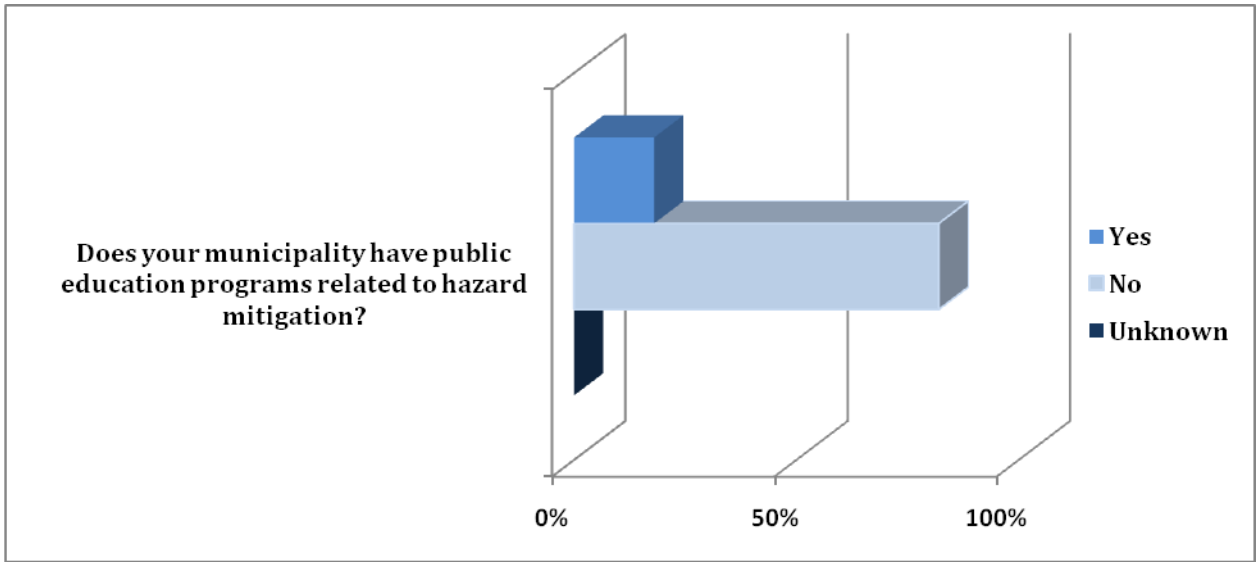
Figure 5.2.1-2: Municipal Participation in FEMA Mitigation Programs (Answering 4 of 17)
(Source: NDRR Municipal Capability Assessment Survey, 2010)



Few respondents were aware of how much federal, state, or local funding was spent in their municipality on hazard mitigation activities from 2000-2009. Thirteen percent stated they received no funding, while another 33% stated that their municipalities received between $1 to $250,000. Only one respondent indicated that their municipality received between $251,000 and $1,000,000.

As Figure 5.2.1-3 shows, only 18% of respondents reported that their municipality has any public information programs related to hazard mitigation. Additionally, only 35% stated that their municipalities provide site-specific hazard information to property owners or prospective property owners.

Figure 5.2.1-3: Existence of Municipal Public Education Programs Related to Hazard Mitigation
(Answering 17 of 17)
(Source: NDRR Municipal Capability Assessment Survey, 2010)



5.2.2 Floodplain Management

As Table 5.2.2-1 shows all 22 municipalities in Warren County participate in the NFIP, meaning that they are required under state law to have adopted a floodplain management ordinance and have a designated floodplain manager.

Two municipalities in the county takes additional steps to reduce their Community Rating System (CRS) score below the default rating of 10. Additional proactive steps can reduce the CRS rating, which in turn reduces property owners' NFIP premiums.

Table 5.2.2-1: NFIP and CRS Participation in Warren County
(Source: FEMA)

Municipality	Participating in the National Flood Program as of 6/30/08	CRS Rating
Allamuchy Township	Yes	10
Alpha Borough	Yes	10
Belvidere, Town of	Yes	10
Blairstown Township	Yes	10
Franklin Township	Yes	7
Frelinghuysen Township	Yes	10
Greenwich Township	Yes	9
Hackettstown, Town of	Yes	10
Hardwick Township	Yes	10
Harmony Township	Yes	10
Hope Township	Yes	10
Independence Township	Yes	10
Knowlton Township	Yes	10
Liberty Township	Yes	10
Lopatcong Township	Yes	10
Mansfield Township	Yes	10
Oxford Township	Yes	10
Phillipsburg, Town of	Yes	10
Pohatcong Township	Yes	10
Washington Borough	Yes	10
Washington Township	No	10
White Township	Yes	10

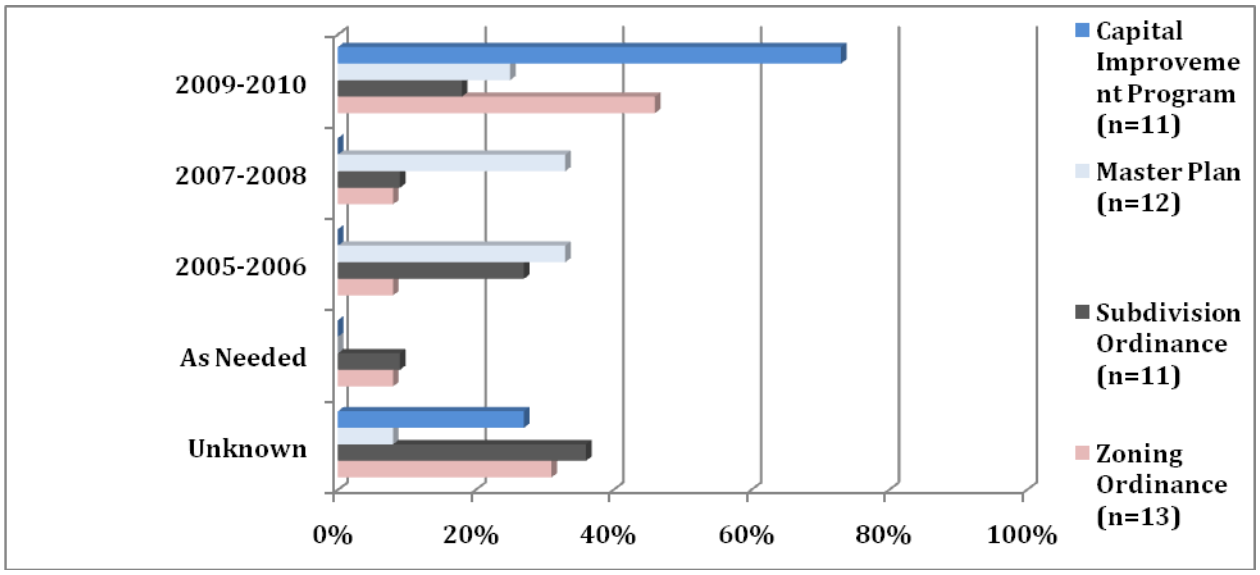
5.2.3 Land Use Planning and Regulation

Seventy-one percent of primary contacts who responded to the survey reported that their municipality Master Plan was updated every three to five years, while only 7% stated their Master Plan was updated annually. Fifty-eight of the respondents reported that their Master Plans were last updated between 2009 and 2010.

All of the respondents reported that their municipality has a zoning ordinance and 80% reported that their municipality has a subdivision ordinance. Of the respondents, less than half have updated their zoning and subdivision ordinances within the last three years.

Similarly, 71% of the primary contacts who responded to inquiries regarding the Capital Improvement Program (CIP) indicated that their municipality updated their CIP every three to five years, while 21% reported that their CIP was not updated on a regular schedule. Figure 5.2.3-1 displays the update dates for municipality's Master Plans, Capital Improvement Program, Subdivision Ordinance, and Zoning Ordinances.

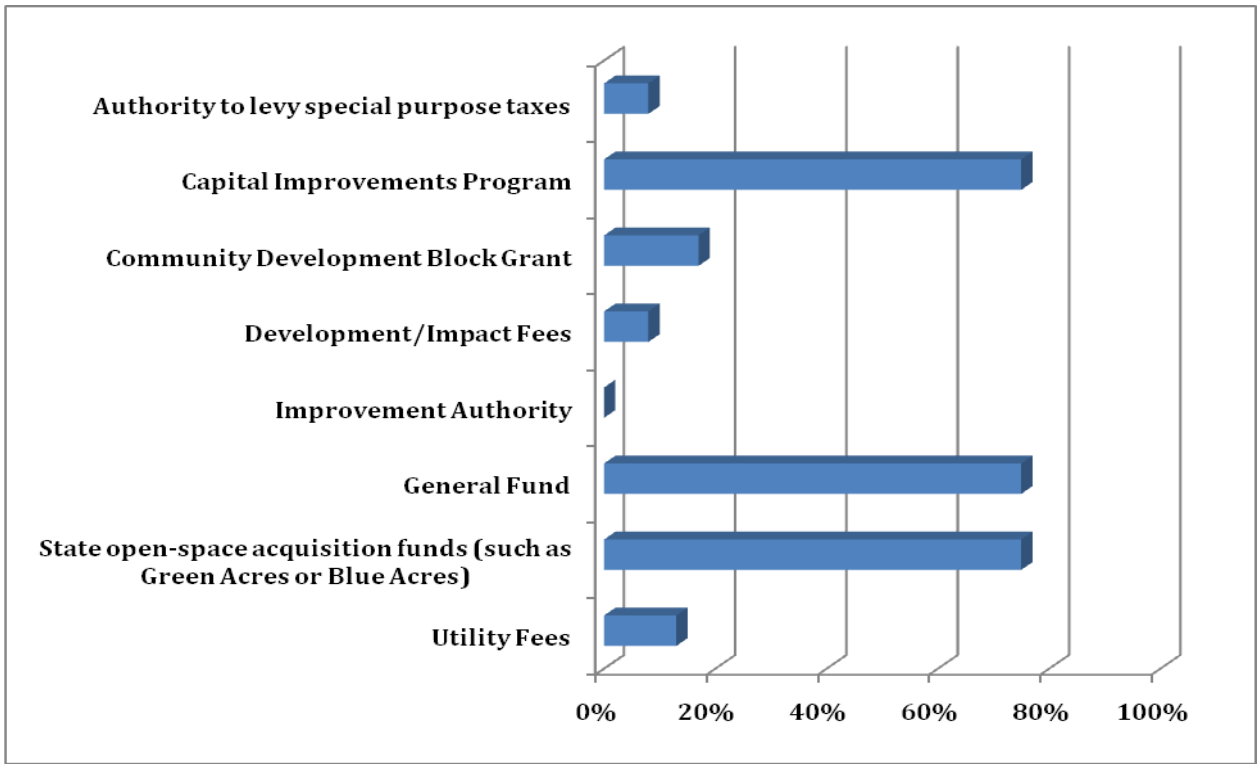
Figure 5.2.3-1: Updates to: Master Plan, Capital Improvement Program, Subdivision Ordinance, and Zoning Ordinance
(Source: NDRR Municipal Capability Assessment Survey, 2010)



5.2.4 Funding Sources

Most municipalities received their funding for hazard mitigation projects from the General Fund (75%), the Capital Improvements Program (75%), and the State open-space acquisition funds such as Greene Acres or Blue Acres (88%). However, funding sources such as Utility fees, Authority to levy special purpose taxes, Improvement authority, and Development/impact fees were not often used or accessible within respondents' municipalities. Figure 5.2.4-1 details the funding sources available and in use in Warren County.

Figure 5.2.4-1: Municipality Funding Sources (Answering 8 of 13)
(Source: NDRR Municipal Capability Assessment Survey, 2010)



5.2.5 Intra- and Inter-Jurisdictional Coordination

Many municipal primary contacts coordinate their mitigation activities with other agencies, mostly within the same municipality. Respondents reported that departments that assisted in implementing hazard mitigation related work include: the Department of Public Works (71%), the Engineering Department (75%), the Planning Department (25%), and the Fire Department (25%). Respondents also reported working with departments such as the Police Department, Emergency Medical Services, and the Office of Emergency Management. Additionally, municipalities reported working with agencies such as the New Jersey Department of Environmental Protection and the U.S. Environmental Protection Agency.

5.3 NJOEM Support for Hazard Mitigation

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 Department of Environmental Protection (NJDEP), the Department of Community Affairs (NJDCA), the Department of Transportation (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 or 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. 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 particular as it relates to education of affected communities, project assessment, and development of mitigation projects that have been recommended but not initiated.

5.4 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 awarded grant. Outside assistance or an augmented staff with knowledge in hazard mitigation project management would be beneficial in bolstering Warren 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.

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Section 6
Mitigation Action Plan

Contents of this Section

6.1 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.*

6.2 Mitigation Goals, Objectives, and Actions

This section contains goals, objectives, and action items for the Warren County All-Hazards Pre-Disaster 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 3 and 4 consisted of identifying the hazards that affect Warren County and the potential for damage to community assets that are vulnerable to the hazards. Section 5 identified the strengths and weaknesses of local capabilities. The goals and objectives described below were established by the Northern Delaware River Region Hazard Mitigation Steering Committee (HMSC) and validated by the Warren 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 Warren County All-Hazards Pre-Disaster 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

6.3 Potential Mitigation Actions

Warren 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 Warren 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, hurricanes, tornadoes, and thunderstorms/lightning/high winds 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 Flood Mitigation Assistance (FMA) Grant Program, Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) Grant Program, Severe Repetitive Loss (SRL) grant program, and Repetitive Flood Claims (RFC) grant program, 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 Service (NJFS) 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 7.13 percent of Warren County is located in a 100-year 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 6.3-1 for the dates on which of the municipalities in Warren County joined the NFIP. Each municipality within Warren 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.

Table 6.3-1: National Flood Insurance Program

Name of Community	Date Joined NFIP
Allamuchy Township	08/15/83
Alpha Borough	12/23/77
Belvidere, Town of	12/18/79
Blairstown Township	09/01/83
Franklin Township	08/02/82
Frelinghuysen Township	02/04/83
Greenwich Township	08/02/82
Hackettstown, Town of	09/01/83
Hardwick Township	01/21/83
Harmony Township	11/04/81
Hope Township	03/04/83
Independence Township	04/08/83
Knowlton Township	01/06/83
Liberty Township	03/18/83
Lopatcong Township	01/02/81
Mansfield Township	09/15/83
Oxford Township	03/11/83
Phillipsburg Town	01/16/81
Pohatcong Township	09/30/81
Washington Borough	08/16/82
Washington Township	09/02/82
White Township	05/15/84

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 jurisdiction has joined, participants residing in that jurisdiction receive a discount on their flood insurance premiums. As a result of being part of the CRS, the jurisdiction 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 jurisdiction and consist 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 municipality in Warren 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 Warren County should encourage additional training opportunities for all code enforcement personnel and 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.

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 flood-proofing, wet flood-proofing, drainage improvements, and installation of generators.

- Elevation: involves raising a structure on a new foundation so that the lowest floor is above the 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 municipality 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 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 flood-proofing: techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and the installation of special backflow valves for water and sewer lines. Wet flood-proofing includes low cost mitigation measures such as raising air conditioners, heat pumps, and hot water heaters on platforms above the BFE.

- Wet flood-proofing: 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, protecting mechanical and utility equipment, and use of openings or breakaway walls. Application of wet flood-proofing 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 municipality.

- 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, and installing check valves and inverts in certain culverts. Maintaining and improving drainage serves to assist the municipalities with problems experienced from floods 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 municipalities. The installation of generators serves to assist a municipality with problems experienced from floods, high wind, severe storms, earthquakes, and dam failure.

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 winds, and severe storms.

Early Warning Systems

With sufficient warning of a flood, a community 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 municipalities with problems experienced from floods, high winds, severe storms, and dam failure, as well as other lower priority hazards.

Earthquakes

Significant seismic events, while not common to the region, do pose a potentially significant threat to Warren 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.

For example, one technique is a building retrofit involving the use of reinforced concrete materials in combination with cross ties to provide current structures with additional stabilization. The addition of seismic stabilizer platforms for important or critical mechanicals within buildings will also 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' safety zone, including keeping grass below 2" 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.

6.4 Warren County Mitigation Actions

The HMSC and HMWG developed the following program of mitigation actions in response to the risk and capability assessments (see Sections 4 and 5) that will be implemented on a countywide basis. These general actions are presented in Table 6.4-1.

Table 6.4-1: Warren 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**	**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 6.3.2-1).	1.A.1: Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness. See additional description regarding Action 1.A.1 on page 6-12.	High	WCOEM and municipal OEM	One Year	WCOEM 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 for hazard safety.	Medium	WCOEM and municipal OEM	Six Months-One Year	WCOEM and municipal OEM personnel, local public TV	A better informed and involved population reduces risk and loss.

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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	1.A.3: Conduct yearly workshops related to the Federal Emergency Management Agency (FEMA) hazard mitigation grant programs, including Flood Mitigation Assistance (FMA) program, Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation (PDM) program, Severe Repetitive Loss (SRL) program, and Repetitive Flood Claim (RFC) program, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below).	High	WCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Makes local officials and the public aware of federal grants; increases participation.
	1.A.4: Educate the public through New Jersey Office of Emergency Management (NJOEM) and New Jersey Fire Safety outreach programs and hazard mitigation workshops.	High	WCOEM, NJOEM, New Jersey Forest Fire Service	Ongoing	Existing state resources	Encourages the development of Pre-Disaster Mitigation plans and participation in mitigation grant programs.

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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
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	WCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Makes local officials aware of federal grants and increases participation.
Objective 1.C: Increase local government official awareness regarding opportunities for participating in and contributing to future Plan updates.	1.C.1: Reach out to municipal Floodplain Administrators, departments of planning, public works, engineering, etc. regarding the importance of hazard mitigation planning and provision of municipal plans and data for planning purposes.	High	WCOEM and municipal OEM	Ongoing	Existing county and municipal resources	Makes local officials aware of benefits of plan participation.

County Action 1.A.1: Develop All Hazards public education and outreach program for hazard mitigation and preparedness.

Responsible Agency: County and municipal OEMs.

WCOEM will implement a county-wide committee with local municipalities to develop an "All Hazards" Public Education and Outreach Campaign. The Hazard Mitigation Awareness and Education Campaign will include ***all natural hazards*** identified as applicable to Warren County.

To foster a more hazard-resilient community, WCOEM will work closely with external stakeholders – especially organizations that can provide technical information and/or assistance in the areas of hazard identification and risk assessment. Tapping into local resources, the County will institute a robust, multi-pronged campaign. Participating jurisdictions will work closely with WCOEM to ensure that the targeted outreach meets its intended audience.

County Tasks:

1. WCOEM will host a Hazard Mitigation Awareness and Education Website on the Warren County website.
2. WCOEM and the Warren County Planning Department will be responsible for conducting outreach to other relevant stakeholders – e.g., FEMA, NJOEM, colleges and universities, Regional Planning Commissions, river and watershed-based non-profits, the NJ American Planning Association — and internal stakeholders— Warren County Departments of Planning, Health, Parks, and GIS. WCOEM and the Warren County Planning Department will create flyers for dissemination via the Warren County Fair and other Warren County events as well as for local distribution via municipal offices, libraries, schools, etc.
3. WCOEM and the Warren County Planning Department will each be identified as a local resource.

Participating Jurisdiction Tasks:

1. Jurisdiction will provide a direct link to the Warren County website from the jurisdiction website.
2. Jurisdiction OEMs (with/or Planning Department) will be responsible for identifying and engaging any local agencies or nonprofits that could serve as hazard and/or mitigation subject matter experts and providing contact information (and regular updates) to WCOEM for inclusion on the website.
3. Jurisdiction OEMs (with/or Planning Department) will publicize the website via in-person methods. In-person methods may and should be tailored to the community. Examples include the jurisdiction representative speaking at local fairs, May Day, little league games, and public meetings.
4. Jurisdiction OEMs (with/or Planning Department) will publicize the website via posting/distribution of the Warren County promotional flyer at high-visibility locations, e.g., municipal offices, libraries, schools, etc.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**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.	High	WCOEM, Rutgers University, New Jersey Geologic Survey (NJGS), National Oceanic 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 6.3.3-1 for additional detail).	Medium	WCOEM and municipal OEM	Starting within six months, then ongoing	WCOEM staff, municipal staff	This is an essential step in developing flood mitigation actions.
	2.A.3: Use best possible flood data, including Digital Flood Insurance Rate Map and Map Mod data, if available, in next plan update. Track implementation of Risk MAP initiative to ensure Warren County and municipalities gain full advantage of opportunities under this program.	High	WCOEM and municipal OEMs	Three 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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.4: Bi-annually update and verify status of repetitive loss and severe repetitive loss lists from the National Flood Insurance Program (NFIP).	Medium	WCOEM 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.5: 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.	High	WCOEM, with support from NJGS.	One-Two Years	FEMA grants, existing staff	Allows risk-based decisions regarding protection of critical facilities.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.6: 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	WCOEM, FEMA, NJGS	One Year	FEMA grants, existing staff	Serves as first step in a long-term plan to reduce risks to the most critical county facilities.
	2.A.7: Work with New Jersey Geological Survey (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	WCOEM and municipal OEMs	Two Years	TBD, potential collaboration with ongoing NJGS Hazards US-based earthquake studies	This is an essential step in developing appropriate mitigation actions for priority facilities.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.8: Coordinate with NJGS and other county, state and federal agencies to better identify specific sites in Warren County that may be exposed to the effects of geo-hazards such as landslides, sinkholes, and subsidence.	High	WCOEM, municipal OEMs, NJDEP, NJGS	One Years	FEMA grants, existing 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.9: 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.	Medium	WCOEM, NJOEM, with cooperation of other agencies that own and/or operate the facilities; New Jersey State Climatologist	One Year	Existing staff and resources	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 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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.10: 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	WCOEM and municipal OEMs	One Year	Existing staff and resources	Quantifies risk to most important facilities.
	2.A.11: 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	WCOEM, municipal OEMs, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing staff and resources	Establishes basis for additional studies and eventually mitigation actions, if they are indicated.
	2.A.12: Coordinate with state efforts to maintain current information about fuel loads and conditions that may affect potential for fires.	High	WCOEM, municipal OEMs, New Jersey Forest Fire Service	Ongoing	Existing staff and resources	Provides a basis for risk assessment.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.13: For areas with significant risk from wildfires or urban interface fires, perform detailed studies to objectively determine (a) potential for wildfires, including likely magnitude, & (b) vulnerabilities of surrounding populations, built environment, and functions.	Medium	WCOEM, municipal OEMs, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing staff and resources	Provides a basis for risk assessment.
	2.A.14: 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.	High	WCOEM, 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.15: Maintain effective coordination and information sharing related to hazardous material sites with NJOEM and the Right to Know Network.	Medium	WCOEM, RTK Network, NJOEM.	Ongoing	Existing staff and resources	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.16: Complete data collection for Geographic Information System (GIS) analysis and mapping of potential areas of impact related to hazardous material sites.	High	WCOEM, county agencies	Ongoing	Existing staff and resources	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.
	2.A.17: Integrate data about hazardous materials with most current available information about other risk factors, e.g. population, climate, other site-specific characteristics.	High	WCOEM, RTK Network, NJDEP, United States Environmental Protection Agency	Ongoing	Existing staff and resources	Potentially allows integration of hazardous materials information with data related to natural hazards.
	2.A.18: Complete a detailed analysis of past losses related to winter storms to determine if additional study is indicated.	High	Warren County and local agencies with critical facilities	One-Two Years	Existing staff and resources	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.
	2.A.19: 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.	High	Warren County and local agencies with critical facilities	Two Years	FEMA grants and existing staff	Provides a basis for prioritizing actions, including mitigation.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.20: 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.	High	WCOEM, NOAA, USACE, local officials, NJDEP	Three Years	FEMA grants and existing staff	Provides a basis for determining if any further risk assessment action is warranted.
	2.A.21: Work with New Jersey Department of Environmental Protection to more fully understand the dam hazard rankings and methodology behind them, particularly regarding high-hazard sites.	High	WCOEM, NJDEP	Three Years	NJDEP	Provides a basis for further development and prioritization of any future actions or strategies.
	2.A.22: 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	WCOEM, NJDEP, NJOEM	Ongoing	NJDEP	Provides a basis for any additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.
	2.A.23: Conduct detailed risk assessments for dams that appear to have vulnerabilities, and where there is potential for significant damage or loss of life.	High	WCOEM, NJDEP, engineering consultants	Ongoing	WCOEM, NJDEP, USACE	Quantifies potential losses from dam failures where vulnerabilities have been identified

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	2.A.24: Consolidate and incorporate relevant local data related to hazards, extent, probability, exposure, risk, history, etc.	High	WCOEM and Municipal OEMs	Ongoing	Existing resources	Basis for hazard identification, risk assessment, and mitigation strategies
	2.A.25: Work with ongoing county, state, and federal efforts to develop and maintain hazard-specific geospatial data necessary to perform full risk assessments for all relevant hazards in Warren County.	High	WCOEM	Ongoing	Existing county staff, FEMA, NJOEM, Rutgers University, NJGS, other federal agencies including NOAA and USACE	Essential step in developing mitigation actions
	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	WCOEM, DELO, NJDEP, engineering consultants	Ongoing	NJDEP, DELO, USACE	Quantifies potential losses from levee failure where vulnerabilities have been identified.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	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).	High	WCOEM, DELO, NJDEP, engineering consultants	Ongoing	NJDEP, DELO, USACE	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: Conduct a detailed study to identify and map erosion hazard zones.	High	WCOEM, NJDEP, and USACE	Ongoing	NJDEP, USACE	Mapping and defining erosion hazard zones will be useful to future development decisions.
	2.A.29: 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	WCOEM, NJDEP, NJOEM	Within 6 months of plan adoption	NJDEP	Basis for any additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.
	2.A.30: Coordinate with state efforts to undertake detailed vulnerability assessments and develop mitigation options for critical facilities in A and AE zones.	Medium to High	Warren 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.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
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	WCOEM 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, and 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	WCOEM and municipal OEM	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.
	2.C.2: Prioritize critical facilities and complete Phase 1 site surveys to identify vulnerabilities.	High	WCOEM and municipal OEM	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**	**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 offering municipalities technical support in carrying out the requirements of FEMA mitigation programs as well as current information related to RL and SRL properties.	High	WCOEM	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	WCOEM, 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	WCOEM	Ongoing	Existing resources	Increases efficacy and participation in hazard mitigation planning

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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	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	WCOEM	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 and 1.B).	High	WCOEM, 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.
	3.B.2: Encourage municipalities to participate in the Community Rating Survey (CRS) program, including potentially setting up CRS site visits and/or workshops for interested municipalities.	High	WCOEM, NJOEM	Ongoing	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	WCOEM and municipal OEM	Ongoing	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved.

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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 3.C: Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/ county zoning, regulation, 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	WCOEM, NJDEP, municipal officials	Ongoing	Existing Resources and federal grant funds (FEMA Community Assistance Program-State Support Services Element)	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.	High	WCOEM 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**	**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 Update.	High	WCOEM, New Jersey Department of Community Affairs, 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.	High	WCOEM working with neighboring counties	One-Two Years	Existing staff and resources	Provides a basis for understanding risks and maintaining most current information; provides a good means of maintaining data needed for periodic updates to the hazard mitigation plan; and (potentially) helps to identify promising sites mitigation actions and grant proposals.

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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
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	WCOEM	Three Years	Existing staff and resources	This could help support, coordinate, and consolidate hazard mitigation capabilities.
	3.F.2: Increase understanding of the capabilities of municipal mitigation programs by continuing to encourage local coordinators to participate in the Municipal Capabilities Assessment Survey.	Medium	WCOEM	Ongoing	WCOEM, staff time	Better understand local planning and implementation capabilities; provide a baseline for future capabilities assessments.
Objective 3.G: Provide opportunities for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the plan update process.	3.G.1: Provide regular summaries to neighboring communities re: plan monitoring and update procedures (as outlined in Section 7) and post updates on Warren County's website for public access to the plan update process.	High	WCOEM	On-going	Existing resources and staff	This will help Warren County meet plan update requirements as well as provide a mechanism for identifying possible cooperative efforts for neighboring communities.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities						
Objective	**Action**	**Priority**	**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	WCOEM, 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 6.3.3-1 for further detail).	High	WCOEM, 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 6.3.3-1 for further detail).	High	WCOEM and municipal OEM Coordinators	Ongoing	Federal grants, other state and local sources	Reduces exposure and risk to critical facilities.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities						
Objective	**Action**	**Priority**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	4.A.4: Implement other mitigation projects and programs as appropriate at the municipal level (see Table 6.3.3-1 for further detail).	High	WCOEM and municipal OEM Coordinators	Ongoing	Federal grants, other state and local sources	Varied
	4.A.5: Promote acquisition and elevation of repetitive loss and severe repetitive loss structures (see Table 6.3.3-1 for further detail).	High	WCOEM, NJOEM	Ongoing	Federal grants	To eliminate repetitive loss structures
	4.A.6: Work 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.	High	WCOEM, NJDEP, NJGS	Ongoing	Existing Resources and Federal grant funds	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.
Objective 4.B: Maintain and enhance local regulatory standards related to future development and investments.	4.B.1: Ensure full and effective enforcement of building codes, floodplain management, zoning, and other risk-reducing regulations.	High	WCOEM, municipal OEMs and 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**	**Responsible Agency**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	4.B.2: Integrate hazard mitigation priorities into Capital Improvement Plans, transportation planning, and other capital planning.	High	WCOEM, municipal OEMs and local permitting and planning offices	Ongoing	Existing County and Local Resources	Advances all goals in the plan by ensuring consistency of major investments with mitigation priorities
	4.B.3: Integrate hazard mitigation Plan and priorities into floodplain management, zoning, subdivision regulation, and other local regulations as appropriate.	High	WCOEM, municipal OEMs and 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

Notes:

(1) Priority rankings were developed by WCOEM. See Appendix D and Table D-1 for details of STAPLEE analysis of these mitigation actions.

(2) In all of the action items in Table 6.4-1, WCOEM is indicated as one of the responsible agencies. In addition, there are several references to local agencies as responsible parties as well. One of the main roles of WCOEM in these actions - and in general regarding hazard mitigation planning and implementation - is support and facilitation of efforts to be encouraged at the local level. In some cases, municipalities have identified parallel action items (for example, County Action 1.A.1). In those situations, a specific relationship can be described and pursued as joint efforts. However, for most of these actions, the working relationships and specific responsibilities of WCOEM and the participating jurisdictions will need to be developed over time as part of the implementation of each action. It is envisioned that during the five-year period, WCOEM will be able to define workable programs with the municipalities on an on-going basis to better define these implementation strategies and keep workloads within the limits of county and local capabilities.

6.5 Municipality-Specific Mitigation Actions

Strategies for hazard mitigation within Warren 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 Warren County identified mitigation actions and programs based upon the risk assessment (Section 4) and capabilities assessment (Section 5). These are detailed below in Table 6.5-1. 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 6.5-1: Municipality Specific Mitigation Actions

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
WARREN COUNTY DEPARTMENT OF BUILDING AND GROUNDS								
Warren County Building & Grounds 1: Harden/Bury utility lines affecting the Department of Public Works garage on Silver Spring Road, Hope NJ.	Straight Line Winds	Existing	Emergency Management	County Department of Public Works Supervisor	One Year	$20,000	PDM-C & HMGP if available	Medium
Warren County Building & Grounds 2: Harden/Bury utility lines affecting the Department of Public Works garage located in Alpha Twp NJ.	Straight Line Winds	Existing	Emergency Management	County Department of Public Works Supervisor	One Year	$20,000	PDM-C & HMGP if available	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Warren County Building & Grounds 3: Storm-water management system upgrade and improvement at the Department of Public Works Salt Shed located off Washington Avenue Oxford Township.	Flood	Existing	Emergency Management	County Engineer	One Year	$250,000	PDM-C & HMGP if available	High
Warren County Building & Grounds 4: Retrofit proper grounding for administration building located on Route 519, White Township.	Severe Weather Lighting	Existing	Emergency Management	County Department of Public Works Supervisor	One Year	$75,000	PDM-C & HMGP if available	High
ALLAMUCHY TOWNSHIP								
Allamuchy Township 1: Stream-bank stabilization of the Musconetcong River for 1 mile along Waterloo Road.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One-two Years	$700,000	PDM-C & HMGP if available	High
Allamuchy Township 2: Implement Fire Wise Program for the Township.	Wild Fire	Existing	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	High
Allamuchy Township3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
ALPHA BOROUGH								
Alpha Borough 1: Retrofit rood to meet current snow load standards on Alpha Public School located on North Boulevard.	Severe Winter Storm	Existing	Emergency Management	School Board Administrator	One-two Years	$95,000	PDM-C & HMGP if available	High
Alpha Borough 2: Storm-water management system upgrade and improvement along Route 519 near Homa Lane.	Flood	Existing	Emergency Management	OEM Coordinator	One-two Years	$375,000	PDM-C & HMGP if available	High
Alpha Borough 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
TOWN OF BELVIDERE								
Belvidere Town 1: Acquisition/ Elevation of two Severe Repetitive Loss properties on Water Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$500,000	SRL, FMA, PDM-C & HMGP if available	High
Belvidere Town 2: Acquisition/ Elevation of one Severe Repetitive Loss property on South Water Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$180,000	SRL, FMA, PDM-C & HMGP if available	High
Belvidere Town 3: Acquisition/ Elevation of one Severe Repetitive Loss property on Wall Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$275,000	SRL, FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Belvidere Town 4: Acquisition/Elevation of four flood prone properties located on Wall Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$1,100,000	FMA, PDM-C & HMGP if available	High
Belvidere Town 5: Acquisition/ Elevation of 17 Repetitive Loss properties on Water Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$4,250,000	FMA, PDM-C & HMGP if available	High
Belvidere Town 6: Acquisition/ Elevation of 11 Repetitive Loss properties on Depue Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$3,200,000	FMA, PDM-C & HMGP if available	High
Belvidere Town 7: Acquisition/ Elevation of six Repetitive Loss properties on Front Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$1,350,000	FMA, PDM-C & HMGP if available	High
Belvidere Town 8: Acquisition/ Elevation of one Repetitive Loss property on Mansfield Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$200,000	FMA, PDM-C & HMGP if available	Low
Belvidere Town 9: Acquisition/ Elevation of one Repetitive Loss property on Fourth Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$175,000	FMA, PDM-C & HMGP if available	High
Belvidere Town 10: Storm-water management system upgrade and improvement along access way to the Belvidere Ambulance Corps located on Paul Street.	Flood	Existing	Emergency Management	OEM Coordinator	One Year	$470,000	FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Belvidere Town 11: Elevation of utilities out of flood prone basement and flood proofing of foundation of the Food Mart located on Water Street.	Flood	Existing	Emergency Management	Store manager	One Year	$270,000	PDM-C & HMGP if available	High
Belvidere Town 12: Elevation of utilities out of flood prone basement and flood proofing of foundation of Zack's Pharmacy located on Market Street.	Flood	Existing	Emergency Management	Store manager	One Year	$270,000	PDM-C & HMGP if available	High
Belvidere Town 13: Stream bank stabilization of ¼ mile of the Pophanduysen Creek located by Fourth Street and Depue Street.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	Two Years	$450,000	PDM-C & HMGP if available	High
Belvidere Town 14: Stream bank stabilization of 800 yards along Pequest River located near Water and Wall Street.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	Two Years	$250,000	PDM-C & HMGP if available	High
Belvidere Town 15: Flood-proofing of the Good Will Fire Company building.	Flood	Existing	Emergency Management	Municipal Fire Chief	One–two Years	$95,000	PDM-C, FMA & HMGP if available	High
Belvidere Town 16: Flood-proofing of the Belvidere Police Department building.	Flood	Existing	Emergency Management	Municipal Police Chief	One–two Years	$85,000	PDM-C, FMA & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Belvidere Town 17: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
BLAIRSTOWN TOWNSHIP								
Blairstown Township 1: Acquisition/ Elevation of two Repetitive Loss properties on Bridge Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$480,000	FMA, PDM-C & HMGP if available	Medium
Blairstown Township 2: Acquisition/ Elevation of two Repetitive Loss properties on Main Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$560,000	FMA, PDM-C & HMGP if available	Medium
Blairstown Township 3: Acquisition/ Elevation of one Repetitive Loss property on Carhart Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$150,000	FMA, PDM-C & HMGP if available	Medium
Blairstown Township 4: Acquisition/ Elevation of one Repetitive Loss property on East Avenue.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$250,000	FMA, PDM-C & HMGP if available	Medium
Blairstown Township 5: Acquisition/ Elevation of one Repetitive Loss property on Vail Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$180,000	FMA, PDM-C & HMGP if available	Medium
Blairstown Township 6: Conduct inundation study of the Blair Falls Dam located on Blair Academy grounds.	Dam Failure	Existing	Floodplain Management	OEM Coordinator	One Year	$70,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Blairstown Township 7: Elevate utilities in 50 homes and businesses in flood prone areas: Bridge Street, Main Street, Vail Street, Carhart Street East Avenue and Douglas Street.	Flood	Existing	Floodplain Management	OEM Coordinator	One Year	$500,000	PDM-C & HMGP if available	High
Blairstown Township 8: Install backflow suppressors in current storm-water management system along Route 94.	Flood	Existing	Floodplain Management	Department of Public Works Supervisor	One Year	$200,000	PDM-C & HMGP if available	High
Blairstown Township 9: Berm construction along Paulinskill River at Paulinskill Fields.	Flood	Existing	Floodplain Management	Department of Public Works Supervisor	One–two Year	$100,000	PDM-C & HMGP if available	High
Blairstown Township 10: Flood-proofing of the Blairstown Elementary School.	Flood	Existing	Emergency Management	School Board Administrator	One–two Years	$95,000	PDM-C, FMA & HMGP if available	High
Blairstown Township 11: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
FRANKLIN TOWNSHIP								
Franklin Township 1: Retrofit roof to meet current standards for snow load on the area over the bays and kitchen at the Franklin Township Fire Department Station 2 building located on Second Street.	Severe Winter Weather	Existing	Emergency Management	Station Commander	One-two Years	$85,000	PDM-C & HMGP if available	High
Franklin Township 2: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
FRELINGHUYSEN TOWNSHIP								
Frelinghuysen Township 1: Anchoring of facility trailers to withstand extreme high winds at the Ridge And Valley Charter School located on Route 94.	Straight Line Winds	Existing	Emergency Management	Facility Administrator	One Year	$500,000	PDM-C & HMGP if available	Medium
Frelinghuysen Township 2: Retrofit impact resistant windows and shutters to Frelinghuysen Municipal Building located on Route 661 (Building is over 100 years old).	Straight Line Winds	Existing	Emergency Management	Department of Public Works Supervisor	One Year	$75,000	PDM-C & HMGP if available	Medium
Frelinghuysen Township 3: Culvert upgrade and improvement located on Main Street and Mill Road.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One Year	$250,000	FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Frelinghuysen Township 4: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
GREENWICH TOWNSHIP								
Greenwich Township 1: Acquisition/ Elevation of one Repetitive Loss property on Route 519.	Flood	Existing	Emergency Management	OEM Coordinator	One Year	$175,000	FMA, PDM-C & HMGP if available	High
Greenwich Township 2: Hardening/Retrofitting, burying utility lines along Ravine Road between SH 173 and Municipal Drive.	Straight Line Winds	Existing	Emergency Management	OEM Coordinator	One Year	$750,000	PDM-C & HMGP if available	High
Greenwich Township 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
TOWN OF HACKETTSTOWN								
Hackettstown 1: Acquisition/Elevation of one Repetitive Loss property on Water Street.	Flood	Existing	Emergency Management	OEM Coordinator	One-two Years	$300,000	FMA, PDM-C & HMGP if available	High
Hackettstown 2: Flood proofing the House of Good Sheppard Willow Grove Street between Bilby Road and Stephens State Park Road.	Flood	Existing	Emergency Management	Township Engineer	One-two Years	$350,000	FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Hackettstown 3: Emergency backup generator for Municipal Emergency Operations Center located in the Moore Street Firehouse on Moore Street.	All	Existing	Emergency Management	OEM Coordinator	One-two Years	$125,000	HMGP 5% Initiative	High
Hackettstown 4: Raise embankment to eliminate flooding at River Edge Trailer park along Route 182 at Route 57.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One-two Years	$350,000	PDM-C & HMGP if available	High
Hackettstown 5: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
HARDWICK TOWNSHIP								
Hardwick Township 1: Flood proof the Hardwick Township Municipal Building located on Spring Valley Road.	Flood	Existing	Emergency Management	Municipal Engineer	One-two Years	$400,000	PDM-C & HMGP if available	High
Hardwick Township 2: Culvert pipe upgrade and improvement to prevent backwater over Spring Valley Road between Hardwick House Restaurant and Ferla's Swamp.	Flood	Existing	Emergency Management	Municipal Engineer	One-two Years	$250,000	PDM-C & HMGP if available	High
Hardwick Township 3: Implement Fire Wise Program throughout the Township.	Wildfire	Existing and New	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Hardwick Township 4: Protect utility lines by identifying and removing potential hazard causing trees along 28 miles of Municipal Roads.	Straight Line Winds	Existing	Emergency Management	Department of Public Works Supervisor	One-two Years	$50,000	HMGP if available	High
Hardwick Township 5: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
HARMONY TOWNSHIP								
Harmony Township 1: Acquisition/ Elevation of six Severe Repetitive Loss properties on Harmony Station Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$900,000	SRL, FMA, PDM-C & HMGP if available	High
Harmony Township 2: Acquisition/ Elevation of four Severe Repetitive Loss properties on Hutchinson River Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$100,000	SRL, FMA, PDM-C & HMGP if available	High
Harmony Township 3: Acquisition/ Elevation of two Severe Repetitive Loss properties on Harmony Terrace.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$600,000	SRL, FMA, PDM-C & HMGP if available	High
Harmony Township 4: Acquisition/ Elevation of two Severe Repetitive Loss properties on Lenape Lane.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$400,000	SRL, FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Harmony Township 5: Acquisition/ Elevation of two Severe Repetitive Loss properties on South River Terrace.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$500,000	SRL, FMA, PDM-C & HMGP if available	High
Harmony Township 6: Acquisition/ Elevation of one Severe Repetitive Loss property on Goat Farm Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$300,000	SRL, FMA, PDM-C & HMGP if available	High
Harmony Township 7: Acquisition/ Elevation of one Repetitive Loss property on Harmony Station Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$150,000	FMA, PDM-C & HMGP if available	Medium
Harmony Township 8: Acquisition/ Elevation of one Repetitive Loss property on River Edge Lane.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$200,000	FMA, PDM-C & HMGP if available	Medium
Harmony Township 9: Acquisition/ Elevation of one Repetitive Loss property on South River Terrace.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$250,000	FMA, PDM-C & HMGP if available	Medium
Harmony Township 10: Retrofit impact resistant windows and shutters on Radiant Star Nursing Home located on Reeder Road.	Straight Line Winds	Existing	Emergency Management	Nursing Home Administrator	One Year	$300,000	PDM-C & HMGP if available	Low
Harmony Township 11: Retrofit the roof to meet current snow load standards on Harmony Township Municipal Building located on Belvidere Road.	Severe Winter Weather	Existing	Emergency Management	Township Administrator	One Year	$250,000	PDM-C & HMGP if available	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Harmony Township 12: Retrofit roof to meet current snow load standards on Harmony Township Fire Department building located on Brainards Road.	Severe Winter Weather	Existing	Emergency Management	Station Commander	One Year	$450,000	PDM-C & HMGP if available	Medium
Harmony Township 13: Upgrade and improvement of culverts passing under Harmony Station Road located near Brainards Road.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One–two Years	$ 450,000	PDM-C & HMGP if available	High
Harmony Township 14: Review applicable Building Code requirements to ensure that structures are designed for appropriate wind loads.	Straight Line Winds	Existing and New	Emergency Management	Township Construction Official	One Year	Staff Time	Township Operating Budget	High
Harmony Township 15: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
HOPE TOWNSHIP								
Hope Township 1: Acquisition/ Elevation of one Repetitive Loss property on Kostenbader Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$250,000	FMA, PDM-C & HMGP if available	Low
Hope Township 2: Flood proofing of Hope Elementary School located on Johnsonburg Road.	Flood	Existing	Floodplain Management	School Board Administrator	One–two Years	$300,000	PDM-C & HMGP if available	Low

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Hope Township 3: Implement the Fire Wise program throughout the Township.	Wild Fire	Existing	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	Medium
Hope Township 4: Conduct outreach and solicitation for participation for mitigation of flood prone properties.	Flood	Existing	Floodplain Management	OEM Coordinator	One Year	Staff Time	OEM Budget	High
Hope Township 5: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
INDEPENDENCE TOWNSHIP								
Independence Township 1: Stream bank stabilization for 500 yards along the Pequest River near Water Street.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	Two Years	$250,000	PDM-C & HMGP if available	High
Independence Township 2: Installation of rip-wrap in bend of Pequest River near Cemetery Road.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	Two Years	$175,000	PDM-C & HMGP if available	High
Independence Township 3: Storm-water management system upgrade and improvement along Route 46 between Barkers Mill Road and Hill Terrace.	Flood	Existing	Emergency Management	OEM Coordinator	One Year	$270,000	FMA, PDM-C & HMGP if available	High
Independence Township 4: Instillation of reverse 911 systems.	All	Existing	Emergency Management	OEM Coordinator	One Year	$100,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Independence Township 5: Participate in the CRS program.	All	Existing	Emergency Management	OEM Coordinator	One Year	Staff Time	OEM Budget	Medium
Independence Township 6: Establish a data base identifying municipal residents most at risk to severe weather.	Severe Winter Weather	Existing	Emergency Management	OEM Coordinator	One Year	$75,000	PDM-C & HMGP if available	Medium
Independence Township 7: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
KNOWLTON TOWNSHIP								
Knowlton Township 1: Acquisition/ Elevation of five Severe Repetitive Loss properties on US Highway Route 46.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$1,500,000	SRL, FMA, PDM-C & HMGP if available	High
Knowlton Township 2: Acquisition/ Elevation of two Severe Repetitive Loss properties on Riverview Avenue.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$600,000	SRL, FMA, PDM-C & HMGP if available	High
Knowlton Township 3: Acquisition/Elevation of 20 Repetitive Loss properties on US Highway Route 46.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$6,000,000	FMA, PDM-C & HMGP if available	High
Knowlton Township 4: Acquisition/ Elevation of 10 Repetitive Loss properties on Riverview Avenue.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$3,000,000	FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Knowlton Township 5: Acquisition/Elevation of four Repetitive Loss properties on Willow Lane.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$1,200,000	FMA, PDM-C & HMGP if available	High
Knowlton Township 6: Acquisition/ Elevation of two Repetitive Loss properties on Riverview Drive.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$600,000	FMA, PDM-C & HMGP if available	High
Knowlton Township 7: Acquisition/ Elevation of one Repetitive Loss property on Pine Tree Lane.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Years	$300,000	FMA, PDM-C & HMGP if available	High
Knowlton Township 8: Backup generator for the Knowlton Municipal Complex located on Route 94. Facility is the Emergency Operations Center.	All	Existing	Emergency Management	OEM Coordinator	One–two Years	$125,000	HMGP 5% Initiative	High
Knowlton Township 9: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
LIBERTY TOWNSHIP								
Liberty Township 1: Backup generator for the Liberty Elementary School located Mountain Lake Road. Facility is primary emergency shelter.	All	Existing	Emergency Management	OEM Coordinator	One-two Years	$125,000	HMGP 5% Initiative	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Liberty Township 2: Stream bank stabilization along Mountain Lake Brook by intersection of Lake Side Drive North and Lake Side Drive East	Flood	Existing	Emergency Management	OEM Coordinator	One-two Years	$250,000	PDM-C & HMGP if available	High
Liberty Township 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
LOPATCONG TOWNSHIP								
Lopatcong Township 1: Flood proofing of the Lopatcong Recreational Facility.	Flood	Existing	Emergency Management	Township Engineer	One Year	$325,000	FMA, PDM-C and HMGP if available	High
Lopatcong Township 2: Storm-water management system upgrade and improvement along Belleview Dairy Road and Fox Farm Road.	Flood	Existing	Emergency Management	Township Engineer	One Year	$400,000	FMA, PDM-C and HMGP if available	High
Lopatcong Township 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
MANSFIELD TOWNSHIP								
Mansfield Township 1: Acquisition of two Repetitive Loss properties on Route 57.	Flood	Existing	Emergency Management	OEM Coordinator	Two Years	$1,500,000	FMA, PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Mansfield Township 2: Raise embankment along 3000 feet of the Musconetcong River off River Road between Mouder Hill Road and Washington Township line.	Flood	Existing	Emergency Management	Municipal Engineer	Two Years	$2,000,000	PDM-C & HMGP if available	High
Mansfield Township 3: Backup generator for Mansfield Township Elementary School located on Port Murray Road. Facility is a regional ARC shelter.	All	Existing	Emergency Management	School Board Administrator	One Year	$125,000	HMGP (5% initiative)	High
Mansfield Township 4: Implement Fire Wise Program throughout the Township.	Wild Fire	Existing	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	Medium
Mansfield Township 5: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
OXFORD TOWNSHIP								
Oxford Township 1: Backup generator for Emergency Operations Center located at the Department of Public Works Building on Mt. Pisgah Road.	All	Existing	Emergency Management	OEM Coordinator	One-two Years	$125,000	HMCP 5% Initiative	High
Oxford Township 2: Retrofit foundation pilings on Emergency Squad building located on Academy Street.	Subsidence	Existing	Emergency Management	Township Engineer	One-two Years	$850,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Oxford Township 3: Construction of an earth berm around the lift station to prevent flooding located on Pequest Road at Shippen Ridge.	Flooding	Existing	Emergency Management	Township Engineer	One-two Years	$50,000	PDM-C & HMGP if available	High
Oxford Township 4: Conduct Fire Wise Program throughout the Township.	Wild Fire	Existing	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	Medium
Oxford Township 5: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
PHILLIPSBURG TOWN								
Phillipsburg Town 1: Acquisition/Elevation of two Repetitive Loss properties on Broad Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$175,000	FMA, PDM-C & HMGP if available	Medium
Phillipsburg Town 2: Acquisition/Elevation of one Repetitive Loss property on Center Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$1,500,000	FMA, PDM-C & HMGP if available	Medium
Phillipsburg Town 3: Acquisition/Elevation of one Repetitive Loss property on North Main Street.	Flood	Existing	Floodplain Management	OEM Coordinator	Two Years	$120,000	FMA, PDM-C & HMGP if available	Medium
Phillipsburg Town 4: Flood proof the Mallinckrodt Baker building located on Broad Street.	Flood	Existing	Emergency Management	Facility Administrator	One Year	$475,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Phillipsburg Town 5: Elevate utilities above flood level at the Waste Water Treatment Plant located on South Main Street.	Flood	Existing	Emergency Management	Town Administrator	One–two Years	$750,000	PDM-C & HMGP if available	High
Phillipsburg Town 6: Extend 800 feet to retaining wall along Delaware River and Riverside way.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One–two Years	$600,000	PDM-C & HMGP if available	High
Phillipsburg Town 7: Installation of duckbill valves/flapper valves on Lopatcong Creek.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One–two Years	$900,000	PDM-C & HMGP if available	High
Phillipsburg Town 8: Upgrade and improvement storm water management system with addition of check valves.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One Year	$250,000	PDM-C & HMGP if available	High
Phillipsburg Town 9: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
POHATCONG TOWNSHIP								
Pohatcong Township 1: Acquisition/Elevation of six Severe Repetitive Loss properties on River Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Year	$1,500,000	SRL, FMA, PDM-C & HMGP if available	High
Pohatcong Township 2: Acquisition/Elevation of one Repetitive Loss property on Warren Glen Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Year	$350,000	FMA, PDM-C & HMGP if available	Medium

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Pohatcong Township 3: Acquisition/Elevation of one Repetitive Loss property on River Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Year	$250,000	FMA, PDM-C & HMGP if available	High
Pohatcong Township 4: Acquisition/Elevation of one flood prone property located on Municipal Drive.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Year	$325,000	FMA, PDM-C & HMGP if available	High
Pohatcong Township 5: Acquisition of one flood prone property located on River Road.	Flood	Existing	Floodplain Management	OEM Coordinator	One–two Year	$250,000	FMA, PDM-C & HMGP if available	High
Pohatcong Township 6: Retrofit impact resistant windows and shutters to original portion (100 yrs old) of the Pohatcong Municipal Complex located on Municipal Drive.	Straight Line Winds	Existing	Emergency Management	Township Administrator	One Year	$50,000	PDM-C & HMGP if available	Low
Pohatcong Township 7: Emergency generator for Pohatcong School (shelter) located on Route 519.	All	Existing	Emergency Management	School Board Administrator	One Year	$125,000	HMGP 5% Initiative	Medium
Pohatcong Township 8: Flood proofing of the Huntington Fire Company building located on Maple Avenue.	Flood	Existing	Emergency Management	Station Commander	One Year	$475,000	PDM-C & HMGP if available	High
Pohatcong Township 9: Install rip-wrap along 100 yards of the Pohatcong Creek along Ravine Road.	Flood	Existing	Emergency Management	Department of Public Works Supervisor	One Year	$175,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Pohatcong Township 10: Flood-proofing of the Police Department building located in Phillipsburg.	Flood	Existing	Emergency Management	Municipal Fire Chief	One–two Years	$95,000	PDM-C, FMA & HMGP if available	High
Pohatcong Township 11: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
WASHINGTON BOROUGH								
Washington Borough 1: Emergency generator for shelter and Emergency Operations Center located at the Washington Borough Municipal Complex located on Belvidere Avenue.	All	Existing	Emergency Management	Borough Administrator	One Year	$125,000	HMGP 5% Initiative	High
Washington Borough 2: Storm-water management system upgrade and improvement along Route 57 between Lenape Trail and Prospect Avenue.	Flood	Existing	Emergency Management	OEM Coordinator	One Year	$465,000	PDM-C & HMGP if available	High
Washington Borough 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
WASHINGTON TOWNSHIP								
Washington Township 1: Acquisition/ Elevation of one Severe Repetitive Loss property on Rymon Road.	Flood	Existing	Emergency Management	OEM Coordinator	Two Years	$400,000	SRL, FMA, PDM-C & HMGP if available	Low
Washington Township 2: Acquisition/ Elevation of one Repetitive Loss property on Butler Park Road.	Flood	Existing	Emergency Management	OEM Coordinator	Two Years	$300,000	FMA, PDM-C & HMGP if available	Medium
Washington Township 3: Acquisition/ Elevation of one Repetitive Loss property on Roaring Rock Road.	Flood	Existing	Emergency Management	OEM Coordinator	Two Years	$350,000	FMA, PDM-C & HMGP if available	Low
Washington Township 4: Acquisition/ Elevation of 10 flood prone properties located on Butlers Park Road.	Flood	Existing	Emergency Management	OEM Coordinator	Two Years	$3 ,000,000	FMA, PDM-C & HMGP if available	High
Washington Township 5: Storm-water management system upgrade and improvement along Mill Pond Road.	Flood	Existing	Emergency Management	Town Administrator	One Year	$475,000	FMA, PDM-C & HMGP if available	High
Washington Township 6: Raise 200 feet of embankment an additional two feet in height along the stream bank parallel to Kayhart Lane.	Flood	Existing	Emergency Management	Town Administrator	One Year	$500,000	PDM-C & HMGP if available	High
Washington Township 7: Stream bank stabilization at bend of Roaring Rock Creek located near Meadow Breeze Lane.	Flood	Existing	Emergency Management	Town Administrator	One Year	$500,000	PDM-C & HMGP if available	High

Mitigation Action, Program, or Project	Hazard(s) Addressed	Applies to Existing or New Structures	Existing Local Planning/ Implementation Mechanism	Responsible Party	Target Date / Project Duration	Estimated Cost ($)	Funding Source	Priority
Washington Township 8: Conduct inundation study for dam located in Roaring Rock Park.	Flood	Existing	Emergency Management	Town Administrator	One Year	$65,000	PDM-C & HMGP if available	High
Washington Township 9: Flood-proofing of the Good Shepherd Christian School.	Flood	Existing	Emergency Management	School Board Administrator	One–two Years	$95,000	PDM-C, FMA & HMGP if available	High
Washington Township 10: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High
WHITE TOWNSHIP								
White Township 1: Acquisition/Elevation of one Severe Repetitive Loss property on Riverview Avenue.	Flood	Existing	Floodplain Management	OEM Coordinator	One-two Years	$200,000	SRL, FMA, PDM-C & HMGP if available	High
White Township 2: Installation of an early warning siren system along the Delaware River.	Severe Weather and Flooding	Existing	Emergency Management	OEM Coordinator	One Year	$25,000	PDM-C & HMGP if available	High
White Township 3: Conduct all hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with WCOEM	One Year	Staff Time	PDM-C and HMGP	High

Notes:

(1) Priorities and definitions of eligible projects under FEMA funding programs can change from year to year and disaster to disaster. Where multiple federal funding sources are identified under "Funding Source", the applicant will need to be aware of when notices of funding availability are published by FEMA and then carefully review to determine if a particular project will be eligible for that specific funding source. In addition, the definition and scope of the project may need to be adjusted to best conform to eligibility guidelines at the time of application

(2) Entries in the "Funding Source" column with the name of the municipality indicate projects that are not considered as 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 D, Table D-2 for details of STAPLEE analysis of these mitigation actions.

6.6 Prioritization and Implementation of Mitigation Actions

The preceding sections identify specific actions to achieve identified goals, an appropriate responsible party for each action, 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. Action items are feasible and are anticipated to reduce 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 6.6-1 describes the basic steps in the STAPLEE methodology.

Table 6.6-1–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 WCOEM to weigh the various criteria for each of the identified county-level mitigation actions including the relative cost-effectiveness as part of the "Economic" criteria. The resulting priority rankings are shown in Tables 6.4-1. The detailed scoring of each action for each criterion is shown in Table D-1 in Appendix D.

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 6.5-1. The detailed scoring of each action for each criterion is shown in Table D-2 in Appendix D.

Per the results of the Capability Assessment in Section 5, 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 secure grants and 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. 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.

Notes regarding Benefit-Cost Analysis

Per the IFR, communities are required to use benefit cost analysis (BCA) 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.

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 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 eligible for receiving funds from the grant program and perform a BCA. The BCA will help rank the structures as part of the STAPLEE process to determine which structure should receive funding first.

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Section 7
Plan Monitoring and Maintenance

Contents of this Section

7.1 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.*

7.2 Method for Monitoring the Plan

This Plan will be monitored by the Warren County Office of Emergency Management (WCOEM) for several related purposes:

- Maintain the currency of hazard and risk information
- Ensure that mitigation projects and actions reflect the priorities of Warren County and stakeholders
- To comply with the Federal Emergency Management Agency (FEMA) and the State of New Jersey requirements for plan maintenance and maintain Warren County's eligibility for federal disaster assistance and mitigation grants

The Warren County Emergency Management Coordinator will continuously monitor the Plan with respect to the purposes noted above, according to the schedule described in Section 7.3, and with respect to the update triggers noted in Section 7.5 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 7.4).

7.3 Schedule for Monitoring the Plan

Informal Plan monitoring activities will be ongoing. In addition to the FEMA mandated five-year update cycle, the Warren County Emergency Management Coordinator or their designee (Coordinator) will perform monitoring activities for the Plan as described in Section 7.2 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 6 may be made or additional event-specific actions identified.

7.4 Method and Schedule for Evaluating and Updating the Plan

[**Note to Reviewers**: The missing dates in Section 7.4 will be provided once these events have occurred]

Comprehensive evaluation of and updates to this Plan will be undertaken on a five-year cycle (at a minimum). This Plan was adopted on [Insert Date], and thus must undergo a formal FEMA-compliant update process by [Insert Date + 5 years]. Approximately one year prior to the five-year anniversary of Plan adoption or sooner if circumstances require, the Coordinator will initiate a comprehensive review 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 Warren 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 implementation; and
- Results in implementing the Plan per monitoring reports (per Sections 7.2 and 7.3).

The Coordinator will prepare a report (1) describing the updated 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.

The report will sequentially be provided to the Warren County Hazard Mitigation Working Group (HMWG) and Warren County Board of Chosen Freeholders for consideration. The report will also be posted on the WCOEM website for public review and comment.

The Warren County 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 Warren County HMWG and Board of Chosen Freeholders.

When the draft updates are completed, the Warren County HMWG will be convened to conduct the comprehensive evaluation and revision. The Warren County HMWG and County 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.

7.5 Circumstances that will Initiate Plan Review and Updates

This section identifies the circumstances or conditions under which WCOEM will initiate Plan reviews and updates.

- On the recommendation of the Coordinator or on its own initiative, the Warren 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 Warren County assets, operations, and/or constituents

7.6 Other Local Planning Mechanisms

It should be noted that Warren 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 Warren County Capital Improvement Program. In addition, the WCOEM 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 7.6-1 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 7.6-1: Scheduled Updates to Relevant Plans and Documents

Plan or Document	Next Update
Allamuchy Township Master Plan	2011
Allamuchy Township Zoning Plan	2011
Allamuchy Township Capital Improvement Plan	Annually
Alpha Borough Master Plan	2011
Alpha Borough Zoning Plan	2009
Alpha Borough Capital Improvement Plan	Annually
Town of Belvidere Master Plan	2011
Town of Belvidere Zoning Plan	2010
Town of Belvidere Capital Improvement Plan	Annually
Blairstown Township Master Plan	2007
Blairstown Township Zoning Plan	2007
Blairstown Township Capital Improvement Plan	Annually
Franklin Township Master Plan	2010
Franklin Township Zoning Plan	2010
Franklin Township Capital Improvement Plan	Annually
Frelinghuysen Township Master Plan	2011
Frelinghuysen Township Zoning Plan	2010
Frelinghuysen Township Capital Improvement Plan	Annually
Greenwich Township Master Plan	2006
Greenwich Township Zoning Plan	2006
Greenwich Township Capital Improvement Plan	Annually
Town of Hackettstown Master Plan	2008
Town of Hackettstown Zoning Plan	2009
Town of Hackettstown Capital Improvement Plan	Annually
Hardwick Township Master Plan	2007
Hardwick Township Zoning Plan	2009
Hardwick Township Capital Improvement Plan	Annually
Harmony Township Master Plan	2010

Plan or Document	Next Update
Harmony Township Zoning Plan	2010
Harmony Township Capital Improvement Plan	Annually
Hope Township Master Plan	2006
Hope Township Zoning Plan	1997
Hope Township Capital Improvement Plan	Annually
Independence Township Master Plan	2008
Independence Township Zoning Plan	2008
Independence Township Capital Improvement Plan	Annually
Knowlton Township Master Plan	2006
Knowlton Township Zoning Plan	2003
Knowlton Township Capital Improvement Plan	Annually
Liberty Township Master Plan	2010
Liberty Township Zoning Plan	2010
Liberty Township Capital Improvement Plan	Annually
Lopatcong Township Master Plan	2010
Lopatcong Township Zoning Plan	2010
Lopatcong Township Capital Improvement Plan	Annually
Mansfield Township Master Plan	2008
Mansfield Township Zoning Plan	2007
Mansfield Township Capital Improvement Plan	Annually
Oxford Township Master Plan	2009
Oxford Township Zoning Plan	2009
Oxford Township Capital Improvement Plan	Annually
Phillipsburg Town Master Plan	2010
Phillipsburg Town Zoning Plan	2005
Phillipsburg Town Capital Improvement Plan	Annually
Pohatcong Township Master Plan	2006
Pohatcong Township Zoning Plan	2009
Pohatcong Township Capital Improvement Plan	Annually
Washington Borough Master Plan	2007
Washington Borough Zoning Plan	2010
Washington Borough Capital Improvement Plan	Annually
Washington Township Master Plan	Annually
Washington Township Master Plan	2010
Washington Township Zoning Plan	2009
White Township Master Plan	Annually
White Township Zoning Plan	2010
White Township Capital Improvement Plan	2009

7.7 Continued Public Involvement

As noted above, this Plan will be evaluated and updated periodically and when certain triggering events occur. Warren County will utilize public notices and a centralized website in an effort to include the public in the update process. In addition, the WCOEM 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.