Table of Contents

EXECUTIVE SUMMARY

AUGUSTA – RICHMOND COUNTY, BLYTHE AND HEPHZIBAH HMP UPDATE

The history of Augusta - Richmond County and the Cities of Blythe and Hephzibah reveals a past, present, and future commitment to long-term strategies to reduce the hazard risks and the resulting impact to the community.

Existing Plan, Review and Revision Update Process and Methodology

The Augusta – Richmond County Multi-Jurisdictional Hazard Mitigation Planning Committee (HMPC) formed by the governmental consensus of Augusta – Richmond County Metro Government, the City of Blythe and the City of Hephzibah, comprising all incorporated jurisdictions in Richmond County.

After an exhaustive review of the existing Hazard Mitigation Plan, the HMPC determined the approach to the HMP update would differ from the norm. Rather than attempting to fit new information, challenges, and objectives within the existing plan, the HMPC with the support of their governments decided to re-work the entire plan. The goal was to produce a living document to reflect the individual jurisdictional profiles, circumstances and needs. The resulting plan is essentially new and the identification of each update would be impractical and time-consuming.

The methodological approach used by the HMPC reflects the common goal of sustainability, economy, and protection for the citizens of each community and the county as a whole.

The purpose of the Hazard Mitigation Plan update is to serve as a framework and resource guide to coordinate and implement hazard mitigation policies, procedures, and projects. It expresses the community mitigation goals, objectives, and related activities to assist in reducing risk and eliminating or minimizing losses from natural and technological hazard events. Intentional, informed decisions and processes reduce or avoid hazards and lessen community exposure when appropriate actions are taken before hazardous events occur. Proactive community hazard planning and implementation policies save lives, reduce property loss, and minimize the social, economic, and governmental disruptions following hazard events. Augusta - Richmond County and the municipalities of Blythe and Hephzibah concur that hazard mitigation is an essential component of prudent government function and community service. Identification of vulnerable areas, populations, and services and implementation of sound strategies to minimize exposure reduce (mitigate) the negative impact of natural or technological hazards on the community and maximize emergency response and recovery efforts.

Augusta - Richmond County and its cities developed without consideration of hazard mitigation planning, mitigation, response, and recovery. As a result, some areas are

vulnerable to flooding, tornadoes, high wind, severe storms, lightning, wildfire, and other hazards. The GEMA process of mitigation planning encompasses Hazard Identification, Risk Assessment, Mitigation Strategies, Implementation, Plan Update and Maintenance, and Incorporation of hazard mitigation activities in existing community processes and functions. These plan elements and activities are conducted to ensure that vulnerability to hazard events does not increase.

Encouraging acquisition, relocation, retrofitting of existing vulnerable structures, protection of valuable natural resources, and a sound response and recovery plan seek to minimize damages and foster a stronger, disaster resistant community following a hazard event.

Communities face significant challenges in post-disaster response and redevelopment activities. Balancing the pressing need for rapid recovery with critical long-term hazard mitigation strategies to reduce future exposure is difficult, costly, and frequently politically charged. Search and rescue efforts, meeting basic service and supplies needs, relocation activities for those displaced populations, and activities to stabilize government operations frequently overshadow long-term community resiliency considerations. The push to return to 'normal', the initiation of reconstruction activities and the desire of government to provide services and assistance to neighbors and businesses hamper or circumvent sustainability goals, objectives and implementation.

While common to communities following hazardous events, these factors emphasize the need for pre-disaster planning and mitigation strategies that incorporate resilient development principles within recovery efforts. Proactive hazard mitigation planning facilitates rebuilding to reduce vulnerability to future hazard events, reduces costs to local, state, and federal governments, supports economic vitality, and improves the quality of life.

Once the plan is complete and implemented in the everyday processes, roles, and activities of local government, it is imperative for local decision makers to review plan progress, provide insight, feedback, and suggestions for future updates to the Augusta - Richmond County Hazard Mitigation Plan. Adoption of the plan is the first leg of the journey. As better mitigation techniques and prediction models develop, local governments update and refine the plan to promote the processes, policies, and strategies that lend support to those charged with plan implementation. In doing so these community leaders contribute to a resilient, economically vibrant community, better prepared to respond to hazardous events and dedicated to the success of all citizens and visitors to Augusta - Richmond County and its cities.

Chapter 1: PLANNING PROCESS

PURPOSE - BACKGROUND

Augusta - Richmond County and the cities of Blythe and Hephzibah desire to update the existing Hazard Mitigation Plan (HMP) adopted in April, 2006. Once completed, crucial components of the Plan are integrated within the Augusta - Richmond County Comprehensive Plan (CP, adopted in February, 2006), existing Emergency Operations Plan (EOP, adopted in March, 2009, revised in October, 2009) and other jurisdictional guidance documents. Integration of the updated Plan will produce seamless guidance for staff and personnel throughout the county and contribute to the success of the adopted strategies and mitigation measures. As with all state of Georgia planning processes, the HMP encompasses the entirety of the Augusta - Richmond County area and the Cities of Blythe and Hephzibah.

AUGUSTA – RICHMOND COUNTY MULTI – JURISDICTIONAL HMP PLANNING AREA and PLANNING COMMITTEE

In 1996 the City of Augusta consolidated with Richmond County to form Augusta-Richmond County. Augusta-Richmond County is one of only three consolidated governments in Georgia. The cities of Blythe and Hephzibah are separate municipalities chartered by the State of Georgia. Community Profile data for each jurisdiction is included in Appendix C of this document.

Augusta - Richmond County and the cities of Blythe and Hephzibah established a Multi-jurisdictional Hazard Mitigation Planning Committee (HMPC), hereinafter referred to as Augusta – Richmond County HMPC representative of the three jurisdictions in the county. Inter-governmental cooperation, coordination, and consensus are the foundation of the HMPC and the HMP project approach.

The Augusta - Richmond County Multi-jurisdictional HMP project addressed the update of the existing community Multi-hazard Mitigation Plan to fulfill requirements of the Federal Disaster Mitigation Act of 2000 (DMA2K). The Act is administered by the Georgia Emergency Management Agency (GEMA) and the Federal Emergency Management Agency (FEMA). The Mitigation Act provides federal assistance to state and local emergency management and other disaster response agencies in an effort to reduce damage and loss resulting from disasters. The proposed planning process involves numerous community partners including elected and appointed officials, fire and EMS, emergency management, law enforcement, engineering departments, flood plain and storm water managers, planners, business and economic development entities, social and civic representatives, and citizen representatives from Augusta - Richmond County and the Cities of Blythe and Hephzibah.

Typically, mitigation planning has the potential to produce long-term and recurring benefits by breaking the repetitive cycle of disaster loss. A core assumption of hazard mitigation is that hazard investments will significantly reduce the demand for post-disaster assistance by lessening the need for emergency response, repair,

recovery and reconstruction. Mitigation practices will enable residents, businesses and industries to recover in the aftermath of a disaster to ensure the community economy is rapidly re-established and with minimum disruption.

The primary goals of Hazard Mitigation planning and implementation are to identify manmade and natural risks to the community, assess the potential impact of the identified risks, develop goals and objectives based on a prioritized impact framework, and implement strategies to reduce or eliminate community vulnerability.

The benefits of mitigation planning go beyond reducing hazard vulnerability. Measures including land acquisition or regulation in known hazard areas help to achieve community goals, such as preserving open space, maintaining environmental health and enhancing recreational opportunities. It is vitally important that mitigation planning is integrated with other planning efforts, and that mitigation strategies are congruent with other community goals or initiatives.

In preparing the HMP, Augusta - Richmond County, Blythe, and Hephzibah will utilize a multi-jurisdictional planning process consistent with those recommended by FEMA (Publication Series 386). A local mitigation plan crosswalk, found in Appendix D, provides a summary of FEMA current minimum standards of acceptability for compliance with the DMA2K and notes the location where each requirement is met within the plan. These standards are based upon FEMA's Interim Final Rule, as published in the Federal Register on February 26, 2002, in Part 201 of the Code of Federal Regulations (CFR).

Augusta - Richmond County, Blythe, and Hephzibah, like many communities in Georgia, each espouse a documented commitment to the planning process and active participation throughout the HMP update process. Area universities and colleges were invited to participate in the update process. The Hazard Mitigation Planning Committee (HMPC) and Augusta - Richmond County, Blythe and Hephzibah personnel participated in the general session planning meetings to gather data including known hazards, flood prone areas, areas of vulnerability, existing mitigation plans and projects, and technical data for the plan. Scheduled meetings with each jurisdiction facilitated community input, data collection, and shared information. The data collected was forwarded to the HMPC for review and incorporation into the plan. Additional technical meetings were held to ensure accuracy of information and data, and that agency, organization, and public input are included as presented. Resolutions documenting each jurisdiction's support for the HMP are included in the plan. The plan update process is conducted over the course of several weeks.

Disaster Mitigation Act of 2000: To support the expanded role of emergency management, Congress passed the DMA2K, the Stafford Act. Section 322, an amendment to the Act, deals with the development of local HMPs. DMA2K was signed into law on October 30, 2000 (Public Law 106-390). The Interim Final Rule for planning provisions (44 CFR Part 201) was published in the Federal Register in February 2002, and again in October 2002. Local hazard mitigation planning

requirements are implemented in 44 CFR Part 201.6. The purpose of DMA2K is to amend the Stafford Act to establish a national program for hazard mitigation, streamline administration of disaster relief, and control federal costs of disaster assistance. Congress envisioned that implementation of these new requirements would result in the following key benefits:

- Reduction of loss of life and property, human suffering, economic disruption and disaster costs;
- Prioritization of hazard mitigation planning at the local level, with an increased emphasis placed on planning and public involvement, assessing risks, implementing loss reduction measures, and ensuring critical services/facilities survive a disaster;
- Establishment of economic incentives, awareness and education to state, tribal and local governments that result in forming community-based partnerships, implementing effective hazard mitigation measures, leveraging additional non-federal resources, and establishing commitments to long-term hazard mitigation efforts.

The DMA2K legislation requires all local, county and tribal governments to develop a HMP for their respective communities in order to be eligible to receive Hazard Mitigation Grant Program (HMGP) funds. Each community's HMP must be submitted to, and approved by, their respective State EMA and FEMA. DMA2K requires that each Plan must, at minimum, address or include the following general items:

- Plan adoption by all jurisdictions;
- Planning process including public involvement;
- Hazard identification and risk assessment;
- Mitigation strategy;
- Plan implementation and maintenance procedures;
- Any specific GEMA, FEMA, or Augusta – Richmond County requirements

Hazard Mitigation Grant Program: In 1988, Congress established the Hazard Mitigation Grant Program (HMGP) by enactment of Section 404 of the Stafford Act. In 2002, regulations pertaining to the HMGP to reflect the DMA2K were changed by 44 CFR Part 206, Subpart N. An Interim Final Rule was issued in October 2002, wherein the final compliance date was set to November 1, 2004. The HMGP assists states and local communities to implement long-term hazard mitigation measures by providing federal funding after a major disaster declaration. Eligible applicants include state and local agencies, tribal organizations and certain non-profit organizations. Examples of typical HMGP projects include the following:

- Property acquisition and relocation projects;
- Structural retrofitting to minimize damages from high winds, earthquake, flood, wildfire or other natural hazards;
- Elevation of flood-prone structures;
- Vegetative management programs

Pre-Disaster Mitigation Program: The Pre-Disaster Mitigation Program (PDM) was authorized by Section 203 of the 2000 Stafford Act, 42 USC (Public Law 106-390). Funding for the program is provided through the National Hazard Mitigation Fund to assist state, local and tribal governments in implementing cost-effective hazard mitigation activities that complement a comprehensive mitigation program. The following two types of grants are offered under the PDM Program:

- Planning Grants − Allocated funds to be used for HMP development;
- Competitive Grants − Distributed funds using a competitive application process wherein all state, local and tribal governments interested in obtaining grant funds can submit applications to be reviewed and ranked by FEMA using pre-determined criteria. The minimum eligibility requirements for jurisdictions receiving competitive HM funds include the following:

    1. Participation in the National Flood Insurance Program (NFIP);
    2. Must not be suspended or on probation from the NFIP;
    3. Must have a FEMA-approved HMP

Flood Mitigation Assistance Program: The Flood Mitigation Assistance Program (FMA) was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101) with the goal of reducing or eliminating claims under the NFIP. Funding for the program is provided through the National Flood Insurance Fund. FMA provides funding to assist states and communities in implementing measures to:

- Reduce the number of repetitively or substantially damaged structures and the associated claims on the National Flood Insurance Fund;
- Encourage long-term, comprehensive mitigation planning;
- Respond to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development review and permitting;
- Complement other federal, state and local mitigation programs with similar long-term mitigation goals.

The following three types of grants are available under FMA:

1. FMA Planning Grants are available to states and communities to prepare Flood Mitigation Plans. NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project Grants.
2. FMA Project Grants are available to states and NFIP participating communities to implement measures to reduce flood losses.
3. Management Cost Grants are a part of Project Grants. Up to 10 percent of the Project Grants funding is made available to the states for technical assistance. These funds may be used by the state to help administer the program.

The NFIRA stipulates that to be eligible to receive an FMA grant, a community must have a FEMA-approved mitigation Plan and must be participating in the NFIP. Examples of eligible FMA projects include the following:

- Acquisition of NFIP-insured structures and underlying real property;

- Demolition of NFIP-insured structures on acquired or restricted real property;
- Minor physical flood mitigation projects that do not duplicate flood-prevention activities of other federal agencies, lessen the frequency or severity of flooding, and decrease predicted flood damages in local flood areas. These include modification of existing culverts and bridges, installation or modification of floodgates, stabilization of stream banks, and creation of small debris or flood/storm water retention basins. Construction or improvement of major structural flood-control structures such as dikes, levees, dams, seawalls, groins and jetties, and projects consisting of channel widening or stream alignment are not eligible, as indicated in Section 1366;
- Other activities that bring an NFIP-insured structure into compliance with the authorized statutory floodplain management requirements of 44 CFR Part 60.3;
- Relocation of NFIP-insured structures from acquired or restricted real property to sites not prone to flood hazards;
- Elevation of NFIP-insured residential structures, and elevation or dry flood proofing of NFIP-insured non-residential structures, in accordance with 44 CFR Part 60.3

Incorporation of Mitigation Plan in Existing Planning Mechanisms

Plan responsibilities for each participating jurisdiction determined additional implementation procedures when appropriate. This included integration of the requirements of the HMP into other local planning documents for all jurisdictions in the planning area, processes or mechanisms including the following:

- Comprehensive Plan;
- Strategic Plans;
- Capital Improvement Plans;
- Growth Management Plans;
- Ordinances, Resolutions and Regulations;
- Emergency Operations Plan;
- Flood Hazard Mitigation Plan

Continuity of Operations Plans

Opportunities to integrate the requirements of this HMP into other local planning mechanisms were identified in meetings of the HMPC and will continue throughout the five-year review process.

The primary means for integrating mitigation strategies into other local planning mechanisms is through the revision, update and implementation of each jurisdiction's individual action plans that requiring specific planning and administrative tasks, e.g., plan amendments, ordinance revisions, and capital improvement projects.

The members of the HMPC were tasked with ensuring the goals and strategies of new and updated local planning documents for their jurisdictions and/or agencies are consistent with the goals and actions of the HMP, and do not contribute to increased hazard vulnerability in Augusta - Richmond County, Blythe, and Hephzibah.

During the planning process for new and updated local planning documents (such as a Comprehensive Plan, Capital Improvements Plan or Emergency Management Plan), Augusta - Richmond County, Blythe, and Hephzibah will provide a copy of the HMP to the appropriate parties and recommend that all goals and strategies of new and updated local planning documents are consistent with, and in support of, HMP goals and do not contribute to increased hazards in the affected jurisdiction(s).

Although it is recognized that there are many possible benefits to integrating components of the Plan into other local planning mechanisms, the development and maintenance of this stand-alone HMP was deemed by the Augusta - Richmond County HMPC to be the most effective and appropriate method to ensure implementation of local hazard mitigation actions at this time.

1.1 PLANNING PROCESS METHODOLOGY

PLAN PURPOSE

In response to unacceptable loss of life and property resulting from natural disasters, Augusta - Richmond County and the Cities of Blythe and Hephzibah developed its original HMP in February of 2006, an initial Plan providing homes, businesses, and communities with safeguards to mitigate the impacts of hurricanes, floods, tornadoes, wildfires, and other natural hazards. This Plan update assesses the effectiveness of current programs and activities in the community; identifies shortfalls; and develops mitigation measures to reduce Augusta - Richmond County, Blythe and Hephzibah's exposure to these natural hazards.

Augusta - Richmond County, Blythe, and Hephzibah remain dedicated in continuing the work program established by the 2006 Plan and improving hazard mitigation strategies through the current Plan update in order to:

- Protect life and property by reducing the potential for future damages, community disruption, and economic loss resulting from natural hazards;
- Qualify for additional grant funding, in both pre-disaster and post-disaster environment;
- Provide quick recovery and redevelopment assistance and services following future disasters;
- Integrate existing mitigation documents, processes, and plans;
- Demonstrate a firm local commitment to hazard mitigation principles; and
- Comply with state and federal legislative requirements governing local hazard mitigation planning.

PLAN SCOPE

The visioning scope of the Augusta - Richmond County Multi-jurisdictional HMP proposal included the following:

- Involved committee members and citizens in drafting a HMP to guide future development and preparedness activities across the county;
- Identified risks and hazards that may affect Augusta - Richmond County, Blythe, and Hephzibah using a systematic hazard identification and risk assessment process;
- Prioritized loss reduction and emergency preparedness activities for disasters;
- Determined hazard vulnerability areas within Augusta - Richmond County, Blythe, and Hephzibah;
- Developed strategies and best practices to reduce and/or mitigate the impact of identified hazards;
- Developed a Continuity of Operations Plan to integrate the Plan in existing local government plans, regulations, policies and administration; and
- Developed a Plan Update & Maintenance Matrix.

PLAN METHODOLOGY & ORGANIZATION

The scope of the HMP encompassed all areas of Augusta - Richmond County, Blythe, and Hephzibah. The HMP identified all natural, manmade, and technological hazards that potentially threatened community life, property, quality of life, and sustainability. Elements of the HMP include short and long-term mitigation goals and objectives, implementation strategies and projects with possible sources of project funding.

Additionally, the HMP contains the following components:

- The mitigation vision of the community;
- A profile of Augusta - Richmond County, Blythe, and Hephzibah, geography, history, assets, critical facilities, physical features and community indicators;
- Planning process overview and participation program for project committee, local, state and federal governments, citizens, industry and community entities;
- Review of Existing Plans to determine validity, integration, and revision opportunities;
- Review and Documentation of past and predicted exposure to natural hazards, including potential impact of risks to critical infrastructure, facilities, and operations;
- Assessment of anticipated losses resulting from identified hazards;
- Assessment of capabilities to implement hazard mitigation goals, objectives and policies to effectively mitigate community risks;
- Strategies and Procedures to implement and maintaining an effective, long range HMP;

- Assessment of recommendations for revisions to current policies, goals and regulations resulting from the HMP;
- Critical facilities information and mapping;
- Intergovernmental Coordination between Augusta - Richmond County, Blythe, and Hephzibah, GEMA, and FEMA; and
- Process documentation.

SCOPE OF WORK – PRODUCTS

This Plan update meets the requirements set forth by FEMA and GEMA and ensures that Augusta - Richmond County, Blythe, and Hephzibah remains eligible for funding and technical assistance from State and Federal hazard mitigation programs. Routine updates and maintenance addresses the natural and technological hazards ranked as high and moderate hazard risks and defined by the updated local hazard, risk, and vulnerability summary. Additional natural hazards will be evaluated during future updates to the Plan to determine vulnerability and risk to the community and needed development of specific mitigation measures to reduce impact. The HMP is updated and FEMA-approved on a five-year cycle.

Chapter 1 – HMP: PLANNING PROCESS – PRODUCTS

AUGUSTA - RICHMOND COUNTY, BLYTHE, AND HEPHZIBAH EXECUTIVE SUMMARY PRODUCTS

The HMPC and the Consulting Team documented the hazard mitigation planning process, including but not limited to:

- Plan Preparation Process and Documentation;
- Plan Mission – Vision developed by the Consulting Team and HM Planning Committee containing public input;
- Plan Organization;
- Plan Financing;
- Plan Participation

HMPC scheduled public participation and involvement events, (i.e. workshops, community outreach), document comments, survey data, and meeting minutes, encouraged input and commentary from the public, and HMPC.

As part of the public involvement process, Augusta - Richmond County, Blythe, and Hephzibah formed a Hazard Mitigation Planning Committee (HMPC), chaired by Chief Howard Willis, Augusta-Richmond County EMA Director / Fire Chief. Members included a cross-section of the community, such as residents, government officials, EMA personnel, planners, engineers, community leaders, public and private agencies, business owners and the Consulting Team.

HMPC MEMBERS

HMP Update – Planning Committee

1. **Committee Chairman** – Chief Howard Willis; EMA Director / Fire Chief; hwillis@augustaga.gov
2. **Committee Vice-Chair** – Terri Turner; Assistant Zoning & Development Administrator, Augusta-Richmond County Planning Commission; tturner@augustaga.gov
3. **Committee Secretary** – Sharon Bennett; EMA / LEPC; SWBennett@augustaga.gov
4. J R Hatney; Augusta Commission, District 9; jhatney@augustaga.gov
5. Grady Smith; Augusta Commission, District 10; hgssbm@knology.net
6. Deke Copenhaver; Mayor; MayorDeke@augustaga.gov
7. Fred Russell; City Administrator; frussell@augustaga.gov
8. George Patty; Executive Director, Augusta-Richmond County Planning Commission; gpatty@augustaga.gov
9. Scott Gay; Sheriff's Department; sgay@augustaga.gov
10. Robert Buckwitz; Commission Chairman, City of Hephzibah (or his designated representative); cityofhephzibah@bellsouth.net
11. Mayor Patricia Cole; City of Blythe (or her designated representative); pcblythe@yahoo.com

HMP – Stakeholders Committee

Other City Stakeholders:

1. Tameka Allen; Deputy Administrator; allen@augustaga.gov
2. Bill Shanahan; Deputy Administrator; bshanahan@augustaga.gov
3. Bill Wright; Planning Commission Chair; billwr1120@comcast.net
4. Billy Yates; GIS Project Leader; yates@augustaga.gov
5. Randy Wishard; Health Dept; rewishard@dhr.state.ga.us
6. Jonathan Adriano; Director of Emergency Preparedness, GA Health, District 6; jdadriano@dhr.state.ga.us
7. Dominick Nutter; E-911 Director; dnutter@augustaga.gov
8. Jack Womack; Fire Marshall, Augusta Fire Department; JWomack2@augustaga.gov
9. Hameed Malik; Assistant Engineering Director / City Engineer; HMalik@augustaga.gov
10. Abie Ladson; Engineering Director; aladson@augustaga.gov
11. Rob Sherman; Director, License & Inspections; rsherman@augustaga.gov
12. Chester Wheeler; Director, Housing & Development; CWheeler@augustaga.gov
13. Tom Wiedmeier; Director, Augusta Utilities; TWiedmeier@augustaga.gov
14. Dayton Sherrouse; Director, Augusta Canal Authority; sherrouse@augustacanal.com

15. Earl Hilson; LEPC Chair; jehilson@olin.com
16. Frank Carl; Augusta Ports Authority; frankcarl@knology.net

Federal and State Stakeholders:

1. Scott Hyatt; Operations Project Manager – J Strom Thurmond Dam and Lake, USCOE; scott.m.hyatt@us.army.mil
2. Jason Hunter; FP Mgmt & Ins, FEMA Region IV; jason.hunter@dhs.gov
3. Lynne Keating; NFIP Outreach Specialist, FEMA Region IV; Lynne.keating@dhs.gov
4. Brian Laughlin; Hazard Mitigation Planner Central GA, GEMA; brian.laughlin@gema.ga.gov
5. Dee Langley; Planning Program Manager, GEMA; dee.langley@gema.ga.gov
6. Tom McQueen; GDOT Project Manager – Atlanta, GA; tmcqueen@dot.ga.gov
7. George Brewer; GDOT, District 2 Project Manager, Tennille, GA; gbrewer@dot.ga.gov
8. Steve Abbott; Chief Ranger, GA Forestry Commission; sabbott@gfc.state.ga.us
9. John Ambrose, PhD; Assistant Chief, Nongame Conservation Section; Wildlife Resources Division; GA DNR; Jon.Ambrose@dnr.state.ga.us
10. Steve Willard; Chief of Environ & Nat, Fort Gordon; steve.willard@us.army.mil

Local Stakeholders:

Industry
1. Bill Walls; Environmental Specialist, Solvay; william.walls@solvay.com
2. Phillip Delk; St Technician – Sr. Specialist HSE & Emergency Response Chief, Elanco; delkph@lilly.com

Hospitals
1. Susan James; Emergency Management Coordinator, University Hospital; susanj@uh.org
2. Dennis Jones; MCG; djones@georgiahealth.edu
3. David Brown; Emergency Preparedness Coordinator, VA Medical Center; David.Brown1@va.gov
4. Brad Thompson; Director of Safety and Security, Doctors Hospital of Augusta; brad.thompson@hcahealthcare.com
5. Bill Welsh; Director of Plant Operations, Trinity Hospital; Bill.Welsh@TriadHospitals.com

Emergency Services
1. Tom Knight; Special Projects Coordinator – South Star; tknight.ssems@gmail.com

Universities

1. James Reid; Paine College; reidj@mail.paine.edu
2. Jasper A Cooke; Public Safety Director, Augusta State University; jcooke@aug.edu

Schools

1. Chief Patrick Clayton; Dept. of School Safety and Security, RCBOE; ClaytPa@BOE.Richmond.k12.ga.us

Business Leaders

1. Braye Boardman; President, Beacon Blue, LLC; braye@beaconblue.com
2. Barry Storey; Co-Owner, Hull-Storey Gibson Companies; LLC; BStorey@HullStoreyGibson.com

Chamber of Commerce/CVB

1. Susan Parr; President/CEO, Augusta Metro Chamber of Commerce; sparr@augustagausa.com
2. Scott MacGregor; Augusta Metro Chamber of Commerce; scott@oglethorpepublicaffairs.com
3. Barry White; President, Augusta Visitors and Convention Bureau; bwhite@augustaga.org

Non-Profit Organizations

1. Jennifer Pennington; Executive Director, East Georgia Chapter of the American Red Cross; jpennington@arcaug.org
2. Mie Lucas; Emergency Services Director, American Red Cross of Augusta; mlucas@arcaug.org
3. Katie Atkinson; Volunteer and Disaster Services Coordinator - Salvation Army / Kroc Center; Katie_Atkinson@uss.salvationarmy.org

Environmental Groups

1. Hazel Langrall; Director, Central Savannah River Land Trust; hazel@csrlt.org
2. Tonya Bonitatibus; Savannah RiverKeepers; tbonitatibus@comcast.net
3. Susan Nicholson; Executive Director; Southeastern Natural Sciences Academy; snicholson@naturalsciencesacademy.org

Citizens

1. James Germany; Elderberry Subdivision – District 3; (706) 796-6588; gman6011@comcast.net
2. Leo Jackson; Belair Hills Estates – District 3; (706) 863-0519
3. Bobby Hankerson; Breeze Hill Plantation – District 5; (706) 793-2342; bobby@bobbyhankerson.com
4. Calvin Holland; Laurel Hills - District 5; (706) 798-5294

The Consulting Team, under the direction of the HMPC, drafted and implemented a Public Participation Program to solicit input from citizens and professionals with knowledge of applicable hazards. The Multi-Jurisdictional Augusta - Richmond County, Blythe, and Hephzibah project website, Augusta Richmond County HMP Update, serves as the repository for all documents, Public Meeting announcements and Agendas.

Consulting Team Members

Augusta – Richmond County and its municipalities hired a consulting team to facilitate the Plan update process. Members of the team include:

Pudar Mitigation Consulting, Inc.

- Ranko S. Pudar, P.E., CFM, – Overall Project Manager, Risk Assessment Coordinator

Plans & More, LLP

- Sharon Caton, M.S., AICP – Principal Planner, Outreach Coordinator;
- Alan (Mike) Armstrong, CFM - Data Collection, Ordinance Review, Field Assessment;
- Rachael Davis, GIS Technician III, - Database Management, GIS support

The HMPC held public hearings, meetings, and/or workshops during the Plan development period. Press releases, articles, and workshop presentations explained the planning process, solicited input and responded to comments. The Committee conducted key informant interviews and surveys, conducted field assessments and reported findings on the project website, in workshops, press releases, and other documents.

Activities included:

- Interagency and Intergovernmental Coordination, meeting facilitation, documentation;
- Hazard Identification and Risk Assessment;
- Plan Goals;
- Mitigation Goals, Objectives and Strategy Organization;
- Solicited input regarding the feasibility of potential mitigation measures for each hazard and the prioritize mitigation projects;
- Plan Implementation;
- Preparation of the draft and final HM Plan, Plan goals and objectives, mitigation projects, and recommendations for integration of Plan elements in existing documents, policies, procedures;
- Drafted strategies for implementation and update of Plan goals and mitigation projects including cost analysis and potential community funding sources.

Initial Scoping Meeting – June 14, 2011

Representatives from Augusta - Richmond County HMPC met with the project Consulting Team on June 14, 2011 to discuss the HMP Project Timeline, Scope, HMPC and jurisdictional roles and responsibilities, and community outreach and input activities. The Initial Community Meeting Minutes are included in Appendix A of the HM Plan.

Augusta – Richmond County HMPC Meeting – June 14, 2011

A HMPC Kick-Off Public Hearing was held on June 14, 2011 at 9:00 AM at the Augusta Municipal Building, Room 802. The Consulting Team presentation explained the HM Planning Process, HM Project Timeline, Scope, HMPC and jurisdictional roles and responsibilities, and community outreach and input activities. The HMPC Workshop Presentation, Meeting Video, and Meeting Minutes are included in Appendix B of this document. Following the Kick off Meeting a HMPC Workshop was conducted at 11:00 AM in the Commission Chamber of the Augusta Municipal Building. GEMA Representatives Dee Langley, Planning Program Manager and Brian Laughlin, Mitigation Planning Specialist conducted a training presentation for the HMPC and citizens. View the GEMA HM Plan Kickoff Presentation and HMPC Workshop Presentation.

HMPC Public Hearing – June 14, 2011

The HMPC held their first Public Hearing on June 14, 2011, 5:00 PM to roll out the HMP process, solicit community input, and present the project timeline to the citizens of Augusta – Richmond County. View the Public Hearing Presentation.

Augusta – Richmond County HMPC Workshop – June 22, 2011

The Augusta - Richmond County, ESF11 Group, held a HMP Update meeting on June 22, 2011, at the Julian Smith BBQ Pit, from 1:00 PM to 5:00 PM to complete the Hazard Identification – Risk Assessment Worksheets. View the Meeting Presentation, Sign-in Sheet, and Minutes.

Augusta – Richmond County HMPC Workshop – July 14, 2011

The Augusta – Richmond County HMPC held two meetings on July 14, 2011, at the Augusta Municipal Building (9:00 A.M.) and at City Hall in Hephzibah (1:30 P.M.). View the Sign-in Sheets, See Meeting Agenda, Hephzibah - Blythe Meeting Minutes, and Augusta Meeting Minutes for the HMPC Meetings, held July 14, 2011.

Augusta – Richmond County HMPC and Shelter in Place Meeting – July 12, 2011

The Augusta – Richmond County HMPC held a joint HMP Update and ESF11 Shelter in Place Meeting and presentation on July 12, 2011, at the Julian Smith Casino to gather input on the HMP.

Augusta – Richmond County HMPC Meeting and Public Hearings – 25 July, 2011

The Augusta – Richmond County HMPC held a Hazard Mitigation Plan Update Planning Committee/Stakeholders Committee meeting, at the Augusta Municipal Building, 9:00 A.M. – Noon, to review, comment and revise the HMP Update Draft.

The Augusta – Richmond County HMPC held three Public Hearings at 6:00 P.M. - 7:00 P.M. to roll out the draft plan to the community. The meetings were hosted by three facilitation teams comprised of a HMPC Officer and Consulting Team member:

Public Meeting #1 – Augusta Municipal Building
Facilitation Team: Sharon Bennett, HMPC Secretary and Mike Armstrong, Consulting Team;

Public Meeting #2 - Carrie Mays Community Center
Facilitation Team: Terri Turner, HMPC Vice-chair and Ranko Pudar, Consulting Team);

Public Meeting #3 - Warren Road Community Center
Facilitation Team: Chief Howard Willis, HMPC Chair and Sharon Caton, Consulting Team.

HMP AUTHORITY

The Draft HMP was adopted by Augusta - Richmond County and the cities of Blythe and Hephzibah after the 30 public review period and concurrent with submission to GEMA and FEMA for review and comment in accordance with the authority granted to cities and counties by the State of Georgia. The Final HMP was adopted by Augusta - Richmond County and the cities of Blythe and Hephzibah after approval by GEMA and FEMA in as to form and content in accordance with the authority granted to cities and counties by the State of Georgia.

This Plan was updated in accordance with current State and Federal rules and regulations governing local hazard mitigation plans. The Plan shall be monitored and updated on a routine basis to maintain compliance with the following legislation and guidance:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C., Section 322, Mitigation Planning, as enacted by Section 104 of the DMA2K (P.L. 106-390) and by FEMA Interim Final Rule published in the Federal Register on February 26, 2002, at 44 CFR Part 201;
- Georgia Emergency Management Act of 1981;
- Authorization of the Augusta - Richmond County, Blythe, and Hephzibah Emergency Management Agency

The following FEMA and GEMA guides and reference documents were used to prepare this document:

- FEMA Publication 386-1: Getting Started, September 2002;
- FEMA Publication 386-2: Understanding Your Risks: Identifying Hazards and Estimating Losses, August 2001;
- FEMA Publication 386-3: Developing the Mitigation Plan, April 2003;
- FEMA Publication 386-4: Bringing the Plan to Life, August 2003;
- FEMA Publication 386-5: Using Benefits-Cost Review in Mitigation Planning, May 2007;
- FEMA Publication 386-6: Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning, May 2005;
- FEMA Publication 386-7: Integrating Manmade Hazards into Mitigation Planning, September 2003;
- FEMA Publication 386-8: Multi-Jurisdictional Mitigation Planning, August 2006;
- FEMA Publication 386-9: Using the Hazard Mitigation Plan to Prepare Successful Mitigation Projects, August 2008;
- FEMA; Local Mitigation Plan Crosswalk with GEMA Highlights;
- GEMA; Georgia Mitigation Information System (GMIS) Critical Facilities Database;
- GEMA; Hazard Mitigation Worksheets 1 – 4; Hazard Frequency Table; County Sample Documents and Templates.

Chapters 2 - 3 – Risk Assessment (Hazard Identification and Vulnerability)

In these chapters the historical hazards of Augusta - Richmond County, Blythe, and Hephzibah were recorded and analyzed. The information was identified by using both primary and secondary research materials that included FEMA and GEMA resources and reports from local, state, and national agencies, media accounts, state and local weather records, and conversations with key personnel and residents in the county. The analysis explains the possible severity and magnitude, and the potential impact of damage within each governing jurisdiction from future hazards.

To facilitate the risk assessment effort, two distinct methodologies were used, i.e., quantitative and qualitative. The first utilizes HAZUS®MH (GIS based loss estimation software available from the Federal Emergency Management Agency). The second uses the Georgia Mitigation Information System (GMIS), a GIS-based approach independent of the HAZUS®MH software. The consulting team is familiar in using both methodologies. The quantitative assessment focused on potential loss estimates, while the qualitative assessment is comprised of a scoring system built around value assigned by the HMPC to the likelihood of occurrence, consequence of impact and potential impact of each hazard studied.

It is important to note the vulnerability determinations presented are developed using best available data, and the methodologies applied result in approximation of risk. These estimates are used to understand relative risk from hazards and potential losses that may occur; however, uncertainties are inherent in any loss estimation method.

HAZARD ITENTIFICATION PROCESS: HMPC and the Consulting Team developed a description and prioritization of the natural hazards that occurred within Augusta - Richmond County, Blythe, and Hephzibah. The Hazard Risk Identification and Vulnerability Assessment Elements were developed using the State of Georgia Local Hazard Plan Update Template and FEMA "How To," Guides, Pub. Nos. 386 -1 through 9, FEMA Plan Review Crosswalk with GEMA Requirements, GEMA Highlights, Local Mitigation Plan Guidance, GEMA GMIS Program and Mitigation Information System Guide, and locally produced data, input, and reports. The planning process involved the following steps:

- Identification of Augusta - Richmond County, Blythe, and Hephzibah Natural and Manmade Hazards;
- Hazard Profile;
- Assets Exposed to Hazard
    - Report and Mapped Exposure;
    - Estimation of Potential Losses;
- Land Use and Development Trends (including Special Character, Overlay, DCA, DNR, EPA or other Designated Areas);
- Multi-Jurisdictional Concerns;
- Hazard Summary

BROAD HAZARD CATEGORIES: HMPC and the Consulting Team developed a description and prioritization of the natural hazards that occurred within Augusta - Richmond County, Blythe, and Hephzibah. The Risk Assessment Chapter natural hazards categories, are consistent with the State of Georgia HMP including, but are not limited to:

- Flood-Related Hazards (river flooding, erosion, dam failures as the result of winter storms and hurricanes) that include, at a minimum, flood hazard areas as defined by FEMA in the Digital Flood Insurance Rate Maps (DFIRMs) for the jurisdiction as well as state and local historical data and maps.
- Wind-Related Hazards (hurricanes, coastal storms, winter storms, tornadoes) based on information provided by the National Weather Service (NWS), GEMA HMP and local data.
- Fire-Related Hazards (drought, wildfires) based on local historical data, the NWS, GEMA HMP, and local sources.
- Geologic Hazards (earthquakes, landslides, sink holes) based on local historical information, GEMA HMP, state agency reports, and local sources.
- Other Hazards not listed above as determined by local history and experience. Consideration is given to man-made hazards, i.e. chemical spills and/or fires, based on GEMA HMP, state agency reports and local sources.

HAZARD MAPPING: Using the best available existing data, the HMPC and the Consulting Team coordinated development of a map series to illustrate areas affected by multiple natural hazards working with the Augusta - Richmond County HMPC and GIS personnel. In conjunction with mapping, the HMPC and the Consulting Team created a comprehensive inventory (database) for use in developing map data layers, of the following items:

- Critical facilities, including, but not limited to the following: emergency operations center, police/fire stations;
- Emergency Equipment Locations;
- Hospitals and emergency shelters;
- Water and wastewater treatment plants and associated pumping stations;
- Power generation, transmission, and delivery facilities;
- Special population centers, such as day-care facilities, nursing homes/elderly housing, correctional facilities;
- Hazardous material facilities;
- Evacuation routes and equipment locations;
- Repetitive flood loss and substantial damage structures, as defined by FEMA;
- Maps that depict the location of structures, land use, and population with structure delineation by use (e.g. residential, commercial, industrial, institutional, other).

VULNERABILITY ASSESSMENT: Based on the previous information, the HMPC and the Consulting Team developed an overview of community vulnerability to specific hazards. Vulnerability assessment includes:

- Types and numbers of buildings, infrastructure, and critical facilities located in the identified hazard areas;
- Existing multiple hazard protection measures within Augusta - Richmond County and Hephzibah (Blythe does not participate in the NFIP) including protective measures under the National Flood Insurance Program (NFIP);
- A description of each measure and the method of enforcement and/or the point of contact responsible for implementation of each measure;
- Historical performance of each measure and a description of improvements or changes needed; and
- General description of land uses and development trends to incorporate future land use decisions.

FEMA – GEMA List of Potential Hazards for Consideration

- Landslides and Mudslides
- Sinkholes
- Civil Disturbance
- Atmospheric Hazards
- Winter Storms
- Severe Thunderstorms/Windstorms
- Tropical Storms/Hurricanes
- Tornadoes
- Lightning
- Wildfires
- Hydrologic Hazards
- Flooding
  - Repetitive Loss Projects
  - Drainage Improvement Project
  - HAZUS-MH Summary
- Drought

- Seismic Hazards
- Earthquakes
- Technological Hazards
- Dam/Levee Failures
- Cyber Crime
- Hazardous Material Spills
- Pandemics/Epidemic Incidents
- Terrorism
- Critical Facilities and Infrastructure

A HMPC meeting was held on June 14, 2011 at 9:00 AM at the Augusta - Richmond County Municipal Building, Room 802. Stakeholders joined the HMPC and the Consulting Team to begin the process of determining community risk to locally Identified Hazards in preparation for the Mitigation Strategies element of the Plan. View the Hazard Identification Questionnaire-Worksheet the HMPC used during the meeting.

Chapter 4 – Community Capability Assessment

The Consulting Team in concert with the HMPC performed an analysis and report of Community Capability after researching legal documents, authorities, ordinances and plans to determine the overall capability of Augusta - Richmond County, Blythe, and Hephzibah and the ability to conduct mitigation-related activities. The HMPC collaborated with the Tax Assessor's Office, Planning and Zoning, EMA, and citizens to collect and analyze data related to the NFIP and the Community Rating System (CRS), stormwater management, floodway regulations, and land use controls.

The HMPC and the Consulting Team coordinated with County/City departments, including Augusta - Richmond County, Blythe, and Hephzibah Public Schools, hospitals, businesses and community stakeholders to assess their institutional and fiscal capabilities. It is anticipated the interviews, document research, and data will provide sufficient data to assess the overall fiscal and political capabilities of local government. The document review and interview process will include the following:

- Legal Capability;
- General Authority;
- Building Codes and Inspections;
- Land Use Planning;
- Zoning;
- Subdivision Ordinance;
- Acquisition;
- Taxation;
- Floodway Regulations;
- NFIP and Community Rating System;
- Stormwater Management;
- FEMA Floodplain Map Modernization Program;
- Emergency Management;
- Institutional Capability;

- Political Capability;
- Technical Capability;
- Fiscal Capability

The **Consulting Team**, at the direction of the HMPC produced a Community Capability Report containing the following elements:

Community Capability and Capacity Report

- Analysis Conclusion;
- Legal Capability Conclusion;
- Institutional Capability Conclusion;
- Political Capability Conclusion;
- Technical Capability Conclusion

Chapter 5 –Mitigation Strategies

The foundation of the HM Plan is the identification of strategies through which Augusta - Richmond County, Blythe, and Hephzibah can implement natural, human caused and technological hazard mitigation goals, objectives and actions. As identified in Chapters 2 – 4, Hazard Vulnerability Assessment, the Multi-Jurisdictional HMPC acquired a clear understanding of the community's hazards and risks. The next step was to develop a mitigation strategy. The multi-jurisdictional hazard mitigation goals, objectives and actions discussed in this chapter were prioritized under each hazard. The methodology used to determine the priority of projects and actions was based on repetition of hazard events, monetary loss, anticipated costs, and the potential for loss of life. For each of the hazards identified in Chapter 2 - 4, the Multi-Jurisdictional HMP outlines clear, directive goals and objectives as part of the mitigation strategy. Mitigation actions for all the cities and townships within Augusta - Richmond County were incorporated in Augusta - Richmond County, Blythe and Hephzibah goals, objectives and actions.

Natural, Human Caused, and Technological Hazard Mitigation Goals and Objectives

The Consulting Team assisted the HMPC in developing local mitigation strategies specific to each community's exposure and impacts by identified natural hazards. The strategy included a list of mitigation goal statements focusing on reduction of risks from the identified natural hazards. Goal development and project prioritization were drafted by the Consulting Team in coordination with the HMPC.

HMPC and the Consulting Team drafted a prioritized project list and analysis of a range of specific mitigation actions and projects to reduce the effect of each hazard, emphasizing new and existing buildings and infrastructure.

- Projects included non-structural, e.g., planning, regulatory measures, property acquisition, retrofitting, elevation, or structural, e.g., seawalls, dams, dikes, solutions;
- Prioritized projects list based on cost effective hazard mitigation projects,

HMPC and public input was developed, including:

- An analysis of proposed mitigation projects focused on several key areas, including but not limited to: economic (including benefits and cost), engineering, technical, legal, environmental, social, and political feasibility. Selected options were the best fit for Augusta - Richmond County, Blythe, and Hephzibah needs to meet the criteria of feasibility analysis;
- Coordination with relevant Federal, State and Local agencies for input and technical assistance included FEMA, GEMA, Regional Representatives, HMPC, and other entities identified by Augusta - Richmond County, Blythe, and Hephzibah;
- Previous Hazard Mitigation Accomplishments.

Augusta - Richmond County, Blythe, and Hephzibah made previous efforts to mitigate hazards in the community. Some of these strategies are significant and potentially beneficial in reducing loss of life and property from disasters.

The Consulting Team, working with the HMPC, determined the effectiveness of mitigation strategies identified in the effective HMP**.** In short, the product is a concise report of whether the strategies and/or projects worked and recommendations for improvements to existing strategies, deletions of ineffective strategies, and effective new strategies to accomplish the Goals and Objectives of the Plan in a cost effective manner.

Chapter 6 – HMP Maintenance Process

Local hazard mitigation planning is a process of organizing community resources, identifying and assessing hazard risks, and determining how to minimize or manage those risks. This process results in a HM Plan that identifies specific mitigation actions, each designed to achieve both short-term objectives and a long-term community vision. To ensure the functionality and feasibility of mitigation actions, responsibility was assigned to a specific agency, department or individual, along with a schedule for implementation. Plan maintenance procedures were established to monitor implementation progress and the evaluation and enhancement of Plan. These plan maintenance procedures enable Augusta - Richmond County, Blythe, and Hephzibah to maintain a living, dynamic and effective planning document over time and offers the following benefits:

- Save lives and property
- Decrease costs of hazards
- Facilitate and guide disaster recovery
- Reduce vulnerability with sound development practices and post-disaster recovery and reconstruction
- Expedite applications of pre- and post-disaster grant funding
- Demonstrate a commitment to improved community health and safety

MONITOR, EVALUATE, AND UPDATE: The Consulting Team drafted a plan to assist HMPC in monitoring, evaluating and updating the Plan.

INCORPORATE HM PLAN INTO EXISTING PLANNING MECHANISMS: The HMPC and Consulting Team drafted recommendations for the implementation and incorporation of the Plan goals in local planning processes including the Comprehensive Plan, Zoning Ordinance, Subdivision Regulations, and Development Review and Permitting Processes.

IMPLEMENTATION SCHEDULE: The HMPC and the Consulting Team drafted an implementation schedule with procedures for ensuring the plans' implementation, update and revision every five years or as needed.

CONTINUED PUBLIC INVOLVEMENT: The HMPC and the Consulting Team drafted a Participation Program for continued public involvement and outreach.

Chapter 7 – HMP Adoption and Approval

LOCAL ADOPTION: The Consulting Team assisted the HMPC with the Plan adoption process by governing bodies after holding public hearings for input and comments on the Plan.

PLAN APPROVAL: The Consulting Team assisted the HMPC in Plan submission to GEMA on or before the deadline date for initial review and forwarding to FEMA Region IV for final review and approval.

Chapter 8 – HMP Appendices

APPENDIX A: HAZARD IDENTIFICATION, RISK ASSESSMENT (HRV)
APPENDIX B: GROWTH and DEVELOPMENT TRENDS
APPENDIX C: OTHER PLANNING DOCUMENTS
APPENDIX D: WORKSHEETS USED IN PLANNING PROCESS
APPENDIX E: COPIES OF REQUIRED PLANNING DOCUMENTS
APPENDIX F: GLOSSARY
APPENDIX G: COMMUNITY PROFILE

CHAPTER 2 NATURAL HAZARDS

Chapter 2 of the HMP describes the Natural Disaster Hazard, Risk, and Vulnerability (HRV) summary undertaken by Augusta - Richmond County and participating municipalities. This section consists of the following subsections:

- INTRODUCTION AND UPDATE SUMMARY
- TORNADO WIND STORM HAIL
- FLOODING
- DROUGHT EXTREME HEAT
- WINTER STORM
- WILDFIRE
- EARTHQUAKE

INTRODUCTION AND UPDATE SUMMARY

A key step in the mitigation of disaster losses in Augusta - Richmond County lies in developing a comprehensive understanding of the hazards posing risks to its communities. The following terms define the process of Hazard Identification and Risk Assessment and are found throughout the Plan.

> **Hazard:** Event or physical conditions that have the potential to cause fatalities, injuries, agricultural loss, property damage, infrastructure damage, damage to the environment, interruption of business, other types of harm.
> **Risk:** Product of a hazard's likelihood of occurrence and its consequences to society.
> **Vulnerability:** Degree of susceptibility and resilience of the community and environment to hazards. (Source: Federal Emergency Management Agency, 2001).

The Local Hazard, Risk, and Vulnerability (HRV) summary process methodology evaluates risk defined by probability and frequency of occurrence. An assessment of each hazard event, human and property exposure to the hazard, and the consequences of that exposure form the basis of community hazard investigation. Distinct methodologies used to record community exposure include qualitative and quantitative data.

Augusta - Richmond County and its communities are vulnerable to a broad range of natural hazards that threaten life and property. The Augusta Richmond County Hazard Mitigation Planning Committee (HMPC) identified hazards to include in the HRV summary were determined to pose actual, potential threat to Augusta

Richmond County and its incorporated jurisdictions. Hazards identified are consistent with those identified by the Georgia Emergency Management Agency (GEMA) and the Federal Emergency Management Agency (FEMA) for the Northeast region of the state and this region of the country. The natural hazards for this 2011 Plan update include:

- TORNADO WIND STORM HAIL
- FLOODING
- DROUGHT EXTREME HEAT
- WINTER STORM
- WILDFIRE
- EARTHQUAKE

Natural hazards can be potentially interrelated, (Ex: A tornado may produce rain, hail, wind damage, and localized flooding), therefore an assessment of those hazards identifies commonalities during the HRV process. Where specific hazard risk and exposure categories intersect, risk hazard categories are not duplicated to control data skewing.

Table 2.1 documents the decision-making process used by the Augusta – Richmond County HMPC in re-evaluating those identified, analyzed, and addressed in updating the HRV summary. Identified Hazards were continued, deleted, or changed, and newly identified hazards were added.

Table 2.1: Evaluation of Natural Hazards to Include in 2011 HRV Summary

2006 HAZARD	STATUS	NOTES	2011 HAZARD
Flood and Related Hazards	Changed	N/A	Flooding
Wind Hazards	Changed	Renamed	Tornado/Windstorm/Hail
Severe Winter Storm	Continued	N/A	Severe Winter Storm
Drought	Changed	Renamed	Drought/Extreme Heat
Urban Wildland Interface Fire	Changed	Renamed 'Wildfire' (Includes Wildfires, and Urban Wildland Interface Fires)	Wildfire
N/A	Added	Earthquake Hazard Added	Earthquake

Figure 2.1: HAZARD IDENTIFICATION RANKING SURVEY RESULTS

NATURAL HAZARD RANKING

Where 1 = Highest Risk and 6 = Lowest Risk)

1 TORNADO WIND STORM HAIL
2 FLOODING
3 DROUGHT EXTREME HEAT
4 WINTER STORM
5 WILDFIRE
6 EARTHQUAKE

MANMADE/TECHNOLOGICAL HAZARD RANKING

Where 1 = Highest Risk and 4 = Lowest Risk

1 CHEMICAL LEAK/SPILL CHEMICAL RELEASE (AIRBORNE)
2 TERRORISM
3 NUCLEAR PLANT INCIDENT
4 DAM/LEVEE FAILURE

Raw numeric data for the Hazard Identification Ranking Survey is reported below in Table 2.2:

TABLE 2.2: HAZARD IDENTIFICATION RANKING SURVEY			
RANK	**NATURAL HAZARDS**	**RAW NUMBER**	**# RESPONDENTS**
1	**Tornado/Windstorm/Hail**	**50**	**31**
2	**Flood**	**75**	**31**
3	**Drought/Extreme Heat**	**105**	**31**
4	**Winter Storm**	**111**	**31**
5	**Wildfire**	**135**	**31**
6	**Earthquake**	**175**	**31**
RANK	**MANMADE/TECHNOLOGICAL HAZARDS**		**31**
1	**Chemical Leak/Spill**	**44**	**31**
2	**Terrorism**	**82**	**31**
3	**Nuclear Incident**	**94**	**31**
4	**Dam/Levee Failure**	**95**	**31**
Notes: Respondent numeric results are assigned value with the Hazards in each category ranked where the raw lowest score = the highest risk.			

In the Natural Hazards category respondents ranked Tornado/Windstorm Hail as the highest community risk, followed by Flooding, Drought/Extreme Heat, Winter Storms, Wildfires, and Earthquakes.

In the Manmade/Technological Hazards category respondents ranked Chemical Leak/Spill as the highest community risk, followed by Terrorism, Nuclear Incident, and Dam/Levee Failure.

The HMPC Risk Assessment element of the plan is predicated on a Risk Factor (RF) formula where the HMPC Hazard Identification Questionnaire, Hazard Identification Ranking Survey, and HMPC Qualitative Commentary Report are assigned a 30% (.30) weighted RF value in the overall HMP risk analysis. The HI - RA RF formula for the HMP Update is:

HMPC RA = (.30) + Historic Hazard Event - Declarations (.30) + FEMA HAZUS® - MH and other Risk Analysis Processes (.40).

The HI – RA results were forwarded to the HMPC for review, input, and adoption on 14 July, 2011 at the HMPC – Stakeholders Meeting, 9:00 AM – Noon, Augusta Municipal Building. The HMPC Hazard Ranking Subcommittee incorporated appropriate revisions, clarifications, and community input, and the final HMPC HI - RA was adopted on _____.

To refine the list of identified hazards for the HMP, Table 2.3 contains a list of disaster declarations for Augusta – Richmond County from 1953 to date as reported by FEMA. This list presents the foundation for identifying hazards posing the greatest risk within Augusta - Richmond County.

Table 2.3: Presidential Disaster and Emergency Declarations Augusta - Richmond County, GA

DECLARATION #	DATE	EVENT DETAILS
FEMA-DR-1209-GA	03/11/1998	Severe Storms, Tornadoes and Flooding
FEMA-DR-880-GA	10/19/1990	Flooding, Severe Storm
FEMA-EM-3218-GA	09/05/2005	Hurricane Katrina Evacuation
FEMA-EM-3044-GA	07/20/1977	Georgia Drought

Source: (FEMA, 2011)

Hazards were ranked in order to provide structure, prioritization, and feasibility of proposed mitigation goals and actions. Ranking was both quantitative and qualitative. First, the quantitative analysis considered all the GIS and HAZUS data available. Then, Risk Factor (RF), qualitative approach, was used to provide additional insights on the specific risks and exposure associated with each hazard. This process is a valuable cross-check or validation of the quantitative analysis performed.

The RF approach combines historic hazard data, local knowledge, and consensus risk assessment evaluations to produce numerical values to compare identified hazards in determining community vulnerability. During the planning process, the Augusta - Richmond County HMPC contrasted the results of the hazard profiles with local knowledge to generate the ranking criteria. The criteria were used to evaluate the hazards in order to determine the degree of risk for each.

The process produces numerical values, allowing identified hazards to be ranked against one another (higher RF values = greater hazard risk). RF values are obtained by assigning degrees of risk in five categories for each hazard: *probability, impact, spatial extent, warning time*, and *duration*. Each degree of risk is assigned a value range of 1 to 4 and a weighting factor for each category agreed upon by the HMPC. The HMPC may adjust the RF weighting scheme based on unique concerns or circumstances within the planning area. To calculate RF value for each hazard, risk values are multiplied by the weighting factor. The sum of the five categories equals the final RF value, as demonstrated in the equation and Chart 2-1 below:

RF Value = [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Chart 2-1: AUGUSTA HMPC HAZARD, RISK AND VULNERABILITY (HRV) RISK FACTOR CRITERIA				
RISK ASSESSMENT CATEGORY	**LEVEL**	**DEGREE OF RISK LEVEL**	**INDEX**	**WEIGHT**
PROBABILITY What is the likelihood of a hazard event occurring in a given year?	UNLIKELY	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	MINOR	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	NEGLIGIBLE	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	MORE THAN 24 HRS	SELF DEFINED	1	10%
	12 TO 24 HRS	SELF DEFINED	2	
	6 TO 12 HRS	SELF DEFINED	3	
	LESS THAN 6 HRS	SELF DEFINED	4	
DURATION *How long does the hazard event usually last?*	LESS THAN 6 HRS	SELF DEFINED	1	10%
	LESS THAN 24 HRS	SELF DEFINED	2	
	LESS THAN 1 WEEK	SELF DEFINED	3	
	MORE THAN 1 WEEK	SELF DEFINED	4	

In applying the default weighting scheme, the highest possible RF value is 4.0. The methodology illustrated above contains the categories used to calculate the variables for the RF value.

Additional Sources of Risk Assessment Data

The Social Vulnerability Index (SOVI™) measures the social vulnerability of U.S. counties to environmental hazards. The index is a comparative metric that facilitates the examination of the differences in social vulnerability among counties. SOVI™ is a valuable tool for policy makers and practitioners. It graphically illustrates the geographic variation in social vulnerability. It shows where there is uneven capacity for preparedness and response and where resources might be used most effectively to reduce the pre-existing vulnerability. SOVI™ also is useful as an indicator in determining the differential recovery from disasters.

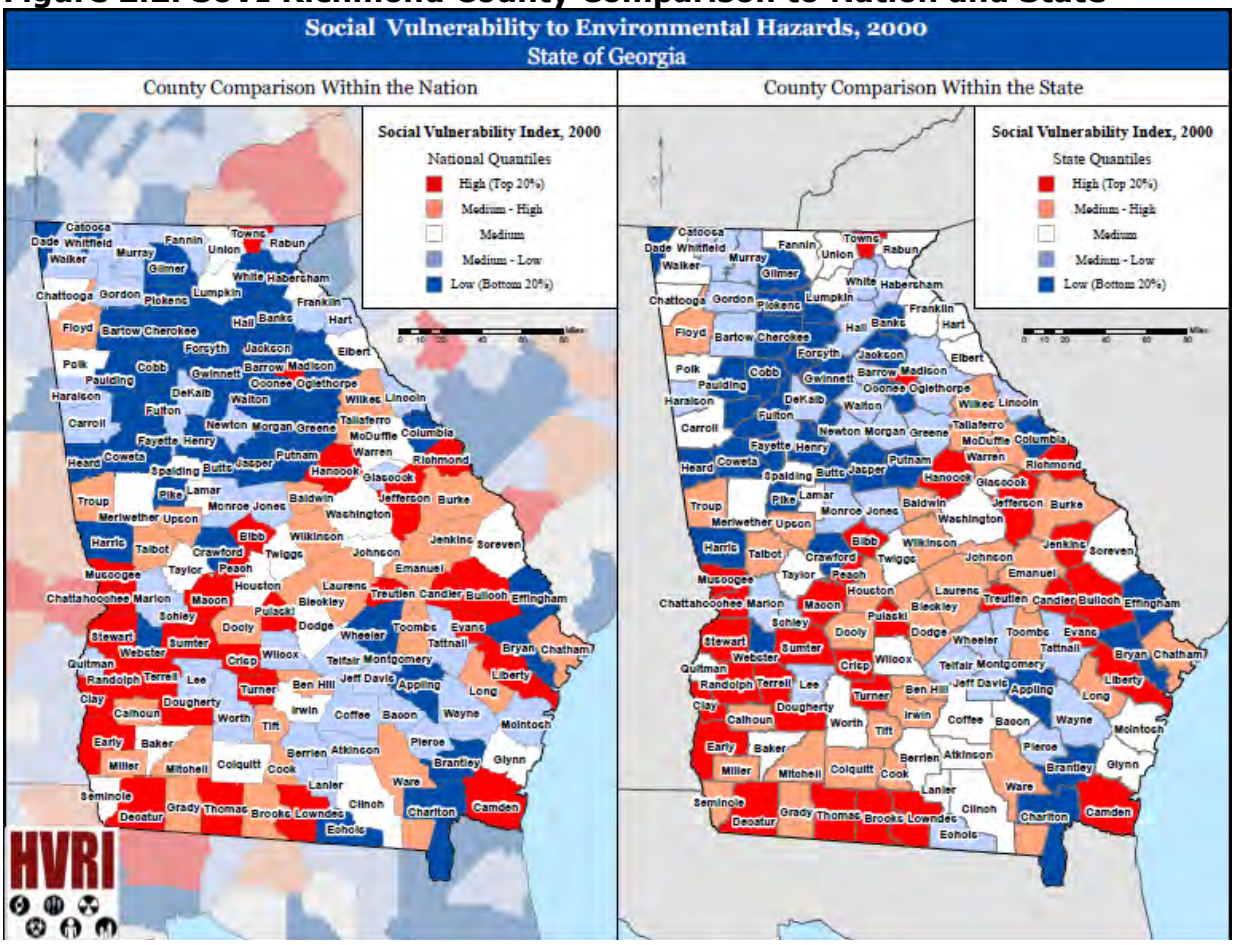
The index synthesizes 32 socioeconomic variables, which the research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. The data were culled from national data sources, primarily those from the United States Census Bureau. The data were compiled and processed by the Hazards and Vulnerability Research Institute (HVRI) at the University of South Carolina. The data were standardized and placed into a principal components analysis to reduce the initial set of variables into a smaller set of statistically optimized components. Adjustments were made to the components' cardinality (positive (+), negative (-), or absolute value (ll) to insure that positive component loadings were associated with increasing vulnerability, and negative component loadings with decreasing vulnerability.

Once the cardinalities of the components were determined, the components were added together to determine the numerical social vulnerability score for each county. For SOVI™ 2000, there are 9 significant components explaining 76% of the variance in the data. Among them are socioeconomic status, elderly and children, rural agriculture, housing density, black female-headed households, gender, service industry employment, unemployed Native Americans, and infrastructure employment.

To visually compare the SOVI™ scores at a national level, they are mapped using quantiles. Scores in the top 20% of the United States are more vulnerable counties (red) and scores in the bottom 20% of the United States indicate the least vulnerable counties (blue)," (Hazards & Vulnerability Research Institute, 2011).

Figure 2.2 below reveals the Richmond County SoVI designation of High Category (Top 20%) compared to the national and state rankings.

Figure 2.2: SoVI Richmond County Comparison to Nation and State



The HVRI SoVI for Richmond County is displayed below in Figure 2.3. The data reveals the county has an SoVI Score of 42 is higher than 61.2% of the nation as a whole using 42 variables including built environment, and a SoVI Score of 32, or 0.938 compared to the nation as a whole, using 32 variables that do not include the built environment.

Figure 2.3: HVRI SoVI

HVRI HAZARDS AND VULNERABILITY RESEARCH INSTITUTE

Home | Maps and Data | Applications | FAQ

Social Vulnerability Index (SoVI) for the United States - Data

Below, you can find data created through Social Vulnerability Index at the county level. Four elements are presented here:

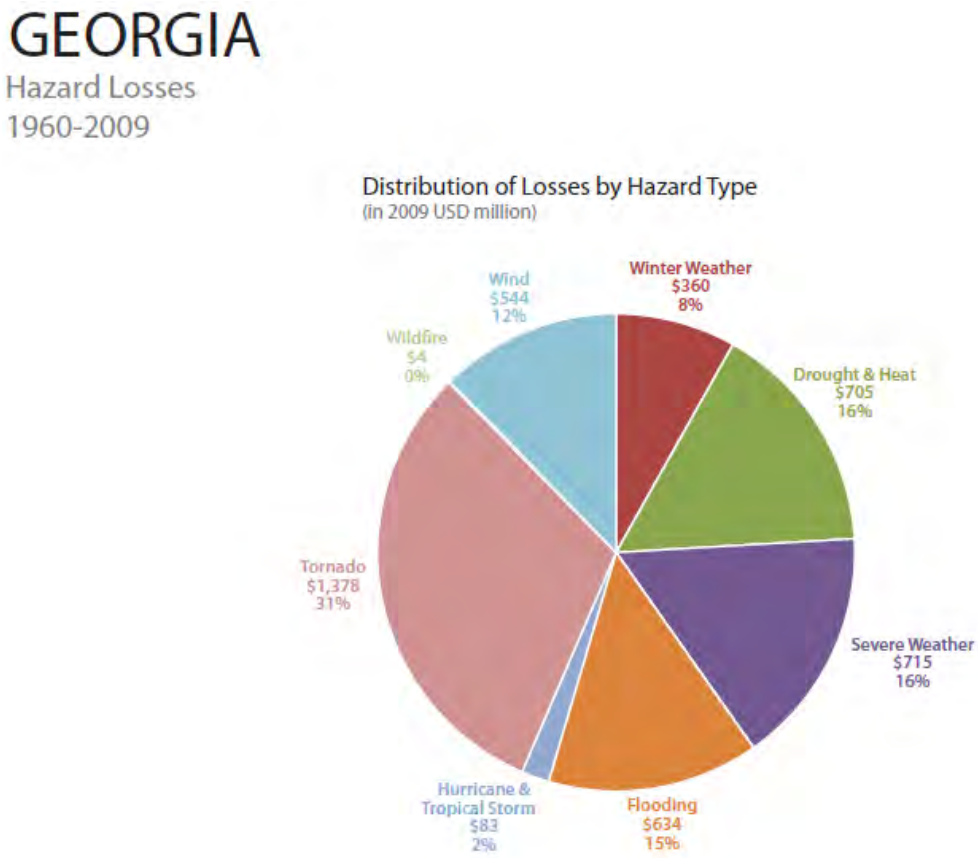
1. **SoVI Score (42)**: The score using the previous version of SoVI with 42 variables. This calculation includes built environment variables.
2. **National Percentile (42)**: Where the county's SoVI 42 score ranks in comparison with the rest of the nation. For example: Armstrong County, PA's SoVI 42 score is higher than 61.2% (.612 x 100) of the nation.
3. **SoVI Score (32)**: The score using the current version of SoVI with 32 variables. This calculation does not include built environment variables.
4. **National Percentile (32)**: Where the county's SoVI 32 score ranks in comparison with the rest of the nation.

Select State Georgia

ID	State	County	SoVI Score (42)	National Percentile (42)	SoVI Score (32)	National Percentile (32)
505	Georgia	Richmond County	4.40638	0.892	4.34983	0.938

Distributions of state economic losses due to hazard events during the period of 1960 -2009 are illustrated in Figure 2.4 below.

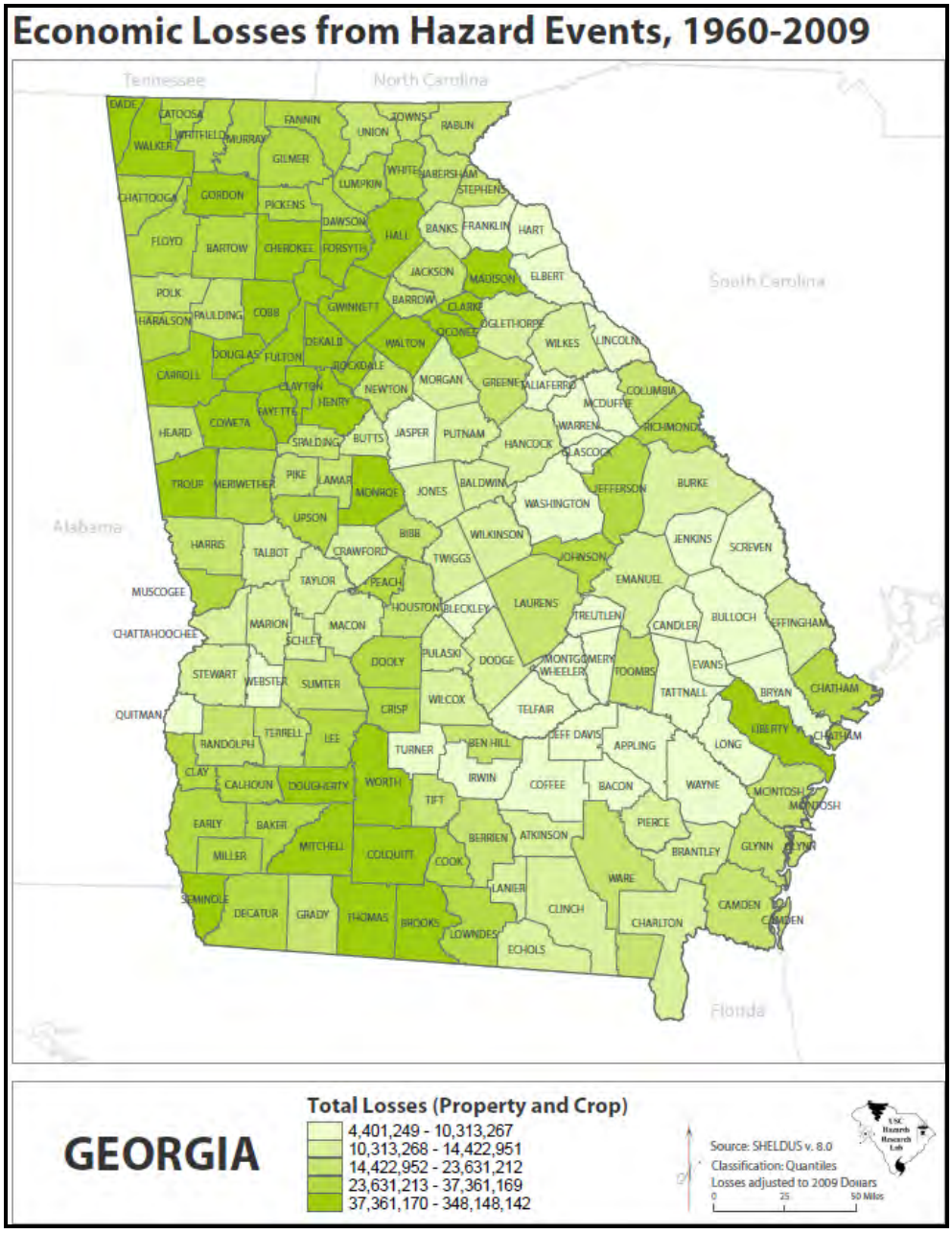
Figure 2.4: Distribution of Georgia Hazard Losses, 1960 – 2009



The data reveals hazards losses ranked in the following order, Tornado, $1,378 million or 31%; Severe Weather $715 million or 16%; Drought & Heat, $705 million or 16%; Flooding, $634 million or 15%; Wind, $544 million or 12%; Winter Weather, $360 million or 8%; Hurricane and Tropical Storm, $83 million or 2%; and Wildfire, $4 million or 0%.

SHELDUS data illustrated in Figure 2.5 below for Richmond County reveal the state economic losses from hazards events during the period 1960 – 2009 were between $23,631,213 and $37,361,169 (Hazards and Vulnerability Research Institute, 2011).

Figure 2.5: Georgia Economic Losses



RANKING RESULTS

The natural hazard with the highest risk potential based on the RF analysis is Tornado – Windstorm-Hail, with a value of 3.0; followed by Flooding, with a value of 2.9; Drought – Extreme Heat, with a value of 2.1, Winter Storms, with a value of 2.0; Wildfire, with a value 1.4; and Earthquakes, with a value of 1.3.

Conclusions drawn from the qualitative and quantitative assessments, combined with the final RF determinations by the HMPC, were categorized into 3 risk

designations (High, Moderate or Low) to produce a summary of hazard risks. Table 2.4 below reveals the analysis results and ranking.

Table 2.4 Augusta – Richmond County HMPC RF						
NATURAL HAZARDS	**PROBABILITY**	**IMPACT**	**SPATIAL EXTENT**	**WARNING TIME**	**DURATION**	**RF RATING (PRIORITY)**
Natural Hazard A: Tornado – Windstorm –Hail	**1.2**	**.9**	**.4**	**.4**	**.1**	**3.0**
Natural Hazard B: Flooding	**.6**	**.9**	**.9**	**.1**	**.4**	**2.9**
Natural Hazard C: Drought – Extreme Heat	**.9**	**.3**	**.4**	**.1**	**.4**	**2.1**
Natural Hazard D: Winter Storm	**.9**	**.3**	**.4**	**.1**	**.3**	**2.0**
Natural Hazard E: Wildfire	**.3**	**.3**	**.2**	**.2**	**.4**	**1.4**
Natural Hazard F: Earthquake	**.3**	**.3**	**.2**	**.4**	**.1**	**1.3**
HIGH RISK (3.0 or higher)						

Table 2.5 below reveals community ranked hazards and lists them in the three categories of High, Moderate, and Low.

Table 2.5: HMPC RF Natural Hazard Risk Conclusions	
HIGH RISK (3.0 or higher)	**Tornado – Windstorm - Hail**
MODERATE RISK (2.0 – 2.9)	**Flooding, Drought – Extreme Heat, Winter Storm**
LOW RISK (0.1 – 1.9)	**Wildfire, Earthquake**

2.1 NATURAL HAZARD A: Tornado – Windstorm - Hail

The HMPC ranked Tornado – Windstorm – Hail as the greatest community hazard risk. Because the three events frequently occur simultaneously and the human and critical facility exposure is widespread, the choice is logical and supported by independent risk analysis. HMPC members reviewed Federal, State, Regional, and Local data sources to inform the profile process and completed the RF analysis to reach the hazard ranking determination.

2.1.1 Tornado Identity

One of the most spectacular and destructive natural disasters are tornados. Each year approximately 1,500 tornadoes touch down across the United States causing an estimated $1.1 billion in damages and over 80 deaths. NOAA's tornado climatology data reveals the central plain region of the United States, stretching from Texas to South Dakota, experiences the greatest number of tornadoes on Earth. This area is frequently referred to as tornado alley (NOAA, 2011).

A tornado is a relatively short-lived storm composed of an intense rotating column of air, extending from a thunderstorm cloud system. Average winds in a tornado, although never accurately measured, are thought to range between 100 and 200 miles per hour; extreme tornadoes may have winds exceeding 300 miles per hour. The following definitions are used by the NWS:

- **Tornado** is a violently rotating column of air that is touching the ground. The Enhanced Fujita Scale and associated enhanced F Scale Damage Indicators classify tornados by wind speed and degree of damage (Table 2.6 below.)

Table 2.6:Enhanced F Scale for Tornado Damage[1]

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

[1] **IMPORTANT NOTE ABOUT ENHANCED F-SCALE WINDS:** *The Enhanced F-scale still is a set of wind estimates (not measurements) based on damage.* Its uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed below. These estimates vary with height and exposure. **Important**: The 3 second gust is not the same wind as in standard surface observations. Standard measurements are taken by weather stations in open exposures, using a directly measured, "one minute mile" speed.

2.6 (a) Enhanced F Scale Damage Indicators[2]		
NUMBER	DAMAGE INDICATOR	ABBREVIATION
1	Small barns, farm outbuildings	SBO
2	One- or two-family residences	FR12
3	Single-wide mobile home (MHSW)	MHSW
4	Double-wide mobile home	MHDW
5	Apt, condo, townhouse (3 stories or less)	ACT
6	Motel	M
7	Masonry apt. or motel	MAM
8	Small retail bldg. (fast food)	SRB
9	Small professional (doctor office, branch bank)	SPB
10	Strip mall	SM
11	Large shopping mall	LSM
12	Large, isolated ("big box") retail bldg.	LIRB
13	Automobile showroom	ASR
14	Automotive service building	ASB
15	School - 1-story elementary (interior or exterior halls)	ES
16	School - Jr. or Sr. high school	JHSH
17	Low-rise (1-4 story) bldg.	LRB
18	Mid-rise (5-20 story) bldg.	MRB
19	High-rise (over 20 stories)	HRB
20	Institutional bldg. (hospital, govt. or university)	IB
21	Metal building system	MBS
22	Service station canopy	SSC
23	Warehouse (tilt-up walls or heavy timber)	WHB
24	Transmission line tower	TLT
25	Free-standing tower	FST
26	Free standing pole (light, flag, luminary)	FSP
27	Tree - hardwood	TH
28	Tree - softwood	TS

[2] **Note:** A 95 page PDF file explaining the development and makeup of the Enhanced F-scale now is available, both here at SPC and from the Texas Tech server.

- **Funnel cloud** is a rapidly rotating column of air that does not touch the ground.
- **Downburst winds** are strong downdrafts, initiated by a thunderstorm, which induce an outburst of straight-line winds on or near the ground. They may last anywhere from a few minutes in small-scale microbursts to periods of up to 20 minutes in larger, longer macro-bursts. Wind speeds in downbursts can reach 150 miles per hour and therefore can result in damages similar to tornado damages.

Tornados, windstorms, and hail events can occur anywhere in the nation, state, and local planning area with limited warning of potential danger. Integrated first response by local emergency management is critically important for search and rescue, evacuation, and recovery operations. Improved coordination of personnel and resources by local emergency response agencies, hospitals, relief agencies, and community volunteers can mitigate the impact of the event. During the aftermath of a large scale incident, State and Federal agencies respond when local resources are insufficient to meet community need. Local emergency personnel and agencies must quickly convey information and resource gaps to State and Federal agencies to lessen community impact.

2.1.1.2 Tornado Profile

Table 2.7 below reveals the costs of tornados in the United States between the years 2000 through 2010.

Table 2.7 Annual U.S. Tornado Summary

Year	Fatalities	Injuries	Property Damage (million $)	Crop Damage (million $)	Total Damage (million $)
2000	41	882	537.97	8.76	546.83
2001	40	743	787.63	9.25	796.88
2002	55	968	1001.63	1.00	1002.63
2003	54	1087	1518.72	19.08	1537.80
2004	35	396	328.41	14.16	642.57
2005	38	537	476.63	92.77	569.41
2006	67	990	827.53	7.37	834.90
2007	81	659	1498.81	7.24	1506.05
2008	124	1711	1827.90	20.80	1848.70
2009	21	351	583.36	19.03	602.39
2010	45	699	1,106.92	27.64	1,134.56

Source: (NOAA, 2011). *(Normalized to 2010 Dollars using Bureau of Labor Statistics, Consumer Price Index [CPI]).*

Georgia historical hazard data reveals an average of 22 tornados impact the state each year. Augusta – Richmond County experienced 9 tornados between 1954 and 2009, an average occurrence far below that of the state. Because of the loss of life and widespread damage caused by tornados, data is readily available and current.

In Augusta – Richmond County, tornado information supplied by NOAA

reveals nine tornados were reported in the planning area between 1950 and 2011, causing 26 injuries, and resulting in 8.1 million dollars of property damage. Table 2.8 below reports the tornado incidents in the planning area.

Table 2.8: 9 TORNADO(s) Reported - 01/01/1950 and 03/31/2011

County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 RICHMOND	08/17/1954	1430	Tornado	F1	0	0	25K	0
2 RICHMOND	02/24/1961	1730	Tornado	F1	0	0	25K	0
3 RICHMOND	05/08/1978	1920	Tornado	F1	0	0	2.5M	0
4 RICHMOND	04/23/1983	1717	Tornado	F0	0	0	250K	0
5 RICHMOND	01/29/1990	1543	Tornado	F2	0	6	250K	0
6 Augusta	05/19/1993	1225	Tornado	F0	0	0	50K	0
7 Augusta	12/17/2000	12:10 AM	Tornado	F2	0	8	0	0
8 Hephzibah	06/12/2001	02:30 PM	Tornado	F0	0	0	0	0
9 Ft Gordon	04/10/2009	21:36 PM	Tornado	F3	0	12	5.0M	0K
TOTALS:					0	26	8.100M	0

Source: (NOAA, National Oceanic and Atmospheric Administration, 2011).

2.1.2: Windstorm Identity

High Winds/Severe Storms.

The term "severe storms" is used to describe weather events that exhibit all or some of these characteristics: high winds, heavy rainfall, lightning, and hail. Thunderstorms are convective storms produced when warm moist air is overrun by dry cool air. As the warm air rises, thunderhead clouds form and generate strong winds, lightning, thunder, hail and rain. Generally, thunderstorms form on warm-season afternoons and are local in effect. Storms that form in association with a cold front or other regional-scaled atmospheric disturbance can become severe, thereby producing strong winds, frequent lightning, hail, downbursts and even tornadoes.

2.1.2.1 Windstorm Profile

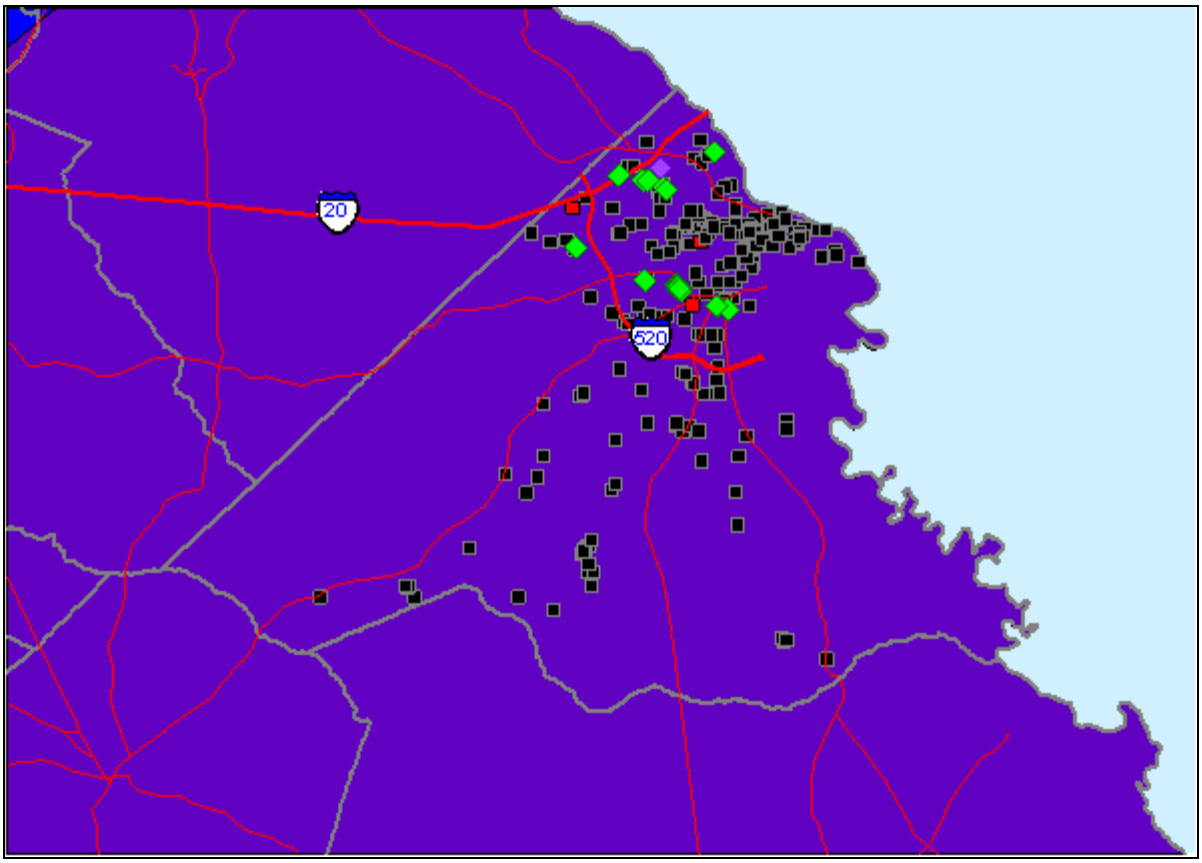
Two high wind events were reported for the Augusta – Richmond County planning area during the period between 1950 and 2011. The first occurred on 11 December, 1993. High winds, gusting to as high as 50 mph for at least four straight hours caused power outages and blocked roads across North Georgia. County Sheriffs reported downed power lines and toppled trees that damaged cars and buildings were widespread throughout North Georgia. The high winds caused power outages through early evening in virtually every county throughout North Georgia. The second occurred on 24 October, 2008, toppling trees and power lines.

One death, 2 injuries and property damage of $520,000 were associated with the events. Table 2.9 reveals the high wind event history for the planning area.

Table 2.9: 2 HIGH WINDS event(s) - 01/01/1950 and 03/31/2011

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 GAZ001>065	12/11/1993	1000	High Winds	0 kts.	1	2	500K	0
2 GAZ064 - 065	10/24/2008	15:00 PM	High Wind	50 kts.	0	0	20K	10K
Source: (NOAA, National Oceanic and Atmospheric Administration, 2011).				**TOTALS:**	**1**	**2**	**520K**	**10K**

Wind Map Produced in GMIS



2.1.3: Hail Identity

Hail accompanies some thunderstorms; in the U.S., hail causes nearly $1 billion in damage to property and crops each year. Hailstorms are violent and spectacular phenomena of atmospheric convection, always associated with heavy rain, gusty winds, thunderstorm, and lightning. Hail is a product of strong convection and occurs only in connection with a thunderstorm where the high velocity updrafts carry large raindrops into the upper atmosphere where the temperature is well below the freezing point of water. Hail stones grow in size when the frozen droplet

is repeatedly blown into the higher elevations. The hailstone ascends as long as the updraft velocity is high enough to hold the hailstone. As soon the size and weight of the hailstone overcomes the lifting capacity of updraft, it begins to fall freely under the influence of gravity.

2.1.3.1 Hail Profile

Table 2.10 below reveals national hail data from the years 2000 - 2010.

Table 2.10: National Hail Data

Year	Deaths	Injuries	Property Damage (million $)	Crop Damage (million $)	Total Damage (million $)
2000	2	57	566.42	158.62	725.04
2001	0	32	2960.38	338.00	3298.38
2002	0	125	406.50	192.25	598.75
2003	0	121	627.00	132.00	759.00
2004	0	4	541.71	85.41	627.12
2005	1	8	542.97	63.39	606.36
2006	0	18	1726.34	146.19	1872.53
2007	0	25	597.87	165.50	763.37
2008	1	13	482.91	180.55	663.47
2009	0	70	1483.20	360.16	1843.36
2010	0	42	924.11	99.82	1,023.93
Source: (NOAA, NOAA Economics, 2011)					

In the Augusta – Richmond County planning area 62 hail events were reported causing $10,000 in property damage. Table 2.11 below reveals the hail data.

Table 2.11: 62 HAIL event(s) Reported - 01/01/1950 and 03/31/2011

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 RICHMOND	05/12/1955	1900	Hail	0.75 in.	0	0	0	0
2 RICHMOND	05/28/1962	1430	Hail	1.00 in.	0	0	0	0
3 RICHMOND	05/21/1967	1615	Hail	1.75 in.	0	0	0	0
4 RICHMOND	05/12/1971	1345	Hail	0.75 in.	0	0	0	0
5 RICHMOND	06/28/1972	0915	Hail	0.75 in.	0	0	0	0
6 RICHMOND	10/04/1979	1603	Hail	1.75 in.	0	0	0	0
7 RICHMOND	02/16/1982	1942	Hail	1.00 in.	0	0	0	0
8 RICHMOND	02/16/1982	2003	Hail	0.75 in.	0	0	0	0
9 RICHMOND	06/10/1982	1445	Hail	1.00 in.	0	0	0	0
10 RICHMOND	07/15/1983	1400	Hail	1.00 in.	0	0	0	0

11 RICHMOND	04/14/1984	1335	Hail	1.75 in.	0	0	0	0
12 RICHMOND	04/14/1984	1400	Hail	1.25 in.	0	0	0	0
13 RICHMOND	04/14/1984	1400	Hail	1.75 in.	0	0	0	0
14 RICHMOND	04/14/1984	1820	Hail	1.75 in.	0	0	0	0
15 RICHMOND	04/14/1984	1835	Hail	1.75 in.	0	0	0	0
16 RICHMOND	04/17/1984	1407	Hail	1.75 in.	0	0	0	0
17 RICHMOND	06/02/1985	1435	Hail	1.50 in.	0	0	0	0
18 RICHMOND	06/02/1985	1512	Hail	1.00 in.	0	0	0	0
19 RICHMOND	06/26/1986	1330	Hail	1.50 in.	0	0	0	0
20 RICHMOND	07/30/1988	1516	Hail	0.75 in.	0	0	0	0
21 RICHMOND	01/29/1990	1535	Hail	0.75 in.	0	0	0	0
22 Augusta	03/31/1993	1625	Hail	1.00 in.	0	0	0	0
23 Augusta	01/02/1996	5:40 PM	Hail	1.75 in.	0	0	0	0
24 Augusta Airport	01/02/1996	5:45 PM	Hail	1.00 in.	0	0	0	0
25 Augusta	03/15/1996	4:52 PM	Hail	0.75 in.	0	0	0	0
26 Hephzibah	03/17/1996	7:05 AM	Hail	1.75 in.	0	0	0	0
27 Augusta	05/07/1996	8:53 PM	Hail	0.75 in.	0	0	0	0
28 Augusta	04/22/1997	7:40 PM	Hail	1.75 in.	0	0	10K	0K
29 Augusta	04/03/1998	11:20 PM	Hail	0.75 in.	0	0	0	0
30 Augusta	04/08/1998	10:46 PM	Hail	1.00 in.	0	0	0	0
31 Augusta	04/22/1998	01:55 PM	Hail	0.75 in.	0	0	0	0
32 Hephzibah	06/10/1998	04:56 PM	Hail	0.75 in.	0	0	0	0
33 Augusta	06/10/1998	05:10 PM	Hail	0.75 in.	0	0	0	0
34 Augusta	06/16/1998	03:58 PM	Hail	1.75 in.	0	0	0	0
35 Augusta	06/19/1998	01:20 PM	Hail	0.88 in.	0	0	0	0
36 Augusta	06/19/1998	02:12 PM	Hail	0.88 in.	0	0	0	0
37 Augusta	03/31/2002	01:30 PM	Hail	0.75 in.	0	0	0	0
38 Augusta	03/31/2002	01:38 PM	Hail	1.75 in.	0	0	0	0
39 Augusta	03/31/2002	02:20 PM	Hail	0.75 in.	0	0	0	0
40 Hephzibah	05/03/2002	05:20 PM	Hail	1.75 in.	0	0	0	0
41 Augusta	05/03/2002	05:40 PM	Hail	1.75 in.	0	0	0	0
42 Augusta	06/03/2002	06:58 PM	Hail	1.75 in.	0	0	0	0
43 Augusta	05/06/2003	04:00 PM	Hail	1.00 in.	0	0	0	0
44 Ft Gordon	02/21/2005	04:30 PM	Hail	1.75 in.	0	0	0	0

45 Augusta	02/21/2005	04:36 PM	Hail	0.88 in.	0	0	0	0
46 Ft Gordon	02/21/2005	09:42 PM	Hail	0.75 in.	0	0	0	0
47 Augusta	04/22/2005	03:35 PM	Hail	0.75 in.	0	0	0	0
48 Hephzibah	05/10/2005	03:48 PM	Hail	0.75 in.	0	0	0	0
49 Ft Gordon	05/10/2005	03:55 PM	Hail	0.75 in.	0	0	0	0
50 Ft Gordon	05/20/2005	01:30 PM	Hail	0.88 in.	0	0	0	0
51 Hephzibah	07/29/2005	01:16 PM	Hail	0.75 in.	0	0	0	0
52 Ft Gordon	12/04/2005	05:14 PM	Hail	0.88 in.	0	0	0	0
53 Hephzibah	12/28/2005	07:59 PM	Hail	0.88 in.	0	0	0	0
54 Augusta	02/13/2007	17:58 PM	Hail	0.88 in.	0	0	0K	0K
55 Hephzibah	02/13/2007	18:15 PM	Hail	1.75 in.	0	0	0K	0K
56 Augusta	06/12/2007	20:15 PM	Hail	1.00 in.	0	0	0K	0K
57 Mc Bean	03/15/2008	17:44 PM	Hail	0.88 in.	0	0	0K	0K
58 Hephzibah	05/20/2008	14:53 PM	Hail	1.75 in.	0	0	0K	0K
59 Augusta	05/20/2008	15:20 PM	Hail	1.25 in.	0	0	0K	0K
60 Mc Bean	08/16/2008	17:36 PM	Hail	0.88 in.	0	0	0K	0K
61 Augusta	08/11/2009	16:46 PM	Hail	0.75 in.	0	0	0K	0K
62 Augusta	07/31/2010	15:35 PM	Hail	0.88 in.	0	0	0K	0K
Source: (NOAA, National Oceanic and Atmospheric Administration, 2011).				TOTALS:	0	0	10K	0

Additional impacts in this category are related to thunderstorms winds. Information obtained from NOAA, reveals 140 thunderstorm wind events occurred in the Augusta – Richmond County planning area during the period of 1950 to 2010. Nine deaths, 19 injuries, $77.24 million in property damage and $50 million in crop damage were reported as shown in Table 2.12.

Table 2.12: 140 THUNDERSTORM WINDS Event(s) Reported 01/01/1950 and 03/31/2011.

County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 RICHMOND	05/22/1955	1500	Tstm Wind	58 kt.	0	0	0	0
2 RICHMOND	05/24/1955	1945	Tstm Wind	0 kts.	0	0	0	0
3 RICHMOND	08/06/1955	1330	Tstm Wind	0 kts.	0	0	0	0
4 RICHMOND	06/29/1956	1530	Tstm Wind	0 kts.	0	0	0	0
5 RICHMOND	07/15/1956	1600	Tstm Wind	58 kts.	0	0	0	0
6 RICHMOND	07/27/1956	1900	Tstm Wind	0 kts.	0	0	0	0
7 RICHMOND	06/11/1961	1700	Tstm Wind	65 kts.	0	0	0	0

8 RICHMOND	07/03/1966	1930	Tstm Wind	0 kts.	0	0	0	0
9 RICHMOND	05/08/1967	1338	Tstm Wind	65 kts.	0	0	0	0
10 RICHMOND	05/25/1968	1525	Tstm Wind	0 kts.	0	0	0	0
11 RICHMOND	07/08/1969	1911	Tstm Wind	50 kts.	0	0	0	0
12 RICHMOND	07/03/1970	1655	Tstm Wind	50 kts.	0	0	0	0
13 RICHMOND	07/16/1970	1530	Tstm Wind	0 kts.	0	0	0	0
14 RICHMOND	07/16/1970	1553	Tstm Wind	53 kts.	0	0	0	0
15 RICHMOND	03/02/1972	1609	Tstm Wind	53 kts.	0	0	0	0
16 RICHMOND	03/16/1972	1127	Tstm Wind	75 kts.	0	0	0	0
17 RICHMOND	07/05/1972	1423	Tstm Wind	0 kts.	0	0	0	0
18 RICHMOND	03/21/1974	0535	Tstm Wind	58 kts.	0	0	0	0
19 RICHMOND	08/07/1974	1313	Tstm Wind	57 kts.	0	0	0	0
20 RICHMOND	05/16/1975	1345	Tstm Wind	0 kts.	0	0	0	0
21 RICHMOND	07/22/1977	1400	Tstm Wind	0 kts.	0	0	0	0
22 RICHMOND	10/02/1977	1300	Tstm Wind	54 kts.	0	0	0	0
23 RICHMOND	08/19/1978	1645	Tstm Wind	0 kts.	0	0	0	0
24 RICHMOND	08/29/1978	1500	Tstm Wind	0 kts.	0	0	0	0
25 RICHMOND	08/29/1978	1515	Tstm Wind	54 kts.	0	0	0	0
26 RICHMOND	10/04/1979	1610	Tstm Wind	0 kts.	0	0	0	0
27 RICHMOND	07/09/1980	1405	Tstm Wind	0 kts.	0	0	0	0
28 RICHMOND	07/26/1980	1910	Tstm Wind	60 kts.	0	0	0	0
29 RICHMOND	08/07/1980	1545	Tstm Wind	0 kts.	0	0	0	0
30 RICHMOND	03/16/1981	1300	Tstm Wind	50 kts.	0	0	0	0
31 RICHMOND	08/10/1981	2000	Tstm Wind	0 kts.	0	0	0	0
32 RICHMOND	08/12/1981	1700	Tstm Wind	0 kts.	0	0	0	0
33 RICHMOND	02/16/1982	1957	Tstm Wind	0 kts.	0	0	0	0
34 RICHMOND	04/26/1982	2130	Tstm Wind	0 kts.	0	0	0	0
35 RICHMOND	06/10/1982	1445	Tstm Wind	0 kts.	0	0	0	0
36 RICHMOND	04/23/1983	1830	Tstm Wind	0 kts.	0	0	0	0
37 RICHMOND	06/05/1983	1230	Tstm Wind	0 kts.	0	0	0	0
38 RICHMOND	07/05/1983	1630	Tstm Wind	0 kts.	0	0	0	0
39 RICHMOND	07/15/1983	1335	Tstm Wind	0 kts.	0	0	0	0
40 RICHMOND	08/24/1983	1410	Tstm Wind	0 kts.	0	0	0	0
41 RICHMOND	04/14/1984	1335	Tstm Wind	0 kts.	0	0	0	0

42 RICHMOND	04/14/1984	1400	Tstm Wind	0 kts.	0	0	0	0
43 RICHMOND	05/03/1984	1600	Tstm Wind	0 kts.	0	0	0	0
44 RICHMOND	07/22/1985	1650	Tstm Wind	0 kts.	0	0	0	0
45 RICHMOND	05/24/1988	1530	Tstm Wind	0 kts.	0	0	0	0
46 RICHMOND	07/30/1988	1435	Tstm Wind	0 kts.	0	0	0	0
47 RICHMOND	04/04/1989	1710	Tstm Wind	0 kts.	0	0	0	0
48 RICHMOND	05/05/1989	1620	Tstm Wind	0 kts.	0	0	0	0
49 RICHMOND	05/05/1989	1720	Tstm Wind	0 kts.	0	0	0	0
50 RICHMOND	02/10/1990	0722	Tstm Wind	0 kts.	0	0	0	0
51 RICHMOND	02/22/1990	1300	Tstm Wind	0 kts.	0	1	0	0
52 RICHMOND	06/09/1990	1515	Tstm Wind	52 kts.	0	0	0	0
53 RICHMOND	03/01/1991	1800	Tstm Wind	0 kts.	0	0	0	0
54 RICHMOND	07/12/1992	1345	Tstm Wind	0 kts.	0	0	0	0
55 RICHMOND	09/03/1992	1600	Tstm Wind	0 kts.	0	0	0	0
56 Augusta	05/13/1993	1515	Thunderstorm Winds	0 kts.	0	0	5K	0
57 Augusta	05/19/1993	1225	Thunderstorm Winds	0 kts.	0	0	5K	0
58 Augusta	05/19/1993	1240	Thunderstorm Winds	0 kts.	0	0	50K	0
59 Hephzibah	06/17/1994	1943	Tstm Winds	0 kts.	0	0	5K	0
60 Mcbean	06/26/1994	1320	Thunderstorm Winds	0 kts.	0	0	1K	0
61 Augusta	06/28/1994	1800	Thunderstorm Winds	0 kts.	0	0	5K	0
62 Augusta	06/28/1994	2115	Tstm Winds	0 kts.	0	0	5K	0
63 Augusta	05/14/1995	1215	Thunderstorm Winds	0 kts.	0	4	2K	0
64 Richmond	06/09/1995	1845	Thunderstorm Winds	0 kts.	0	0	0	0
65 Augusta	06/12/1995	1305	Thunderstorm Winds	0 kts.	0	0	500	0
66 South Augusta	06/12/1995	1307	Thunderstorm Winds	0 kts.	0	0	18K	0
67 Hephzibah	07/16/1995	1842	Thunderstorm Winds	0 kts.	0	0	600	0
68 Augusta	07/24/1995	1855	Thunderstorm Winds	0 kts.	0	0	500	0

69 GAZ001>17 19>23>30>34 >41>46>52> 57 66>70>78>80 89>93 102>106 120 122	10/05/1995	0600	Thunderstorm Winds	0 kts.	8	7	75.0M	50.0 M
70 Augusta	11/07/1995	1515	Thunderstorm Winds	0 kts.	0	0	0	0
71 Augusta	11/11/1995	1513	Thunderstorm Winds	0 kts.	0	0	0	0
72 West Augusta	01/24/1996	08:22 AM	Tstm Wind	50 kts.	0	0	0	0
73 Goeshen	03/07/1996	04:54 AM	Tstm Wind	75 kts.	0	0	2.0M	0
74 Augusta	05/28/1996	01:25 AM	Tstm Wind	50 kts.	0	0	0	0
75 Gracewood	04/22/1997	07:55 PM	Tstm Wind	60 kts.	0	0	7K	0K
76 Blythe	04/22/1997	08:00 PM	Tstm Wind	60 kts.	0	2	15K	0K
77 Hephzibah	04/22/1997	08:05 PM	Tstm Wind	55 kts.	0	0	3K	0K
78 Augusta	05/03/1997	11:20 AM	Tstm Wind	50 kts.	0	0	0	0
79 Blythe	07/27/1997	03:22 PM	Tstm Wind	50 kts.	0	0	0	0
80 Hephzibah	06/10/1998	04:50 PM	Tstm Wind	50 kts.	0	0	0	0
81 Augusta	06/19/1998	01:15 PM	Tstm Wind	55 kts.	0	0	0	0
82 Hephzibah	09/08/1998	05:45 PM	Tstm Wind	50 kts.	0	0	0	0
83 Augusta	04/15/1999	04:22 PM	Tstm Wind	50 kts.	0	0	0	0
84 Augusta	08/23/1999	04:35 PM	Tstm Wind	50 kts.	0	0	0	0
85 Hephzibah	06/22/2000	04:30 PM	Tstm Wind	50 kts.	0	0	0	0
86 Augusta	08/18/2000	05:30 PM	Tstm Wind	50 kts.	0	0	0	0
87 Augusta	06/03/2001	05:13 PM	Tstm Wind	50 kts.	0	0	0	0
88 Augusta	06/03/2001	05:30 PM	Tstm Wind	50 kts.	0	0	0	0
89 Augusta	06/22/2001	04:15 PM	Tstm Wind	50 kts.	0	0	0	0
90 Augusta	07/08/2001	07:25 PM	Tstm Wind	50 kts.	0	0	0	0
91 Ft Gordon	12/17/2001	08:10 PM	Tstm Wind	50 kts.	0	0	0	0
92 Augusta	05/03/2002	05:15 PM	Tstm Wind	70 kts.	0	0	0	0
93 Augusta	05/03/2002	05:20 PM	Tstm Wind	70 kts.	0	0	0	0
94 Augusta	05/03/2002	05:48 PM	Tstm Wind	50 kts.	0	0	0	0
95 Countywide	05/13/2002	05:43 PM	Tstm Wind	60 kts.	0	0	0	0

96 Augusta	05/29/2002	05:30 PM	Tstm Wind	55 kts.	0	1	18K	0
97 Augusta	07/30/2002	05:40 PM	Tstm Wind	55 kts.	0	0	0	0
98 Augusta	08/18/2002	04:05 PM	Tstm Wind	50 kts.	0	0	0	0
99 Augusta	09/18/2002	01:00 PM	Tstm Wind	50 kts.	0	0	0	0
100 Countywide	12/24/2002	10:05 AM	Tstm Wind	50 kts.	0	0	0	0
101 Augusta	02/22/2003	11:15 AM	Tstm Wind	55 kts.	0	0	0	0
102 Central Portion	05/02/2003	08:30 PM	Tstm Wind	60 kts.	0	0	0	0
103 Augusta	05/18/2003	06:45 PM	Tstm Wind	50 kts.	0	0	0	0
104 Augusta	07/11/2003	02:55 PM	Tstm Wind	55 kts.	0	0	0	0
105 Augusta	11/19/2003	05:20 AM	Tstm Wind	50 kts.	0	0	0	0
106 Augusta Bush Arpt	05/02/2004	03:26 PM	Tstm Wind	64 kts.	0	0	0	0
107 Augusta	05/02/2004	03:34 PM	Tstm Wind	55 kts.	0	0	0	0
108 Augusta	04/22/2005	03:35 PM	Tstm Wind	60 kts.	0	0	0	0
109 Augusta	05/20/2005	01:35 PM	Tstm Wind	60 kts.	0	0	0	0
110 Augusta	08/04/2005	07:05 PM	Tstm Wind	50 kts.	0	0	0	0
111 Augusta	07/15/2006	03:27 PM	Tstm Wind	60 kts.	0	0	0	0
112 Augusta	07/20/2006	08:47 PM	Tstm Wind	55 kts.	0	0	0	0
113 Ft Gordon	07/22/2006	03:00 PM	Tstm Wind	55 kts.	0	0	0	0
114 Hephzibah	02/13/2007	18:15 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
115 Ft Gordon	03/01/2007	20:40 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
116 Hephzibah	03/02/2007	01:38 AM	Tstm Wind	55 kts.	0	0	0K	0K
117 Blythe	04/14/2007	18:25 PM	Thunderstorm Wind	55 kts.	0	0	0K	0K
118 (ags)bush Fld August	06/18/2007	18:11 PM	Thunderstorm Wind	58 kts.	0	0	0K	0K
119 Ft Gordon	06/18/2007	18:15 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
120 Augusta	07/11/2007	14:40 PM	Thunderstorm Wind	60 kts.	1	4	0K	0K
121 Augusta	03/04/2008	20:05 PM	Thunderstorm Wind	70 kts.	0	0	0K	0K
122 National Hills	03/15/2008	17:35 PM	Thunderstorm Wind	61 kts.	0	0	0K	0K

123 (ags)bush Fld August	05/20/2008	15:01 PM	Thunderstorm Wind	58 kts.	0	0	0K	0K
124 Augusta	05/20/2008	17:03 PM	Thunderstorm Wind	65 kts.	0	0	0K	0K
125 Augusta	06/22/2008	13:30 PM	Thunderstorm Wind	60 kts.	0	0	0K	0K
126 Ft Gordon	07/31/2008	14:12 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
127 Blythe	08/07/2008	17:15 PM	Thunderstorm Wind	55 kts.	0	0	0K	0K
128 South Nellieville	06/12/2009	16:21 PM	Thunderstorm Wind	55 kts.	0	0	0K	0K
129 Augusta	06/18/2009	17:53 PM	Thunderstorm Wind	55 kts.	0	0	6K	0K
130 Ft Gordon	06/18/2009	18:10 PM	Thunderstorm Wind	50 kts.	0	0	35K	0K
131 (ags)bush Fld August	07/30/2009	13:32 PM	Thunderstorm Wind	50 kts.	0	0	0K	0K
132 Augusta	08/11/2009	16:50 PM	Thunderstorm Wind	50 kts.	0	0	2K	0K
133 Augusta	12/09/2009	06:32 AM	Tstm Wind	50 kts.	0	0	4K	0K
134 Augusta Daniel Arpt	01/24/2010	22:58 PM	Thunderstorm Wind	50 kts.	0	0	5K	0K
135 Augusta	06/15/2010	16:00 PM	Thunderstorm Wind	60 kts.	0	0	40K	0K
136 South Nellieville	06/25/2010	16:07 PM	Thunderstorm Wind	55 kts.	0	0	6K	0K
137 (ags)bush Fld August	07/27/2010	17:11 PM	Thunderstorm Wind	60 kts.	0	0	0K	0K
138 Augusta	07/31/2010	15:44 PM	Thunderstorm Wind	55 kts.	0	0	4K	0K
139 Augusta	10/25/2010	10:45 AM	Thunderstorm Wind	50 kts.	0	0	0K	0K
140 Augusta Daniel Arpt	03/09/2011	16:05 PM	Thunderstorm Wind	50 kts.	0	0	1K	0K
Source: (NOAA, National Oceanic and Atmospheric Administration, 2011). TOTALS:					9	19	77.241M	50.000M

For any given season, predictions of hurricane activity are prepared annually by the members of the Colorado State University Hurricane Forecast Team. The forecasts include individual monthly predictions of activity and seasonal and monthly U.S.

hurricane landfall probabilities. The predictions vary each year based on several atmospheric and oceanic factors and are available at http://typhoon.atmos.colostate.edu/forecasts. In the Augusta – Richmond County planning area no hurricanes or tropical storms were reported by NOAA during the period of 1950 – 2010 (NOAA, National Oceanic and Atmospheric Administration, 2011) however FEMA declared an emergency for Richmond County (See FEMA-EM-3218-GA) for the Hurricane Katrina evacuation.

Map 1 below shows the tracks of hurricanes and tropical storms that passed over or within 65 miles of Augusta between 1950 and 2010. In order to estimate the frequency of occurrence, the number of storms that have come close to the Augusta area (51) is compared to the length of the period of record, the 60 years from 1950-2010. Based on this record, on average 0.85 hurricanes or tropical storms occur somewhere in the area each year (see Table 2.12). The recurrence interval based on this record is an estimate of the amount of time, on average, during which one occurrence of a storm of a given magnitude will take place. It is important to note that, in reality, a storm can occur multiple times during one recurrence interval, and that the recurrence interval is only an estimated average time period.

Map 1: Historical Hurricane Tracks

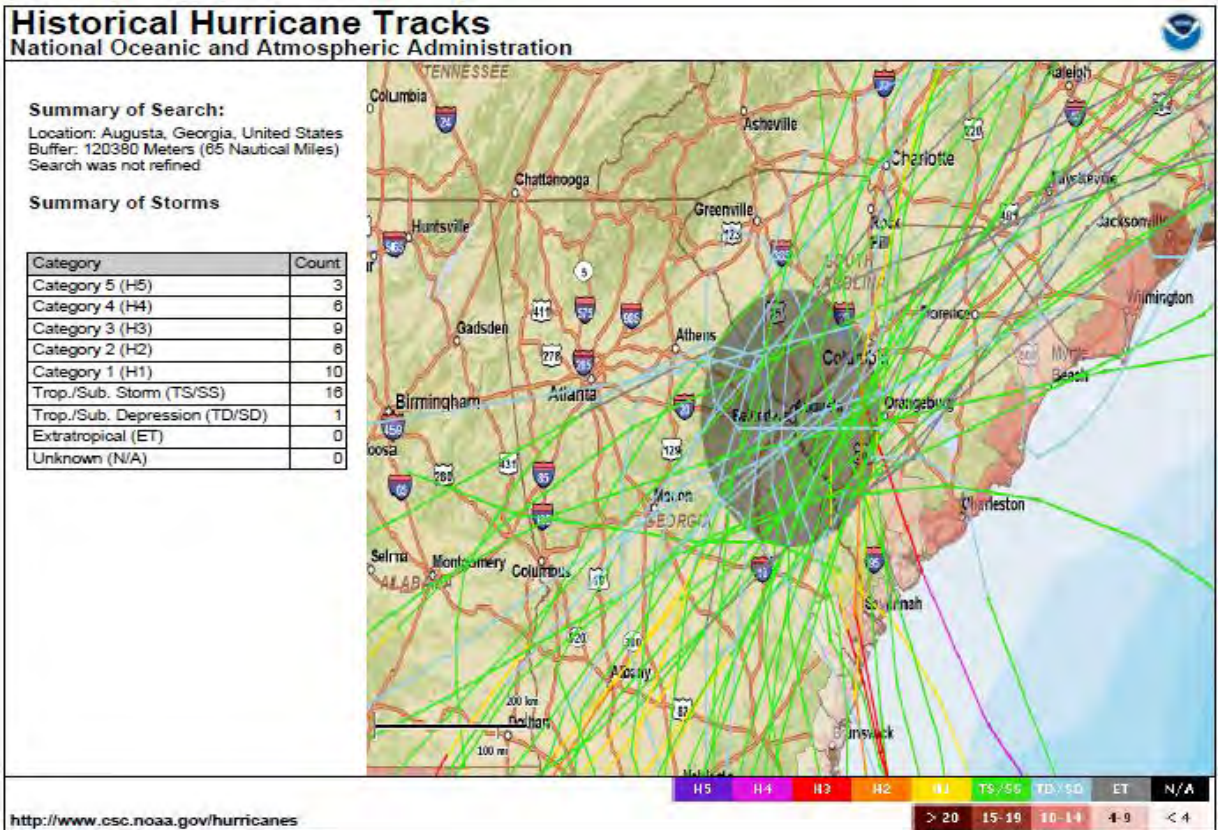


Table 2.12: Historical Hurricane Tracks

Historical Hurricane Tracks
National Oceanic and Atmospheric Administration

Storm Name	Max Saffir-Simpson	Date
NOT NAMED 1851	H3	Aug. 16, 1851 to Aug. 27, 1851
NOT NAMED 1852	H3	Aug. 19, 1852 to Aug. 30, 1852
NOT NAMED 1852	H2	Oct. 6, 1852 to Oct. 11, 1852
NOT NAMED 1854	H3	Sep. 7, 1854 to Sep. 12, 1854
NOT NAMED 1856	H3	Aug. 25, 1856 to Sep. 3, 1856
NOT NAMED 1877	H3	Sep. 21, 1877 to Oct. 5, 1877
NOT NAMED 1882	H3	Sep. 2, 1882 to Sep. 13, 1882
NOT NAMED 1884	H1	Sep. 10, 1884 to Sep. 20, 1884
NOT NAMED 1885	TS	Oct. 10, 1885 to Oct. 14, 1885
NOT NAMED 1886	H2	Jun. 17, 1886 to Jun. 24, 1886
NOT NAMED 1886	H2	Jun. 27, 1886 to Jul. 2, 1886
NOT NAMED 1887	H1	Oct. 9, 1887 to Oct. 22, 1887
NOT NAMED 1888	TS	Sep. 6, 1888 to Sep. 13, 1888
NOT NAMED 1889	H2	Sep. 12, 1889 to Sep. 26, 1889
NOT NAMED 1893	H3	Aug. 15, 1893 to Sep. 2, 1893
NOT NAMED 1893	H4	Sep. 27, 1893 to Oct. 5, 1893
NOT NAMED 1898	H1	Aug. 30, 1898 to Sep. 1, 1898
NOT NAMED 1901	H1	Sep. 9, 1901 to Sep. 19, 1901
NOT NAMED 1902	TS	Jun. 12, 1902 to Jun. 17, 1902
NOT NAMED 1903	H1	Sep. 9, 1903 to Sep. 16, 1903
NOT NAMED 1912	TS	Jun. 7, 1912 to Jun. 17, 1912
NOT NAMED 1915	H1	Jul. 31, 1915 to Aug. 5, 1915
NOT NAMED 1927	TS	Oct. 1, 1927 to Oct. 4, 1927
NOT NAMED 1928	H2	Aug. 3, 1928 to Aug. 12, 1928
NOT NAMED 1929	H4	Sep. 22, 1929 to Oct. 4, 1929
NOT NAMED 1933	H4	Aug. 31, 1933 to Sep. 7, 1933
NOT NAMED 1934	TS	May. 27, 1934 to May. 31, 1934
NOT NAMED 1935	H5	Aug. 29, 1935 to Sep. 10, 1935
NOT NAMED 1941	H3	Oct. 3, 1941 to Oct. 14, 1941
NOT NAMED 1946	H4	Oct. 5, 1946 to Oct. 14, 1946
NOT NAMED 1947	TS	Sep. 20, 1947 to Sep. 25, 1947
NOT NAMED 1947	TS	Oct. 6, 1947 to Oct. 8, 1947
NOT NAMED 1949	H4	Aug. 23, 1949 to Aug. 31, 1949
FLOSSY 1956	H1	Sep. 21, 1956 to Sep. 30, 1956
ARLENE 1959	TS	May. 28, 1959 to Jun. 2, 1959
GRACIE 1959	H4	Sep. 20, 1959 to Oct. 2, 1959
CLEO 1964	H5	Aug. 20, 1964 to Sep. 5, 1964
UNNAMED 1965	TS	Jun. 11, 1965 to Jun. 16, 1965
ABBY 1968	H1	Jun. 1, 1968 to Jun. 13, 1968
AGNES 1972	H1	Jun. 14, 1972 to Jun. 23, 1972
DAVID 1979	H5	Aug. 25, 1979 to Sep. 8, 1979
CHRIS 1988	TS	Aug. 21, 1988 to Aug. 30, 1988
MARCO 1990	TS	Oct. 9, 1990 to Oct. 13, 1990
ALLISON 1995	H1	Jun. 3, 1995 to Jun. 11, 1995
JERRY 1995	TS	Aug. 22, 1995 to Aug. 28, 1995

Historical Hurricane Tracks
National Oceanic and Atmospheric Administration

Storm Name	Max Saffir-Simpson	Date
EARL 1998	H2	Aug. 31, 1998 to Sep. 8, 1998
HELENE 2000	TS	Sep. 15, 2000 to Sep. 25, 2000
ALLISON 2001	TS	Jun. 5, 2001 to Jun. 19, 2001
NOT NAMED 2003	TD	Jul. 25, 2003 to Jul. 27, 2003
JEANNE 2004	H3	Sep. 13, 2004 to Sep. 29, 2004
ALBERTO 2006	TS	Jun. 10, 2006 to Jun. 19, 2006

Tornado, Thunderstorm Wind, High Wind, and Hail data was entered in the GEMA Hazard Frequency Table and calculated using the preloaded formulas. The results were averaged for four categories to determine the frequency of occurrence of the Tornado-Windstorm-Hail Hazard. The results are:

1. Tornado
    a. Historic Recurrence Interval = 6.78 (years)
    b. Historic Frequency Chance/year= 14.75%
2. Thunderstorm Wind
    a. Historic Recurrence Interval = 0.40 (years)
    b. Historic Frequency Chance/year = 250.00%
3. Hail
    a. Historic Recurrence Interval = 0.98 (years)
    b. Historic Frequency Chance/year = 101.64%
4. High Wind
    a. Historic Recurrence Interval = 30.50
    b. Historic Frequency Chance/year = 3.28%

The entries were averaged to produce frequency and recurrence data results. The Historic Recurrence Interval for the Tornado-Windstorm-Hail Hazard is 9.66 years and the Historic Frequency Chance per year is 92.42% (Source: Georgia Emergency Management Agency (GEMA), 2003).

2.1.1.3 Inventory of Assets Exposed to Tornado – Windstorm – Hail

All buildings and structures are within the Augusta − Richmond County planning areas are exposed to the effects of tornados, windstorms, and hail. There were reported losses in excess of 9 million dollars over the recorded history of these events there is substantial evidence of the impact on the planning area (NOAA, National Oceanic and Atmospheric Administration, 2011).

2.1.1.4 Estimation of Losses Due to Tornado – Windstorm - Hail

High winds can damage roofs, ranging from loss of roofing materials to total loss of the roof structure. A great deal of wind damage is due to wind-borne debris which

breaks windows and thus opens building envelopes to additional wind damage as well as the entry of wind-drive rains which soak contents and interiors. Debris can inflict injuries on people who have not sought shelter, or even in result death. High winds dislodge manufactured homes that are not adequately anchored, and bring down electric and telephone lines and poles.

In general, older structures are expected to be more susceptible to wind damage in part because their construction pre-dated building codes but also because older structures may not have been maintained. The type of construction also influences the likelihood of damage, with shingled, overhanging roofs (common on residences) more vulnerable to wind damage than are flat asphalt roofs (common on non-residential buildings).

Using HAZUS-MH, an analysis was performed to assess the relative vulnerability of structures to high wind hazards. Tropical storms, thunderstorms, and tornadoes were the types of events considered most probable to have a widespread effect on the county. Wind vulnerability of structures is dependent on several factors including:

- Level of engineering design (code compliance);
- Quality of materials and construction;
- Structure exposure and height;
- Beneficial or adverse effects of nearby trees and structures;
- Age and condition; and
- Degree of rainfall or water penetration.

The high wind scenario was simulated for a Category 1 hurricane (where 1-minute sustained wind speeds range from 74-95 mph) that passes directly through or within close proximity of the county. This scenario is reasonable because two storms of this magnitude have passed within 65 miles of Augusta between 1950 and 2003. It was assumed that all parts of the area are equally likely to experience similar wind speeds.

The HAZUS analysis for this scenario analysis indicates that on the order of 50 buildings will suffer minor damage and at least 1 building will incur moderate damage. It is highly unlikely that any buildings would be completely destroyed. No households are expected to be displaced due to the hurricane, and consequently, no one is expected to seek temporary shelter in public shelters. The total economic loss is estimated at $2.8 million or approximately 0.02 percent of the total replacement value of the entire building stock of the area.

Perhaps the more significant consequence of a high wind event that affects the whole area is due to debris and the associated costs to manage and dispose of the material. HAZUS-MH projects that as much as 331 tons of woody debris could be generated throughout the area, including forested and undeveloped areas. Thus, it is important to qualify this estimate because a large portion of the area is forested, and thus the amount of debris that would need to be cleared from streets and developed areas after a storm is considerably less.

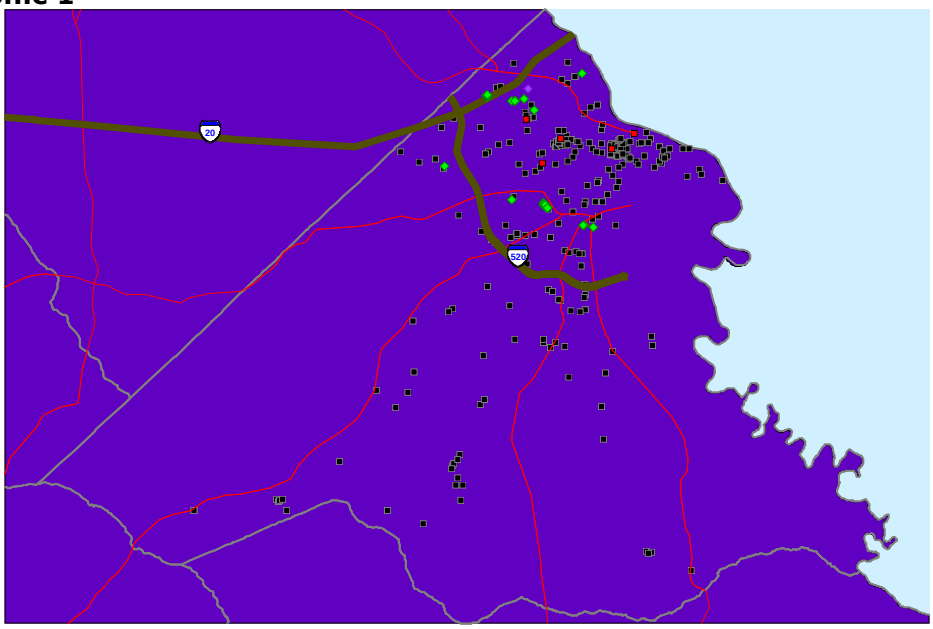
The costs of managing debris are not included in regular budgets. When events prompt massive debris cleanup, staff from the Engineering, Environmental Services, Public Services, and Recreation & Parks departments are diverted from other work, often causing delays. In recent years, events with large quantities of debris have prompted the City to waive landfill fees, thus reducing potential income.

Tornado Loss Estimation. There are no standard loss estimation models and tables for tornadoes. Except for structures such as "safe rooms" that are engineered as refuges, buildings are not designed to resist the effects of tornadoes. Therefore, when buildings are in the path of a tornado, it is expected that the damage will be total. Tornados are not location specific, that is, within a geographic area as small as a county, there are no factors that suggest that tornados will affect one area more than another.

GMIS estimates the damages during a high wind event for each community as:

1. Blythe: Hazard Score = 2; Building Damage by Square Feet, 57,729 sq. ft.; Replacement Costs of Damaged Structures, $1,938,000; Replacement Costs for Contents, $129,000; with 430 person affected by the hazard event.
2. Hephzibah: Hazard Score = 2; Building damage by square feet, 338,139 sq. ft.; Replacement Costs of Damaged Structures, $13,142,859; Replacement Costs for Contents, $290,300 Functional Value Loss, $1,008,500, with 3,097 persons affected by the hazard event.
3. Augusta – Richmond County: Hazard Score = 2; Building damage by square feet, 19,692,499 sq. ft.; Replacement Costs of Damaged Structures, $1,951,908,136; Replacement Costs for Contents, $329,985,275; Functional Value Loss, $5,000; Displacement Costs, $56,135; with 65,360 persons affected by the hazard event. GMIS Graphic 1 below depicts the Critical Facilities exposed to Wind Hazards.

GMIS Graphic 1



GMIS total damage estimates for the planning region are: Hazard Score = 2; Replacement Costs of Damaged Structures, $1,966,988,995; Replacement Costs for Contents, $330,404,575; Functional Value Loss, $1,013,500, Displacement Costs, $56,135; with 68,887 persons affected by the hazard event (Georgia Emergency Management Agency (GEMA), 2003). The GMIS Hazard Frequency Table is located in Appendix A of the plan.

Hurricane

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop multi -hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery. The hurricane loss estimates provided in this report are based on a region that includes 1 county from the following state: Georgia

The geographical size of the region is 328.59 square miles and contains 40 census tracts. There are over 73 thousand households in the region and has a total population of 199,775 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 77 thousand buildings in the region with a total building replacement value (excluding contents) of 12,743 million dollars (2002 dollars). Approximately 92% of the buildings (and 70% of the building value) are associated with residential housing.

General Building Stock and Building Inventory

HAZUS estimates that there are 77,917 buildings in the region that have an aggregate total replacement value of 12,743 million (2002 dollars). Table A below presents the relative distribution of the value with respect to the general occupancies. The report included in Appendix A provides a general distribution of the building value by State and County.

Table A: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	8,967,798	70.4%
Commercial	2,707,355	21.2%
Industrial	495,189	3.9%
Agricultural	26,011	0.2%
Religious	312,465	2.5%
Government	96,570	0.8%
Education	137,831	1.1%
Total	**12,743,219**	**100.0%**

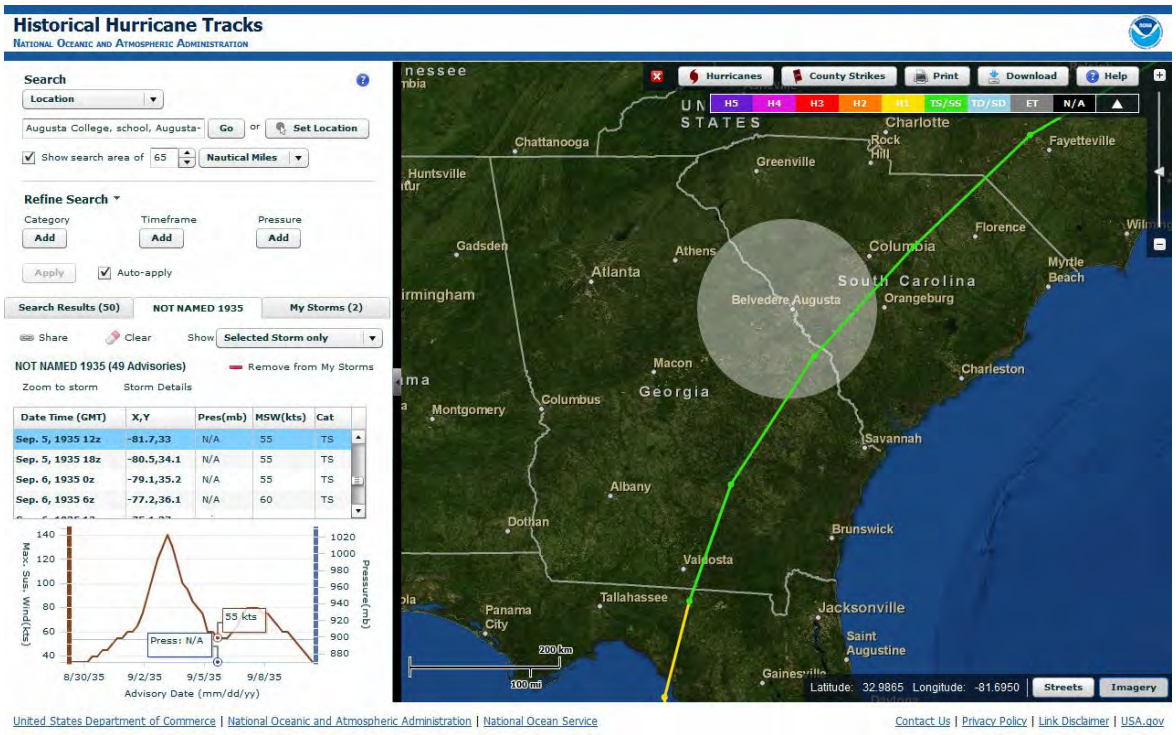
Essential Facility Inventory

The essential facilities in the region are 8 hospitals with a total bed capacity of 2,353 beds. There are 75 schools, 2 fire stations, 4 police stations and no emergency operation facilities.

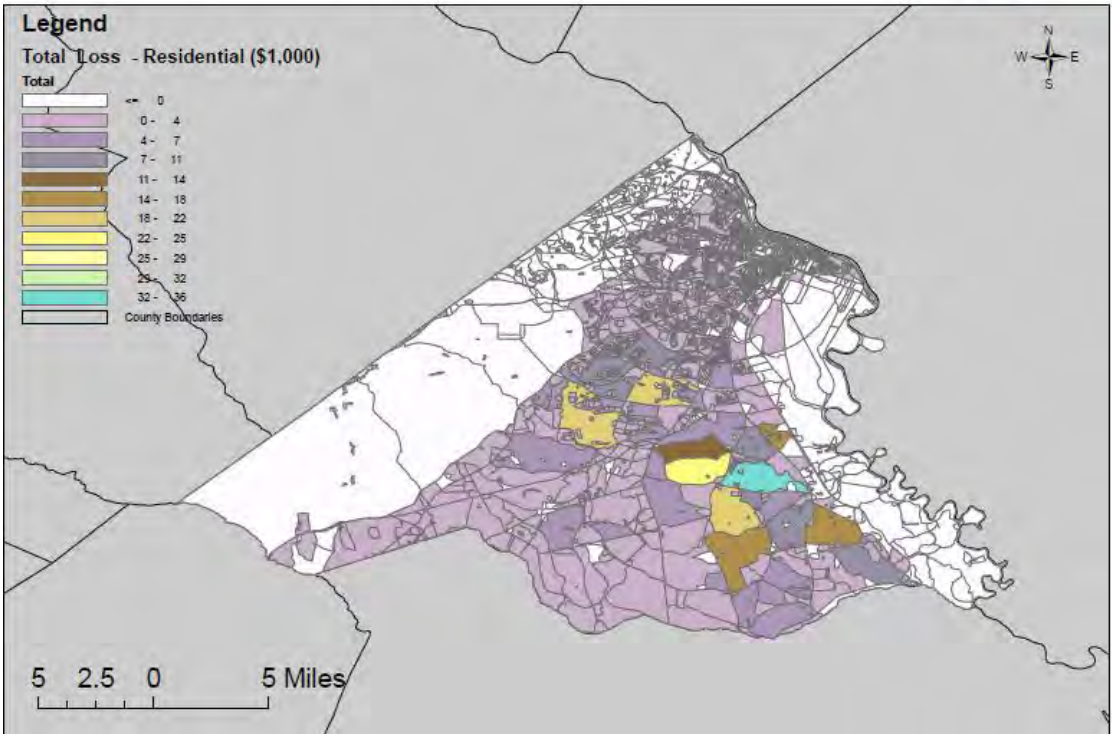
Hurricane Scenario. HAZUS used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report. Graphics, 1, 2, and 3 below depicts the unnamed hurricane and the 2 Plat courses for the event used for the model.

Max Peak Gust in Study Region: 69 mph; **Scenario Name:** UN-NAMED-1935-2; **Type:** Historic

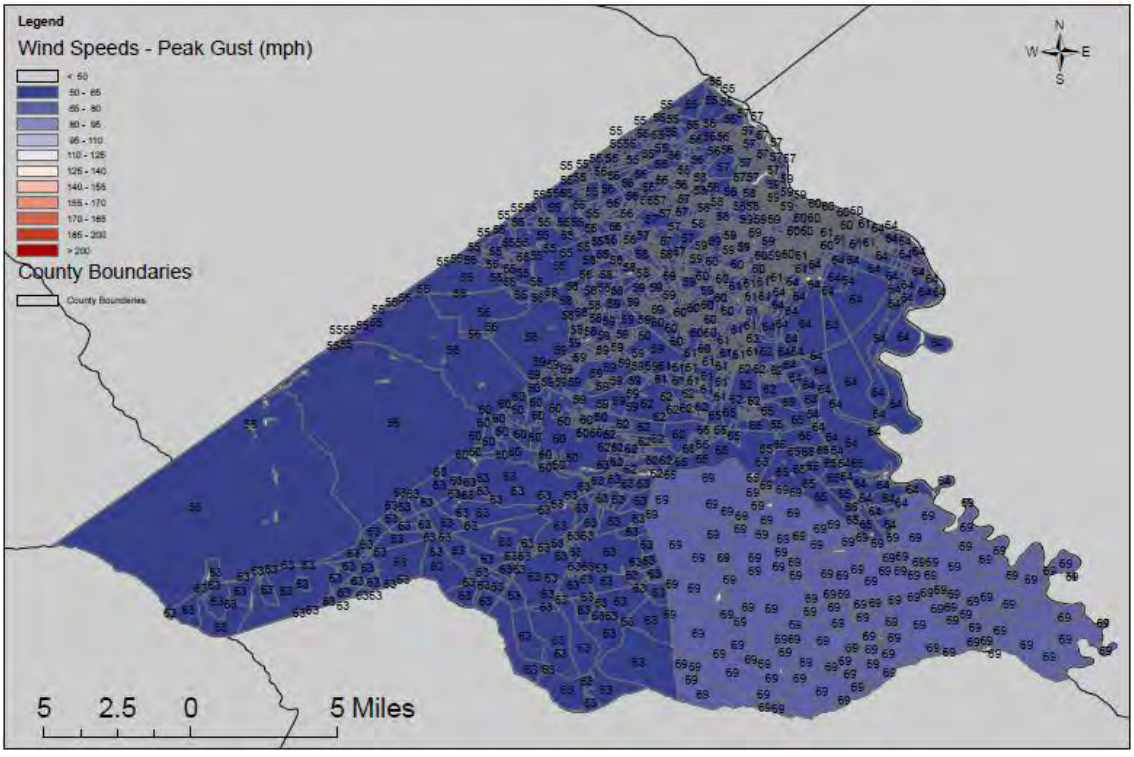
Graphic 1



Graphic 2: Study Region: Augusta-Richmond County
Current Scenario: Historic - Name: Unnamed hurricane 1935



Graphic 3: Study Region: Augusta-Richmond County
Current Scenario: Historic - Name: Unnamed Hurricane 1935



General Building Stock Damage

HAZUS estimates that about 0 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the HAZUS Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table B summarizes the expected damage by general building type.

Table B: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	196	99.76	0	0.24	0	0.00	0	0.00	0	0.00
Commercial	4,189	99.69	13	0.31	0	0.00	0	0.00	0	0.00
Education	145	99.71	0	0.29	0	0.00	0	0.00	0	0.00
Government	129	99.69	0	0.31	0	0.00	0	0.00	0	0.00
Industrial	958	99.68	3	0.32	0	0.00	0	0.00	0	0.00
Religion	514	99.76	1	0.24	0	0.00	0	0.00	0	0.00
Residential	71,733	99.95	36	0.05	0	0.00	0	0.00	0	0.00
Total	**77,863**		**54**		**0**		**0**		**0**	

Table C: Expected Building Damage by Building Type

Building Type	None		Minor		Moderate		Severe		Destruction	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	370	99.59	2	0.41	0	0.00	0	0.00	0	0.00
Masonry	6,152	99.72	17	0.28	0	0.00	0	0.00	0	0.00
MH	7,476	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	2,216	99.65	8	0.35	0	0.00	0	0.00	0	0.00
Wood	56,908	99.98	10	0.02	0	0.00	0	0.00	0	0.00

Essential Facility Damage

Before the hurricane, the region had 2,353 hospital beds available for use. On the day of the hurricane, the model estimates that 2353 hospital beds (only 100.00%) are available for use. After one week, 100.00% of the beds will be in service. By 30 days, 100.00% will be operational. Table D below reveals the estimated damages.

Table D: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	Probability of at Least Moderate Damage > 50%	Probability of Complete Damage > 50%	Expected Loss of Use < 1 day
Fire Stations	2	0	0	2
Hospitals	8	0	0	8
Police Stations	4	0	0	4
Schools	75	0	0	75

Induced Hurricane Damage - Debris Generation

HAZUS estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into three general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, and c) Trees. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 9,531 tons of debris will be generated. Of the total amount, Brick/Wood comprises 0% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the hurricane.

Social Impact - Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters.

The model estimates 0 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 199,775) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 1.4 million dollars, which represents 0.01 % of the total replacement value of the region's buildings.

Building-Related Losses

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

The total property damage losses were 1 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 97% of the total loss. Table E below provides a summary of the losses associated with the building damage.

Table E: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	1,392.55	19.90	22.35	5.68	1,440.49
	Content	0.00	0.00	0.00	0.00	0.00
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**1,392.55**	**19.90**	**22.35**	**5.68**	**1,440.49**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	0.26	0.14	0.00	0.04	0.44
	Rental	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**0.26**	**0.14**	**0.00**	**0.04**	**0.44**
Total						
	Total	**1,392.80**	**20.04**	**22.35**	**5.72**	**1,440.92**

2.1.1.5 Land use and development trends related to Tornado – Windstorm - Hail

All new buildings must be designed and constructed to meet current building code requirements, including wind loads. Manufactured homes are to be installed on permanent foundations with tie-downs in compliance with engineered designs provided by the manufacturer. Accessory buildings are required to be anchored; reroofing projects are subject to permit and code compliance. It is not cost-effective to require buildings to withstand tornadic winds. The effects of high winds and the exposure of the built-environment to high winds are not influenced by land use and development trends.

2.1.1.6 Multi-Jurisdictional Differences in Tornado – Windstorm – Hail Events

There are no differences in exposure to high winds associated with jurisdictional boundaries between Augusta - Richmond , Blythe and Hephzibah.

2.1.1.7 Tornado – Windstorm – Hail HRV Summary

Most high winds accompany large storms such as hurricanes; the exception is microbursts. Large storms are tracked and predicted with reasonable accuracy and

advance warning. An overall summary of vulnerability to wind-related hazards is relatively straightforward because every building in the planning area is equally likely to be exposed to high winds. The most significant consequence associated with high winds are due to downed trees, falling limbs, accumulated woody debris on roads and private property, and power outages. Buildings are damaged by falling tree limbs and may be destroyed by tornados; roof damage due to winds is unusual. Primarily because of frequency (not the anticipated extent or severity of damage for any single event), the relative risk ranking of wind hazards was determined to be "high" (see Table 2.5 for a summary of relative risks).

2.2 Natural Disaster B: Flooding

Currently and historically floods are the most frequent, destructive, and costly natural hazard in the State of Georgia. Most of the State's damage reported for major disasters is associated with floods.

Since 1990, Augusta has been impacted by significant flood events, although not all qualified for major disaster declarations. Localized flooding concerns among citizens are the impacts to homes, yards and streets. Augusta and Hephzibah participate in the National Flood Insurance Program (NFIP), with 3055 flood policies in place.

2.2.1: Flooding Identity

The floodplain maps of the Augusta area have been prepared by FEMA in a basic digital format known as "FEMA Q3 Flood Data." Using the City's Geographic Information System (GIS) and available data layers and databases, specific information about flood-prone buildings can be developed. For the HMP, the City uses these maps and data as the best available data, rather than the flood hazard map and report generated by GEMA's online tool for critical and essential facilities (Appendix C).

GIS is a computer software application that relates physical features on the ground in mapping applications and analyses. The Augusta Information Technology Department manages the GIS functions. When rainfall runoff collects in rivers, creeks, and streams and exceeds the capacity of channels, floodwaters overflow onto adjacent lands. Floods result from rain events, whether short and intense or long and gentle. In recent years, most flooding in Augusta has been associated with large regional storms, some that originate as hurricanes and tropical storms that subsequently move inland. Flood hazards are categorized as follows:

- **Flash floods** not only occur suddenly, but also involve forceful flows that can destroy buildings and bridges, uproot trees, and scour out new channels. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or heavy rains from hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urban areas, where much of the ground is covered by impervious surfaces and drainage ways are designed for smaller flows. Flood

Insurance Rate Maps typically show the 1%-annual-chance (100-year) floodplain for waterways with at least 1 square mile of drainage area. The flood hazard area for waterways with less than one square mile of drainage area typically is not shown.

- **Riverine floods** are a function of precipitation levels and water runoff volumes, and occur when water rises out of the banks of the waterway. Flooding along waterways that drain larger watersheds often can be predicted in advance, especially where it takes 24 hours or more for the flood crest (maximum depth of flooding) to pass. In Augusta, riverine flooding is caused by large rainfall systems and thunderstorm activity associated opportunity for large amounts of rain to fall over large areas. The Flood Insurance Rate Maps show the 1%-annual-chance floodplains.

- **Urban drainage flooding** occurs where development has altered hydrology through changes in the ground surface and modification of natural drainage ways. Urbanization increases the magnitude and frequency of floods by increasing impervious surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and, occasionally, overwhelming sewer systems. Localized urban flooding is not usually shown on the Flood Insurance Rate Maps in areas with less than one square mile of contributing drainage area. The Flood Insurance Rate Maps (FIRMs) prepared by FEMA offer the best overview of flood risks. FIRMs are used to regulate new development and to control the substantial improvement and repair of substantially damaged buildings.

Augusta's revised Flood Insurance Study (FIS), 07/18/11, is a combination of FIS and maps prepared separately for the City of Augusta and Richmond County prior to consolidation of governments in 1996.

Hephzibah's FIRM, dated 07/18/11, shows that the city is "minimally flood prone" and flood hazard areas do not have flood elevations determined using engineering methods.

Blythe was found not to have flood hazards and a FIRM was not prepared.
Figure 2.6 shows the extent of mapped Special Flood Hazard Areas in Augusta (i.e., the100-year floodplain). At 58.77 square miles, the SFHA makes up nearly 25% of the total land area. Much of the land predicted to flood is on the east side of the City and includes the extensive wetlands of the Phiziny Swamp. Figure 2.7 shows the mapped floodplain in Hephzibah.

FEMA's maps show four types of flood zones:

- **AE Zones** lie along rivers and streams where detailed engineering methods were used to determine Base Flood Elevations. AE Zones (or A1-30 Zones) are shaded in gray. Waterways that are mapped using detailed methods that result in designated floodways are listed in Table 2.13 below.

- **A Zones** are 'approximate' flood zones, where detailed information has not been developed. Waterways that are shown with A Zones are listed in Table 2.13. Hephzibah's flood zones are A Zones.
- **B Zones and Shaded X Zones**, which are areas of "moderate" flood hazard, typically associated with the 500-year flood (or 0.2% annual chance).
- **C Zones and Un-shaded X Zones** are areas of "minimal" flood hazard, typically considered to be "out of the floodplain." Although local drainage problems and ponding may still occur, these minor flood problems typically are not shown on the FIRM. It is notable that many smaller streams are shown but do not have mapped flood hazard areas.

Table 2.13: Waterways on Augusta's FIRM.	
Savannah River Little Spirit Creek	Savannah River Little Spirit Creek
Butler Creek and Tributaries No. 1, 2 Rock Creek	Butler Creek and Tributaries No. 1, 2 Rock Creek
Rocky Creek and Tributaries No. 1-11 Augusta Canal	Rocky Creek and Tributaries No. 1-11 Augusta Canal
Beaver Dam Ditch McBean Creek	McBean Creek
Spirit Creek and Tributary No. 1 -	-
No Name Creek -	-
Oates Creek and Tributary No. 1 -	-
Horsepen Branch -	-
Crane Creek -	-
Rae's Creek and Tributaries. 1-3 -	-
Beaver Dam Ditch McBean Creek	-
Spirit Creek and Tributary No. 1 -	-
No Name Creek -	-

Figure 2.6: Augusta – Richmond County Flood Map

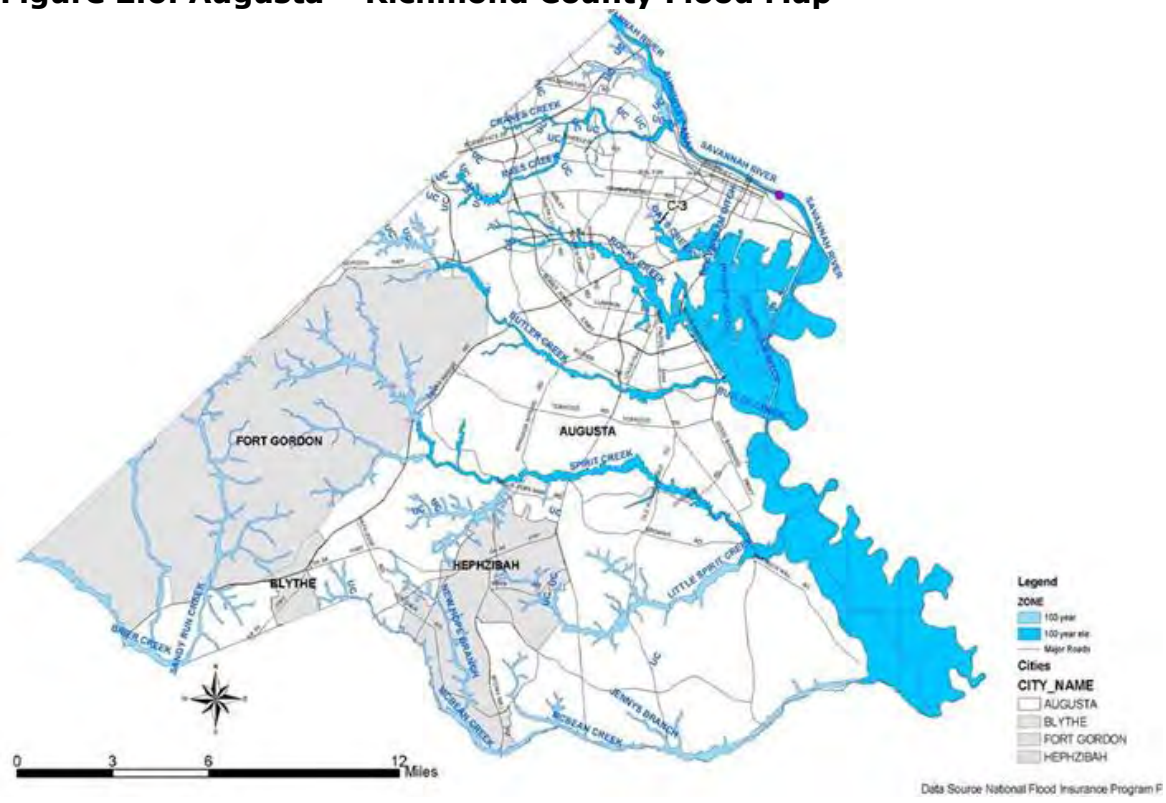
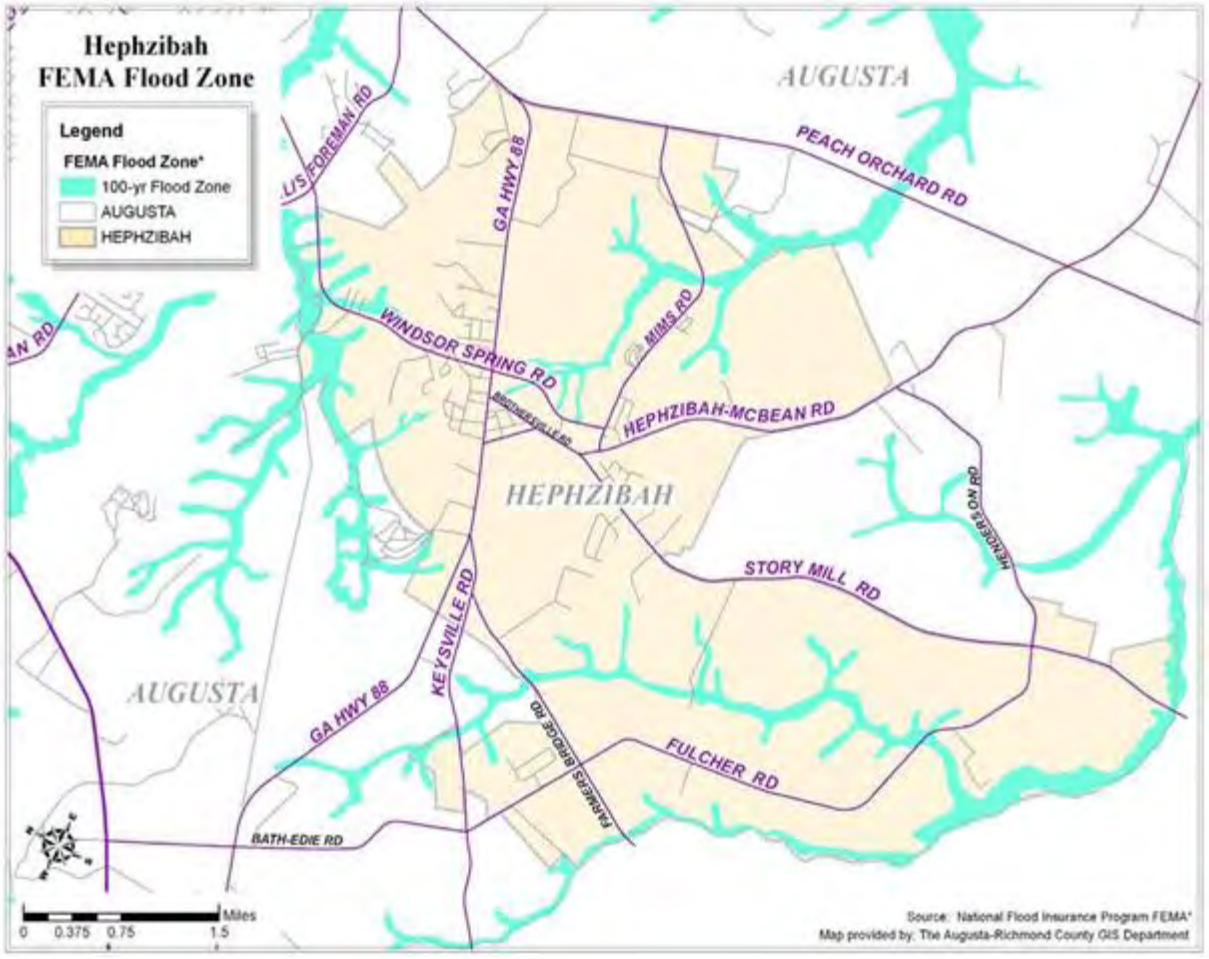


Figure 2.7: Hephzibah Flood Map



Savannah River. Discharges on the Savannah River are controlled by three flood control dams that create the J. Strom Thurmond/Clarks Hill Reservoir, the Hartwell Reservoir, and the Richard B. Russell Reservoir. The urban center of the City of Augusta is protected from Savannah River flooding by the Augusta Levee. Development on the river side of the Levee remains exposed to flood hazards, especially extreme flooding that occurs less frequently than the 1%-annual chance flood (100-year flood). The 1999 revision of the FEMA flood map lowered the predicted water elevations for the 100-year flood:

- Approximately 50 houses in the Water's Edge community (upstream of 13th Street) all appear to be out of the 100-year floodplain, although the water level predicted for the 500-year flood is likely to be under the buildings.
- For the most part, the buildings on Prep Phillips/Riverfront Drive appear to be subject to water depths ranging from 3 feet to 4 feet above the ground due to the 100-year flood. Property owners include the City, the Augusta-Richmond County Port Authority, and the Georgia Department of Transportation/Ports Authority. One or two privately-owned buildings appear to be located on City-owned property.

- The 48+ townhouses on Riverfront Drive and River Bend Drive (Goodale Landing, just east of Sand Bar Ferry Road) are all within the 100-year floodplain and the sites appear to be subject to several feet of flooding.
- The vacant lots and improved lots with 12+ homes on Albeclauss (8 are in the Floodway) appear to be subject to from 2-feet to 7-feet of water.
- On both sides of Sand Bar Ferry Road there are several clusters of buildings that appear to be in areas where flood depths are likely to be 2- to 6-feet deep.
- Below the downstream limit of the Augusta Levee, at the confluence of Butler Creek at New Savannah Bluff, the floodplain of the Savannah River is extensive, ranging from 5,000 to 10,000 feet wide. For the most part, there is little development in this area and there are no NFIP flood insurance policies in-force.

Urban Watersheds. The urban area of Augusta, including Butler Creek and northward, encompasses the former City and surrounding areas. Much of the area is densely developed, with the notable exception of the Phinizy Swamp on the eastern side. As shown on Figure 2.3, most of the federal flood insurance policies are for buildings in the urban watersheds, with most of them constructed before floodplain regulations were adopted.

Table 2-1 lists the urban waterways, all of which have been studied using detailed methods (Rock Creek, upper reaches of other streams, and small tributaries were evaluated using approximate methods). As part of a study underway by the U.S. Army Corps of Engineers (see Section 4.1.4), the FIRMs may be revised; preliminary results indicate that the areas subject to flooding will increase in many places. Generally, the floodplains of these streams can be described as follows:

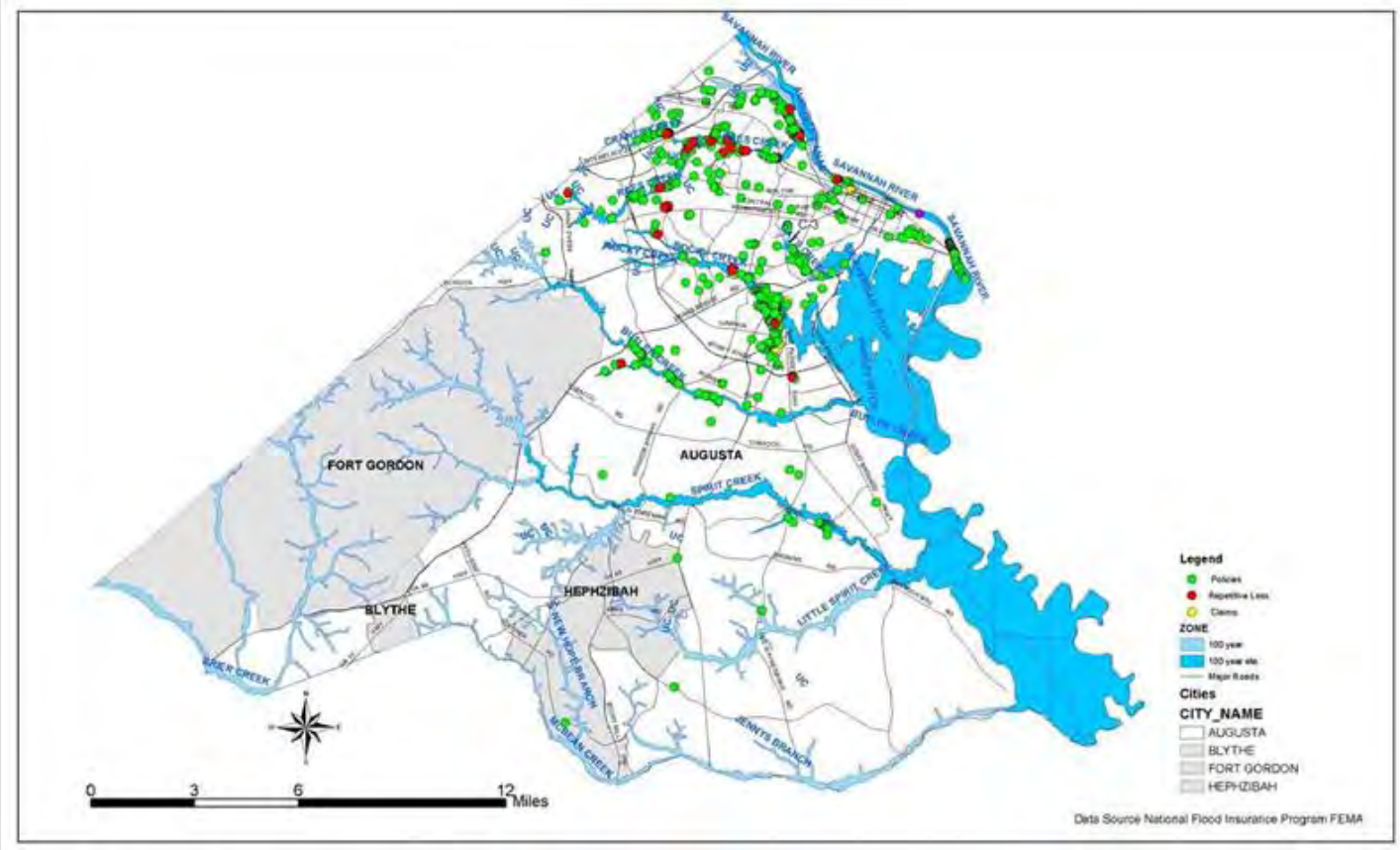
- Rock Creek – 200-400 feet wide (restudied by the Corps of Engineers);
- Rae's Creek – 200-500 feet wide (restudied by the Corps of Engineers; City flood control project);
- Crane Creek, a major tributary to Rae's Creek – 100-300 feet wide;
- Oates Creek – highly modified, 100-500 feet wide, with a number of ponding areas;
- Upper and Lower Rocky Creek – 100-200 feet wide and 500-2,000 feet wide, respectively (restudied by the Corps of Engineers); and
- Butler Creek – 500-700 feet wide.

The Augusta Canal is a source of the City's potable water. It also is the 'collector' into which the other urban streams drain (except Butler Creek). From the Columbia County boundary, the Canal and its floodplain parallel the Augusta Levee. At its juncture with Rae's Creek, a gate allows flows to discharge to the Savannah River (the mechanical gate is closed if high water is predicted on the River). The Canal is included in waterways that are being restudied by the Corps of Engineers; preliminary maps indicate that areas prone to flooding are more extensive than shown on the FIRM.

The extensive flood-prone areas are found on Augusta's east side are associated with Butler Creek, Rocky Creek, and drainage from all streams in the urban district

(former City). The area, also known as Phinizy Swamp, is generally flat and is predicted to experience relatively shallow flooding. There are few buildings that encroach into the floodplain, although a number of industries were built on fill prior to adoption of the Flood Damage Prevention Ordinance, and there are a number of active clay mining sites.

Figure 2.3: Flood Map of Richmond County Flood Policies



The Rocky Creek watershed was the focus on research conducted by the (former) Public Works and Engineering Department in 1998, as supporting documentation for mitigation grant funds. The estimates in Table 2-2 are based on newspaper accounts, local climatological reports, and personal interviews. It is notable that the U.S. Army Corps of Engineers has independently developed a preliminary estimate of average annual damages in Rocky Creek of $1,450,000 (not including damage to industrial properties).

Rural Watersheds. The southern half of Augusta, below Butler Creek, is rural in character with dispersed development. As shown on Figure 2.3, few flood insurance policies are in-force in this area, primarily because floodplains are relatively narrow and easily avoided. As of the end of 2004, there are no flood insurance policies on buildings in Hephzibah.

Most of the streams shown on the Flood Insurance Rate Maps have been evaluated using approximate methods to delineate the flood hazard area, including: Little Spirit Creek, McBean Creek along the southern border, tributaries to Spirit Creek,

and various other streams. The extent of flood hazard areas is limited (watershed boundaries are shown on Figure 2-4):

- Upper Spirit Creek and Johnson Branch − 200-400 feet wide;
- Lower Spirit Creek − 600-800 feet wide;
- Little Spirit Creek and Boggy Branch − 200-600 feet wide;
- McBean Creek − 500-1,000 feet wide;
- Tributaries to McBean − 100-300 feet wide; and
- Many small streams and tributaries do not have mapped floodplains.

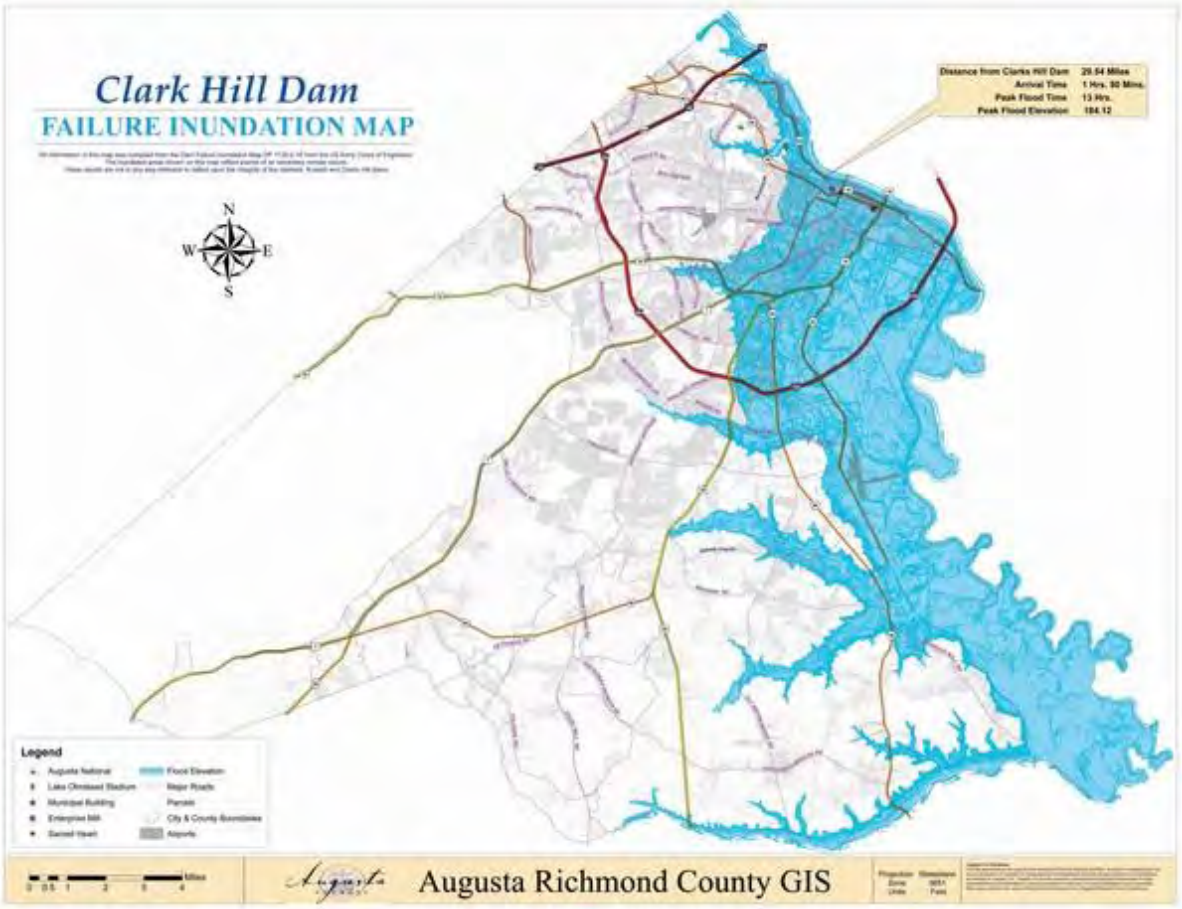
Dams and Flooding. FEMA and the U.S. Army Corps of Engineers maintain the National Inventory of Dams (1998), a database of high and significant hazard dams. For the most part, data is provided by state agencies responsible for regulation and inspection of dams or by the Corps of Engineers. Figure 2-4 is based on that inventory and shows that seven high hazard dams (and 3 significant hazard dams) are located in Augusta and one high hazard dam is located outside the City in the upper portion of Spirit Creek.

High hazard dams are those of specific height or volume of impounded water that, if failure occurred, there would be a high likelihood of loss of life and substantial property damage. Table 2-3 lists information on the high hazard dams. There is no requirement for owners to develop emergency action or maintenance plans, although high hazard dams are required to be brought up to state specifications to protect public safety and property.

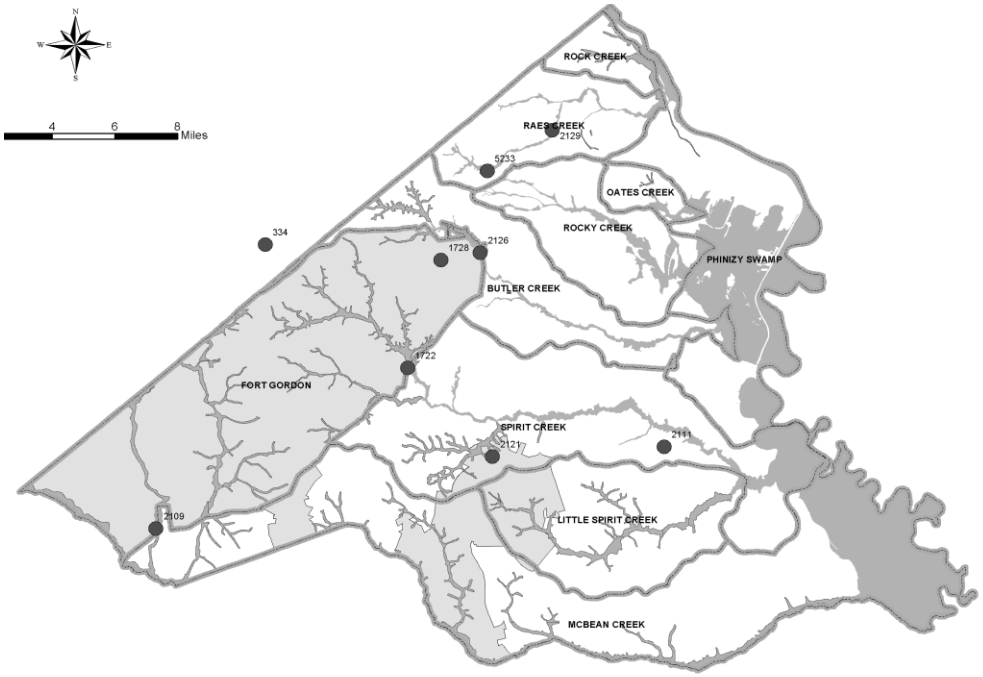
The Augusta Emergency Management Agency reports that the three Savannah River dams are the only high hazard dams for which a response plan and inundation maps are on-file (updated July 1994; DP 1130-2-16). The U.S. Army Corps of Engineers dams, not shown in Figure 2-4, are the Hartwell, Richard B. Russell, and J. Strom Thurmond. The Corps document considered several dam failure scenarios and predicts the arrival times ranging from 4.5 to 13 hours, and peak flood elevations at various locations.

The Corps' Savannah District operates the dams, monitors flood conditions, and notifies emergency management officials in downstream jurisdictions if flooding is predicted. The Augusta Emergency Management Agency has prepared an Emergency Evacuation Plan based on the Corps' report and maintains a response plan for closing the levee openings. Map Series 1 A & B below are inundation and high hazard dam maps produced by the Augusta − Richmond County GIS Department and the National Inventory of Dams, (Source: National Inventory of Dams, 1998).

Map Series 1 – A : Clark Hill Dam Inundation Map



Map Series 1 – B:



In recent years, stormwater detention ponds have failed during storms that produce flooding conditions. For this reason, and because the consequence of a dam or pond failure is downstream flooding, such events are considered under the broader category of flood hazards rather than as a separate hazard. Without the benefit of analyses of failures of the high hazard dams shown on Map Series 1 - B, the impacts associated with such events cannot be estimated.

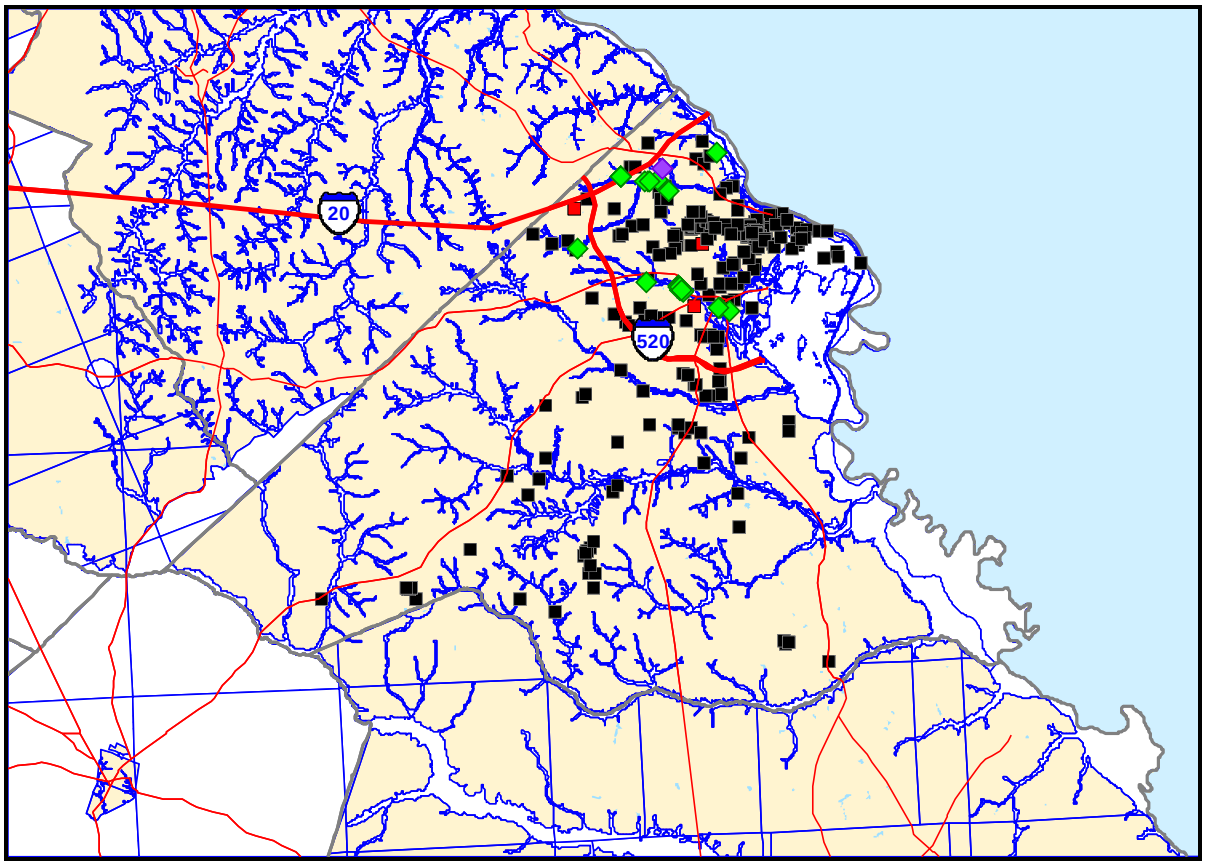
2.2.2 Flooding Events, Frequency & Probability

Thirteen flooding events were reported in the Augusta – Richmond County planning area by NOAA, with $520k in reported damages and FEMA declared two flooding disasters in the area; the first FEMA-DR-1209-GA, occured on 03/11/1998, and the second FEMA-DR-880-GA, occurred on 10/19/1990. Flooding in the Augusta area results both from widespread and prolonged rainfall (e.g., from large systems associated with hurricanes and tropical storms) or locally-intense downpours. Augusta's more significant flooding events since 1990 are listed in Table 2.14. The data indicates that 13 damaging floods occurred in 16 years; thus the frequency of flooding is slightly less than once per year.

Table 2.14 12 FLOOD event(s) Reported - 01/01/1950 and 03/31/2011.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Augusta	10/12/1994	1416	Flood	N/A	0	0	1K	0
2 Augusta	09/24/1995	0630	Flash Flood	N/A	0	0	100K	0
3 124	10/04/1995	0100	Flash Flood	N/A	0	0	0	0
4 Northern Half	03/07/1996	08:25 AM	Flash Flood	N/A	0	0	400K	0
5 Augusta	12/24/1997	02:45 PM	Flash Flood	N/A	0	0	2K	0
6 Augusta	03/08/1998	12:35 PM	Flash Flood	N/A	0	0	0	0
7 Augusta	09/03/1998	03:00 PM	Flash Flood	N/A	0	0	0	0
8 Countywide	06/20/2000	10:14 PM	Flash Flood	N/A	0	0	0	0
9 Countywide	05/30/2002	08:16 PM	Flash Flood	N/A	0	0	0	0
10 Augusta	05/18/2003	06:50 PM	Flash Flood	N/A	0	0	0	0
11 Augusta	08/08/2003	07:20 PM	Flash Flood	N/A	0	0	0	0
12 (ags)bush Fld August	01/25/2010	01:28 AM	Flash Flood	N/A	0	0	20K	0K
(NOAA, National Oceanic and Atmospheric Administration, 2011).				TOTALS:	0	0	523K	0

Map of FLOOD RISK produced in GMIS Graphic 2



Flood Risks – Buildings. Augusta's Information Technology Department coordinates and maintains the Geographic Information System (GIS). The system allows staff in many departments to access numerous digital map products and electronic data files. Among the data and maps is a digital map of the floodplain prepared as an overlay for the property parcel maps (derived from the Flood Insurance Rate Maps). Other GIS layers include county/city boundaries, waterways and watershed boundaries, and ground contours and building footprints from aerial photography data acquired in 2007, parcel boundaries, and National Wetlands Inventory data, from which a wide variety of maps and analyses can be prepared.

There are a numerous methods to characterize buildings and potential development that is subject to flooding:

- Using GIS to compare the flood map with the locations of buildings yields an estimate that 3,755 buildings (greater than 400 square feet in footprint) are located "in" the City's mapped floodplains. It is important to recognize that this number underestimates the total number of buildings that might experience flooding, as evidenced by recent flood damage and the fact that nearly half of the buildings with flood insurance policies are shown to be "out" of the mapped flood hazard area.
- GIS analysis did not identify any buildings located in Hephzibah's mapped floodplain areas.

- U.S. Census data is used to develop a median value for residential buildings ($87,900), yielding estimates of the total value of buildings that plot within the mapped floodplain (Table 2.15). Use of the median value to characterize risk is not intended to imply that every flood-prone building is likely to be a "total loss" due to flooding. It is notable that there are several clusters of non-residential buildings; those higher-values structures are reflected in the table as well.
- Augusta GIS, using the flood hazard overlay to the property parcel data layer, determined that approximately 1,049 undeveloped/vacant parcels of land in Augusta and Hephzibah are wholly or partially affected by mapped floodplains. The development potential is, at least in part, a function of the available land subject to flooding.
- The addresses of buildings that have flood insurance policies and for which flood claims have been filed can be used to identify buildings in mapped floodplains (where lenders require insurance) and where flooding has occurred (where owners are sufficiently concerned that they purchase flood insurance even if not required). This characterization of flood risk is described in the following text.

Manufactured Housing. Manufactured housing units are known to be highly vulnerable to flood damage. The same amount of water inside a site-built home causes considerably less damage (as a percent of total value of the home). One cluster of manufactured homes and three manufactured housing parks are affected by mapped flood hazards and some damage has been reported in the local press:

- Some units along Kissingbower Road and Haynie Drive, north of Cherokee Plaza are in the floodplain fringe of Rocky Creek.
- Durand Trailer Court, south of Gordon Highway on Wylds Road just below the confluence with Tributary No. 7, was affected in June 2000. The City's GIS maps indicate that one parcel of the property is marginally affected, but another parcel has perhaps 10 units shown within the mapped floodplain.
- Gaskins Trailer Park, north of Gordon Highway on private roads (between Sibley Road and Wheeless Road) was flooded by Tributary No. 6 in June 2000. A newspaper account indicated that some units were shifted off their foundations. Because the FEMA mapped floodplain area was artificially terminated in this area, only 6-8 units are in the mapped floodplain. However, it is apparent that many other units are similarly flood-prone.
- Gibbs Park, south of Wrightsboro Road near Maddox Drive, has a portion of the site within the floodplain of Rae's Creek, but the units are shown as outside the flood area.

Historic Resources. The Historic Preservation Commission, assisted by staff of the Augusta-Richmond County Planning Commission, evaluates activities that impact historic properties. There are no known reports of flood damage sustained by designated historic properties. The U.S. Army Corps of Engineers, as part of its flood reduction study, identified a small number of flood-prone historic structures in selected watersheds (other watersheds not examined):

- **Augusta Canal.** In addition to the Canal itself, 13 National Register individually listed buildings, 3 historic districts, and 12 archaeological sites

have been identified. The extent to which specific buildings are at-risk has not been determined.

- **Rae's Creek.** Fruitlands (Augusta National Golf Club) is the only listed property affected; 7 archeological sites have been identified.
- **Rocky Creek.** No nationally listed properties are affected by flooding; 7 archaeological sites may be in the floodplain, primarily where the creek merges with Phinizy Swamp.
- **Phinizy Swamp.** No nationally-listed properties, but there is a recognized high potential for prehistoric and archeological resources in flood-prone areas.

Flood Risks – Public Properties. Using the City's database of 137 buildings and structures owned by the City and the Richmond County Board of Education (and over 500 vacant parcels of land owned by the City), it was determined that nine buildings are located in the floodplain.

The following description of public properties identified as being at some risk of flooding reveals only two facilities were identified as at-risk using GEMA's tool (Fleming Athletic Office and The Boathouse).

Several City-owned buildings are located on the riverside of the Levee. Using only the digital topography available in the GIS and the Base Flood Elevation (100-year), predicted flood depths at these buildings ranges from 3.5-feet to as much as 8-feet. While most of the buildings would be unlikely to sustain major damage at that depth, the actual damage may be more related to velocity (which is not approximated). Contents damage may be more significant in terms of financial impacts on the occupants. Some City-owned buildings are occupied by private entities.

The HMPC requested that certain departments determine if any facilities were in the mapped floodplain (most City offices have access to the Geographic Information System which includes a floodplain layer). This exercise not only identifies vulnerable facilities, but ensures that facility managers are aware that specific buildings are not flood-prone.

Although not part of City government structure, the Richmond County Board of Education and all telephone, electric and gas utility providers were included in the request:

- The Board of Education reported no public schools in the floodplain; one building has experienced drainage problems.
- Georgia Power Company reported that no buildings or electric substations are in the floodplain (other utilities did not respond).

City Buildings. A small number of City buildings and facilities have sustained limited damage due to flooding in the past and, for the most part, are unlikely to experience significant future damage. The following statements of potential flooding are based on the Flood Insurance Rate

Maps and ground elevations interpolated from the City's topographic maps:

- The Traffic Engineering building, located on the river side of the Augusta Levee, may have 3-5 feet of water during the 100-year flood.
- The Augusta Marina Store, also located on the river side of the Augusta Levee, may have 4-5 feet of water during the 100-year flood.

Public & Private Schools. Using data collected for GEMA's critical facilities, a GIS analysis was prepared to determine whether mapped floodplains affect school sites and/or school buildings:

- Nine public schools have at least a portion of the site affected; one building appears to be within the floodplain (Jenkins-White Elementary).
- Nine private schools have at least a portion of the site affected; one building appears to be within the floodplain (C.H. Terrell Academy).

Recreation & Parks Facilities. The Augusta Recreation and Parks Department is responsible for numerous facilities throughout the City: 7 community centers, 15 neighborhood parks, a soccer complex, skate park, BMX track, tennis center, and the municipal golf course. The Department coordinates many programs, including: community athletics, aquatics, boating and fishing, after school, and summer day camps.

The Department uses many factors when selecting sites for new park facilities, primarily population and demand. The presence of mapped floodplain is a factor in site selection, although acceptable if there is sufficient land for the facility. The Diamond Lakes Regional Park, built in
1997, includes wetlands and floodplain areas. The site plan required avoidance of the floodplain and all improvements are on high ground.

With respect to floodplains and flood hazards, the Department reports the following:

- New Savannah Bluff Lock & Dam Park is owned by the Corps of Engineers and leased to the City. The City is responsible for buildings, including maintenance and repair. The entire 50-acre site is flat and has flooded 5-6 times since the initial lease. Damage to grounds includes erosion and debris; costs incurred to clear debris and for stabilization. Due to topography, there is no land outside the flood-prone area. The wood playground equipment is constructed of flood resistant materials.
- City parkland on Lake Olmstead is flood-prone although the buildings are on high ground. Damage due to the flood in 1990 included picnic tables and trails. The Master Plan proposed new playground equipment in the floodplain constructed of flood-resistant materials.
- Julian Smith pavilion, located above the Lake Olmstead floodplain, sustained water damage in 1999; the 2000 flood caused less damage due to the way the water was managed.
- The "Boat House" Community Center is on the bank of the Savannah River. Because the main level of the building is elevated, it is not expected to be flooded during the 100-year event. However, the lower level is more susceptible; it is used for boat storage and a portion is finished space overlooking the river.

- Other parklands are located in flood-prone areas, but have not experienced flood-related damage.

Flood Risks – Utilities. Augusta Utilities is responsible for the City's potable water and wastewater treatment services. The department provides project management, construction inspection and land acquisition services for water and wastewater projects associated with commercial developments, some subdivisions, Georgia DOT projects, and the City's Capital Improvement Program. To facilitate its workload, the department is establishing a computerized maintenance management and work order system for both the wastewater collection system and the water distribution system.

Potable Water Service. The Utility provides potable water to 67,500 customers (including 6,000 commercial/industrial users). The system includes 1,100 miles of water distribution lines. The
Raw Water Pumping Station withdraws water from the Savannah River to provide 75% of the City's potable water. The remaining capacity is provided by the Highland Avenue Surface Water Treatment Plant and three groundwater treatment plants. The New Tobacco Road Surface Water Treatment Plant came online sometime after 2005. The City is phasing out groundwater withdrawal due to available surface water capacity (groundwater sources will be maintained for drought contingency).

Wastewater Service. The Utility provides wastewater collection and treatment services for 40,000 customers. The system includes 650 miles of wastewater collection lines; many more miles of private lines feed the system. Treatment is provided at the Spirit Creek Plant and the J.B. Messerly Plant where constructed wetlands at the Phinizy Swamp Nature Park provide effluent treatment prior to discharge to Butler Creek.

Using the City's GIS, the Augusta Utilities Department compared the physical location of its assets with the floodplain map and determined the following:

- Wastewater treatment plants: the City's two plants, JB Messerly and Spirit Creek, are not within the floodplain.
- Sewage lift stations: the department is acquiring the GPS locations of the City's 24 lift stations. At this time the specific location within mapped floodplains is undetermined; however there is no record of flood damage or outages associated with flooding.
- Sewer manholes: 1,265 manholes plot within the mapped floodplain, an expected outcome given that many sewer lines follow waterways to take advantage of gravity flow.
- Water wells: of the 24 wells, three are located close to areas delineated as approximate floodplain (along Boggy Branch, a tributary to Little Spirit Creek).
- Water storage tanks: by the nature of their function, water tanks typically are located on high ground; the City's 12 ground level and 13 elevated water tanks are not located within the floodplain.

With respect to flooding and flood impacts, Augusta Utilities reports the following:

- The Department is responsible for operation and maintenance of the control gates for the Augusta Canal and the Augusta/Savannah River Levee.
- The preferred construction method for water and sewer lines that run under creeks is jack and bore; there are some aerial crossings mounted on bridges.
- Wastewater treatment flow volumes (and consequently treatment costs) increase during storms and flooding due to infiltration through joints in the collectors and inflow through manholes.
- It is estimated that 70% of the problem is on private property and illegal connections of roof drains. Private property owners are responsible for installing sewer lines from buildings to the right-of-way.
- Through the waste distribution system backflow prevention program the department enforces current requirements for new construction.
- The department addresses backflow problems by educating the public and by planning installations for residential customers and any non-residential customers that are to install backflow devices.
- In 2004, three wet-weather overflows released a total of approximately 43,500 gallons; despite more rainfall events in 2005, only one wet-weather overflow released 15,000 gallons.

Flood Risks – Roads. With respect to roads and flood risks there are two important aspects to consider:

- Nationwide, flooded roads pose the greatest threat to people during floods − most of the more than 200 people who die in floods each year are lost when they try to drive across flooded roads.
- Flood-damaged roads require expenditures of local, state and federal funds for repair and replacement, and traffic flow can be disrupted during the time required to design and construct new crossings. Based on the roads data contained in Augusta's GIS combined with the floodplain map layer indicates that there is a total of 1,391 miles of road in Augusta: Interstate highways (43 mi), state roads (85 mi), major county roads (196 mi), and other roads (1,067 mi). With 206 miles falling within mapped flood hazard areas, approximately 15% of all roads in the City are subject to some degree of flooding. This statement is not intended to imply that such flood-prone roads are likely to be damaged or pose significant risk to the public. The City does not have a definitive list of list of the more susceptible flood-prone roads.
- The City owns and maintains the majority of road miles within its bounds. Factors that are considered for upgrading roads include safety, traffic loads and capacity. While drainage is rarely a primary factor that prompts an upgrade, drainage improvements often are included in designs. State aid supports some road improvement projects, which may include drainage improvements; this aid is sought on a project-by-project basis.

Various flood events have damaged roads throughout the City, primarily causing erosion. The most significant recent damage includes:

- Willis Foreman Road on Spirit Creek washed out in June 1998;

- One lane of Frontage Road near Bobby Jones Expressway washed out in June 1998; and
- Barton Chapel Road at Glen Hills Road, damaged by Rocky Creek in July 1998.

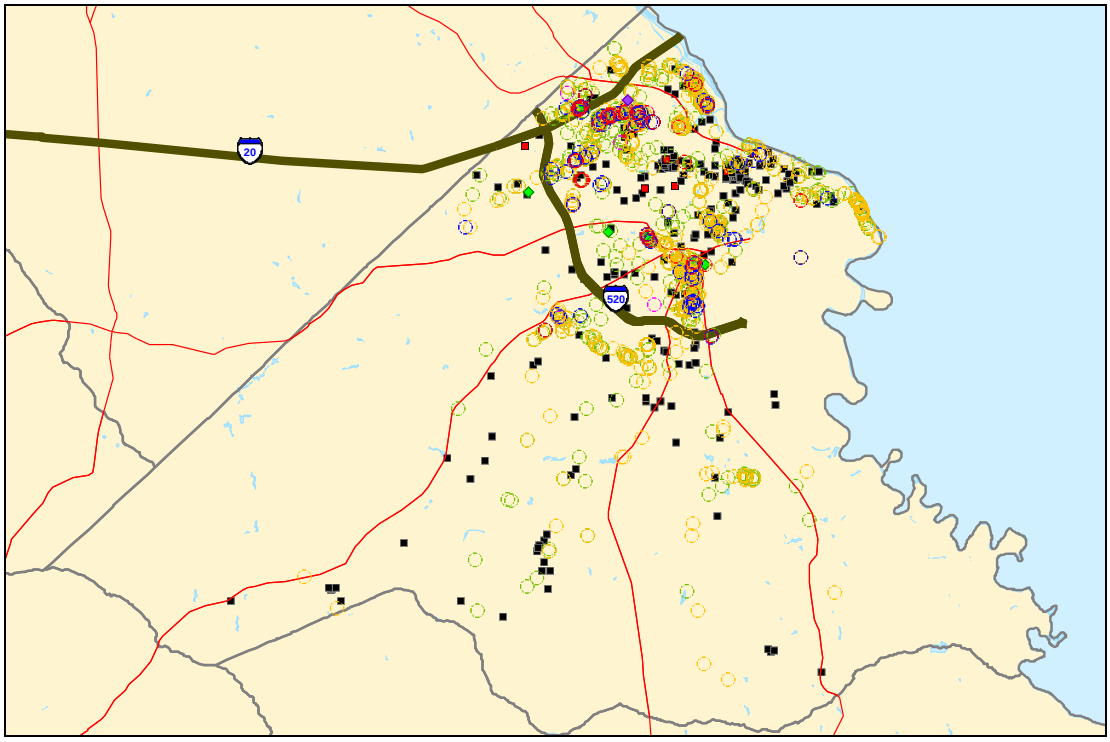
The City considers floodplain and floodway impacts in its planning and design for City roads. Developers must satisfy the City's drainage criteria and other aspects of road designs in order for the City to accept ownership.

When weather conditions suggest that road flooding is likely, the Augusta Emergency Management Agency and other City personnel monitor access routes that are prone to ponding and flooding and that are critical for fire and emergency medical response requirements, such as Walton Way at 13th and 15th Streets.

NFIP Flood Insurance Policies in Richmond County Planning Area

NFIP Flood Insurance Policy information obtained from FEMA Region IV, reveals the number of polices is 3055, with insurance coverage on structures at _____ million and contents coverage at _____ million as reflected in the GMIS Graphic 4 below.

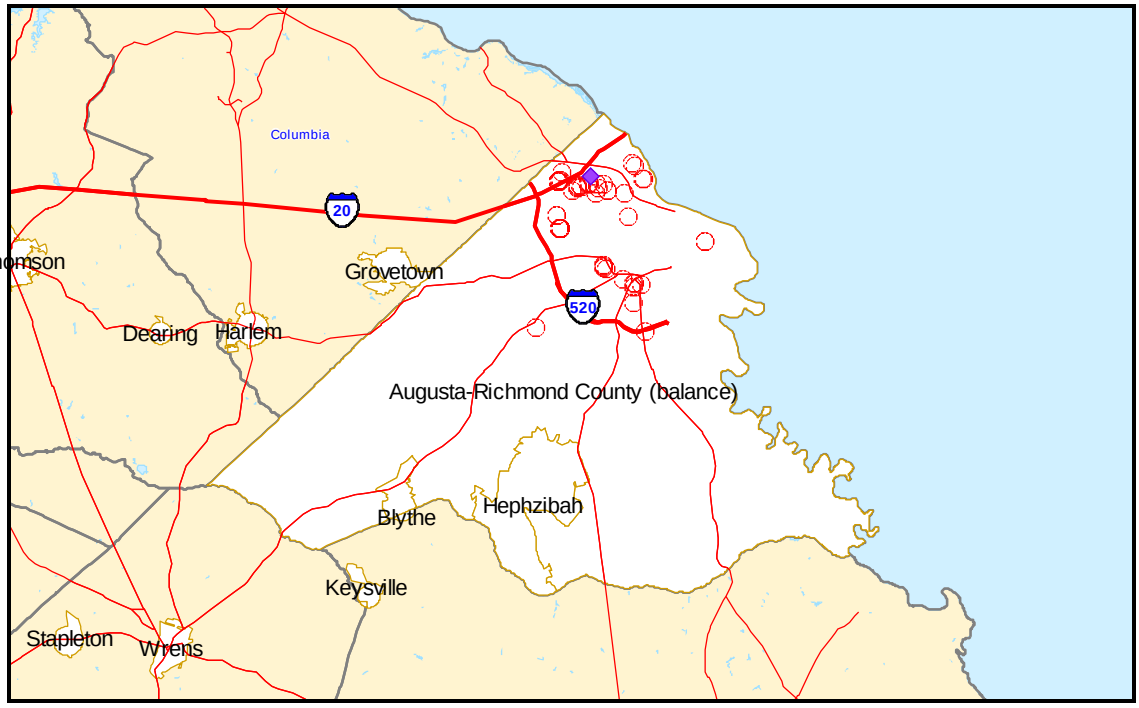
Graphic 4



NFIP Repetitive Loss Information

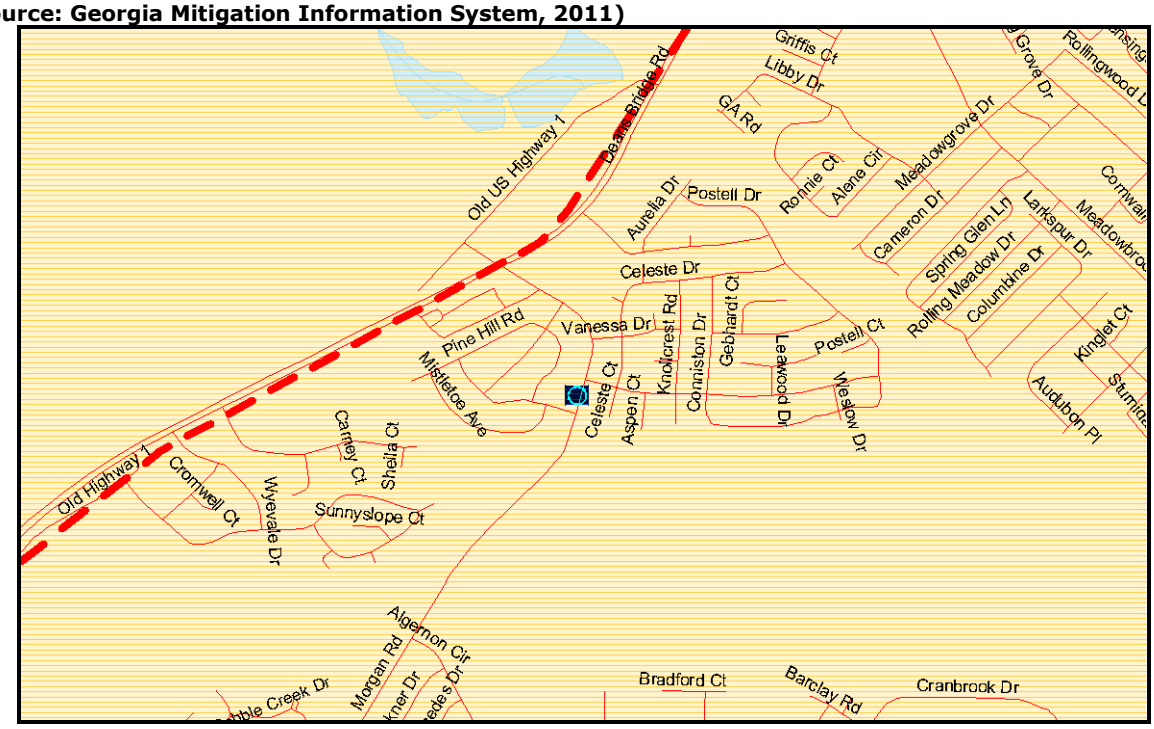
Picture 1 below illustrates repetitive loss locations from the Georgia Mitigation Information System (GMIS) Mapping Platform reflecting 52 NFIP repetitive loss properties in Augusta – Richmond County with a total claims paid figure of $1,981,854.51.

Picture 1: Augusta – Richmond County Repetitive Loss Locations (Georgia Mitigation Information System, 2011)



Picture 2 below illustrates repetitive loss locations from the Georgia Mitigation Information System (GMIS) Mapping Platform reflecting 1 NFIP repetitive loss property in Hephzibah.

Picture 2: Hephzibah Repetitive Loss Locations
(Source: Georgia Mitigation Information System, 2011)



2.2.3 Inventory of Assets Exposed to Flooding

GMIS reports the assets exposed to flooding are:

1. Augusta – Richmond County
    a. 18,827,251 sq. ft. of Building; and 61,869 persons affected.
2. Blythe
    a. 57,729 sq. ft. of Building space; and 430 persons affected.
3. Hephzibah
    a. 338,139 sq. ft. of Building space; and 3,097 persons affected.

The geographical size of the region is 324 square miles and contains 3,367 census blocks. The region contains over 74 thousand households and has a total population of 199,775 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B of the HAZUS report. Assets exposed to flooding in the Augusta – Richmond County planning area are reported below from HAZUS® - MH. The data includes residential, commercial, industrial, and critical facility information (FEMA, 2011).

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

The flood loss estimates provided for the report (See Appendix A: HAZUS Reports) are based on a region that included Augusta – Richmond County, Ga. HAZUS estimates that there are 77,917 buildings in the region with an aggregate total replacement value of $12,743 million (2006 dollars). Table 2.16 and Table 2.17 present the relative distribution of values with respect to the general occupancies by Study Region and Scenario respectively. The data reveals residential buildings experience the highest exposure to the flood hazard at 70.4%; commercial buildings at 21.2%, industrial at 3.9%, religious buildings, education buildings, government buildings, and agricultural buildings at 0.2%.

Table 2.16: Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	8,967,798	70.4%
Commercial	2,707,355	21.2%
Industrial	495,189	3.9%
Religious	312,465	2.5%
Education	137,831	1.1%
Government	96,570	0.8%
Agricultural	26,011	0.2%
Total	**12,743,219**	**100.00%**

General Building Stock Damage

HAZUS estimates that about 857 buildings will be at least moderately damaged. This is over 32% of the total number of buildings in the scenario. There are an estimated 104 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS Flood technical manual. Table 2.17 below summarizes the expected damage by general occupancy for the buildings in the region. Table 2.18 summarizes the expected damage by general building type.

Table 2.17: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	3	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	39	4.58	320	37.56	125	14.67	264	30.99	104	12.21
Total	**0**		**44**		**320**		**125**		**264**		**104**	

Table 2.18: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	64	100.00
Masonry	0	0.00	2	11.11	5	27.78	2	11.11	9	50.00	0	0.00
Steel	0	0.00	4	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	34	4.43	315	41.07	123	16.04	255	33.25	40	5.22

Essential Facilities

There are 8 hospitals in the region with a total bed capacity of 2,353 beds. There are 75 schools, 2 fire stations, 4 police stations and no emergency operation centers. Table 2.19 below reveals two of the seventy-five schools in the hazard exposure area will experience moderate damage and loss of use.

Table 2.19: Essential Facility Damage

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

Table 2.19: Expected Damage to Essential Facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	2	0	0	0
Hospitals	8	0	0	0
Police Stations	4	0	0	0
Schools	75	3	0	2

Social Impact - Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,224 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 5,339 people (of a total population of 199,775) will seek temporary shelter in public shelters.

2.2.4 Estimation of Losses Due to Flooding

The total economic loss estimated by HAZUS for the flood is 245 million dollars, which represents 8.63 % of the total replacement value of the scenario buildings.

Building-Related Losses

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

The total building-related losses were 243.53 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 47.94% of the total loss. Table 2.20 below provides a summary of the losses associated with the building damage.

Table 2.20: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	68.48	17.56	10.77	1.70	98.51
	Content	48.68	46.45	31.20	8.89	135.23
	Inventory	0.00	2.05	7.68	0.07	9.80
	Subtotal	**117.16**	**66.07**	**49.65**	**10.66**	**243.53**
Business Interruption						
	Income	0.02	0.26	0.01	0.03	0.31
	Relocation	0.18	0.07	0.01	0.00	0.27
	Rental Income	0.06	0.05	0.00	0.00	0.11
	Wage	0.05	0.32	0.02	0.40	0.78
	Subtotal	**0.31**	**0.69**	**0.04**	**0.43**	**1.47**
ALL	**Total**	**117.47**	**66.76**	**49.69**	**11.09**	**245.00**

2.2.5 Land Use and Development Trends related to Flooding

In areas where most of the development is occurring and is projected to occur, current floodplain management requirements are deemed adequate to prevent placing new buildings and infrastructure in flood hazard areas. Infrastructure that may not be able to avoid floodplains, such as roads and bridges and water and sewer lines, is required to be designed and constructed to minimize the potential for flood damage.

Redevelopment in the older areas is subject to floodplain management requirements. New buildings built on the site of demolished buildings are treated as new construction and must meet all code requirements. Additions to and renovation of older buildings that are located in mapped flood hazard areas are subject to compliance with requirements of the Flood Ordinance.

2.2.6 Multi-jurisdictional Differences related to Flooding

The City of Blythe does not have mapped flood hazard areas; poor drainage results in standing water in low areas. The City of Hephzibah has mapped flood hazard areas prepared by FEMA, dated 07/18/11; the map illustrates that the city is 'minimally flood prone' and flood hazard areas do not have flood elevations determined using engineering methods. However, the GIS analysis indicates that no buildings are located in the mapped floodplain; 120 parcels of land are wholly or partially affected by mapped floodplain

2.2.7 Flooding – Hail HRV Summary

Digital maps of the floodplain are used for flood hazard identification and assessments of risk. The data, combined with the building footprints and other infrastructure asset information, allow estimations of what is 'at risk' only by identifying whether such assets are 'in' or 'out' of the mapped flood hazard area. No

other characterization of flood risk can be made, i.e., depth of flooding or whether houses are in the floodway or the flood fringe.

Frequent damaging flooding events and the number of at-risk buildings, the relative risk ranking of flood hazards was determined to be "high" (see Table 2.5 for a summary of relative risks). An overall summary of vulnerability to flood hazards is difficult to frame briefly. The following information provides a succinct synopsis of community vulnerability to flooding:

- 25% of the total land area is mapped as flood hazard area.
- More than 3,700 buildings are in mapped flood hazard areas.
- Potential for new development in flood hazard areas is characterized by 929 vacant parcels in Augusta's floodplains and 120 vacant parcels in Hephzibah's floodplains.
- Four manufactured housing parks are shown as partially affected by flooding.
- A small number of individually listed historic structures appear to be subject to flooding.
- Nine public buildings have some exposure to flooding.
- Two schools (one public, one private) may have some flood risk, expected to affect the sites.
- Infiltration due to saturated ground into the wastewater collection system increases the costs of treatment.
- Flood-prone roads are identified by citizen reports, press reports, and examination of flood hazard mapping.
- Stormwater management ponds have failed during intense rainfall events, contributing to downstream flooding.

2.3 Natural Hazard C: Drought – Extreme Heat

Drought is a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area. Severe drought conditions can profoundly impact agriculture, water resources, tourism, ecosystems, and human welfare. According to NOAA, the economic impact of drought in the United States has been estimated to be $6-8 billion annually (FEMA, 1995). Drought may become a more common issue in the future, as suggested by NOAA climate data, showing increased warm U.S. and global temperatures since the mid-1990s. Climate models have also suggested that the likelihood of heat waves could increase in intensity and frequency over several decades, strengthening the environmental conditions for drought and wild fire events, (NOAA, National Oceanic and Atmospheric Administration, 2011).

2.3.1 Drought Identity

Drought is a complex physical and social process of widespread significance, although rarely does a single period of drought affect an entire state. The most commonly used definitions of drought are based on meteorological, agricultural, hydrological and socioeconomic effects:

- **Meteorological** drought is defined by a period of substantially diminished precipitation

duration and/or intensity. This definition is usually expressed as an interval of time, generally on the order of months or years, during which the actual moisture supply at a given place consistently falls below the climatically appropriate (or normal) moisture supply.

- **Agricultural** drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought usually occurs after or during meteorological drought, but before hydrological drought, and can also affect livestock and other dry-land agricultural operations.
- **Hydrological** drought refers to deficiencies in surface and subsurface water supplies. It is measured in terms of stream flow and as lake, reservoir and groundwater levels. There is usually a delay between lack of rain and resultant reduction in measurable water instreams, lakes and reservoirs. Therefore, hydrological measurements tend to lag other drought indicators.
- **Socio-economic** drought occurs when physical water shortages start to affect the health, well-being, and quality of life of residents, or when restricted water supplies affect the supply and demand of an economic product.

2.3.2 Drought – Extreme Heat Events, Frequency & Probability

Temperature extremes are the highest and lowest values of temperature attained for a given time, date and location. Extreme temperatures bring about uncommon risks for routine daily activities (e.g. recreation) and also cause hardship for certain industries (e.g. energy, transportation, agriculture, healthcare, tourism). This was evident during the summer 1988 drought and heat wave across the central and eastern U.S., which killed over 5,000 people from direct (i.e. heatstroke) and indirect (i.e. increased heat attacks) causes while also costing U.S. agriculture $71.2 billion in lost productivity (Lott et al., 2008).

When extreme temperatures are forecast to occur - government officials and emergency managers coordinate efforts to allocate proper resources and warn about the dangers of over exposure. A fine example of this is the Philadelphia Heat Health Watch/Warning System. A report by Ebi et al., 2004 found that from 1995 to 1998 this advanced warning system - in coordination with weather forecasts and climate data - saved 117 lives, with benefits of the system estimated at $468 million. Individuals living in cities have an elevated risk of death when temperature and humidity are high compared to those living in suburban or rural areas. Heat stroke mortality is highest for the poor and elderly who live in the inner cities, as they may lack the proper resources and information to protect themselves against sudden heat waves. This underscores the need of local governments and media to help communicate important weather information and any community assistance/air conditioned shelter available to those who need it (NOAA, NOAA Economics, 2011). Below are major Drought – Extreme events as reported by NOAA.

1. Widespread Drought Entire year, 2008. Severe drought and heat caused agricultural losses in areas of the south and west. Record low lake levels also

occurred in areas of the southeast. Includes states of CA, TX, NC, SC, GA, and TN. Estimate of over $2.0 billion in damages/costs (Lott et al., 2010).

2. During 2005, there were 5,301 hospital discharges related to excessive heat. Of those treated, 27% were between the ages of 65-84, 45% receiving Medicaid/Medicare and 34% classified as low income (DHHS, 2007).
3. During 2005, there were 3,405 hospital discharges related to excessive cold. Of those treated, 24% were between the ages of 65-84, 61% received Medicaid/Medicare and 33% classified as low income (DHHS, 2007).
4. During 2005, the average length of stay (days) to treat hospital stays related excessive heat and cold was 3.5 (days) and the average mean charges to treat excessive heat and cold (dollars) was $16,741. The national hospital bill to treat excessive heat and cold totaled $1,492,981,042 (DHHS, 2007).
5. Great Plains and Eastern Drought, Entire year 2007. Severe drought with periods of extreme heat over most of the southeast and portions of the Great Plains, Ohio Valley, and Great Lakes area, resulting in major reductions in crop yields, along with very low stream-flows and lake levels. Includes states of ND, SD, NE, KS, OK, TX, MN, WI, IA, MO, AR, LA, MS, AL, GA, NC, SC, FL, TN, VA, WV, KY, IN, IL, OH, MI, PA, NY. Preliminary estimate of well over $5.0 billion in damage/costs; some deaths reported due to heat but not beyond typical annual averages (Lott et al., 2010).

Information on local drought status at any given time can be viewed online at http://www.griffin.peachnet.edu/caes/drought/. Regional droughts appear to occur, on average, every ten years. Table 2.21 below reflects the annual drought events from the period of 2000 -2010 and contains summary data for fatalities, injuries, property damage, crop damage, and damage totals. Notable drought events in 2006 and 2007 resulted in 411 deaths, 3,399 injuries, and 541.97 million dollars in property and crop damages (damages year 2006 only).

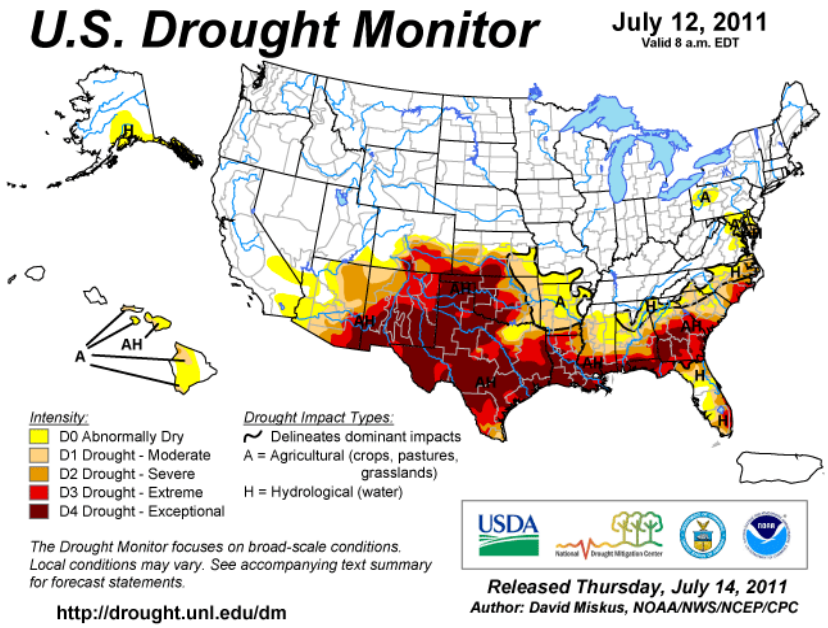
Table 2.21: Annual U.S. Drought Summary 2000 - 2010

Year	Fatalities	Injuries	Property Damage (million $)	Crop Damage (million $)	Total Damage (million $)
2000	158	469	0.00	0.00	0.00
2001	166	445	0.00	0.00	0.00
2002	167	378	0.00	0.00	0.00
2003	36	174	0.00	0.00	0.00
2004	6	74	0.00	0.00	0.00
2005	158	298	3.39	0.00	3.39
2006	253	1,513	0.22	541.75	541.97
2007	105	1,886	0.00	0.00	0.00
2008	71	217	0.05	0.52	0.57
2009	45	204	4.18	0.00	4.18
2010	138	592	3.93	0.38	4.31

(NOAA, NOAA Economics, 2011)

Planning and response coordination related to drought events is difficult because incidents are problematic to monitor. The nonlinear impacts of drought on ecological systems create lag effects in severity. NOAA is leading an initiative to develop the National Integrated Drought Information System (NIDIS) Portal, to improve drought-related information across the United States (NOAA, NOAA Economics, 2011). The Illustration 1 below reflects the national drought monitor information compiled by USDA for 12 July, 2011.

Illustration 1



During the period of 1999 to 2009, Georgia experienced severe drought conditions statewide resulting in water shortages, crop failure, and increased costs associated with water supply infrastructure. Notable drought events in Georgia are reflected in Table 2.22 below.

Table 2.22: Notable Drought Events in Georgia

Year	Area Affected	Remarks
1903-05	Statewide	Severe
1924-27	North Central Georgia	One of most severe of century
1930-35	Mostly Statewide	Affected most of US
1938-44	Statewide	Regional drought
1950-57	Statewide	Regional drought
1968-71	Southern and Central Georgia	Variable severity
1985-90	North and Central	Regional drought
1999-2009	Statewide	Severe
Source: USGS, GA State Climatologist		

Droughts result from prolonged periods of dry weather accompanied by extreme heat and usually occur during the summer months (July and August) in the Augusta area when high pressure systems settle over the area and dry prevailing winds come from the west and southwest. The area is subject to periodic droughts that may impact the ability of the cities to meet all water needs. In Appendix C: Community Profile, Figure A-1 illustrates the community land use map and Table A-2 indicates that about 5% of Augusta is in agricultural use.

A significant drought affected counties in the area in 1986, contributing to three deaths and over $300,000 in crop damage. The long heat spell and drought that affected the area in July 1992 saw record temperatures: 47 of 61 days reached 95° or higher, including 21 days with 100° or higher. In Georgia alone, crop losses exceeded $500 million. The drought during the summer of 1998 saw reduction in the normal flows of the Savannah River, the area's primary source of raw water. Lowered levels affected tourism and river usage, prompting more river accidents (groundings and impacts with exposed snags). The State was concerned with water quality due to higher concentrations of effluent from plants and factories that withdraw water and return it to the river.

2.3.3 Inventory of Assets Exposed to Drought – Extreme Heat

The entire planning area is expected to experience drought conditions without variations. Physical damage to buildings is not associated with droughts. Exterior plantings that depend on periodic watering are at risk and such watering is restricted in the early phases of water conservation. Crop loss for agricultural operations and forestry operations are at risk as well.

Augusta Utilities has sufficient capacity to provide water to the current service area with two surface water treatment plants (groundwater wells are being phased to backup status for extreme drought events) and a new plant came online in 2005.

Other assets exposed drought or extreme heat are less concrete. EMA response to incidents of heat stroke or exhaustion, heat shelter opening and monitoring, and fires may place significant strain on emergency personnel and community facilities.

2.3.4 Estimation of Losses Due to Drought – Extreme Heat

The License & Inspections Department reported that during prolonged dry periods some older homes have experienced settling due to the falling water table which leads to local consolidation and compaction of soils. Individual homeowners employed engineers to determine appropriate solutions that usually include reconstruction of foundations. Only about 20 homes have experienced this problem in the past decade. Prolonged drought conditions can increase the risk of wildfires (see Section 2.5).

Commercial losses for landscape businesses, farmers, outdoor event promoters and tourism destinations are frequently associated with extreme heat events.
GMIS reports the assets exposed to wildfire are:

2.3.5 Land Use and Development Trends related to Drought – Extreme Heat

Availability of water through the existing distribution system is a factor that influences new land development activities. Augusta Utilities constructed a new water plant to serve the southern part of the City; the Savannah River will be the water source. This stimulated additional development. In areas not served by Augusta Utilities, lot sizes are larger to accommodate onsite septic systems; lot sizes may range from 0.86 to 3.3 acres depending on soil types and topography. Blythe reports that 1 acre lot sizes are required in areas on well and septic.

Recent drought events in Georgia resulted in water use restrictions, public outreach campaigns to promote water conservations and increased costs to produce potable water.

2.3.6 Multi-jurisdictional Differences related to Drought – Extreme Heat

In terms of landscape impacts due to drought, there are no notable jurisdictional differences – the planning area is uniformly affected. However:

- The City of Blythe provides water to its residents, relying on two wells. As of 2004, Blythe's system is interconnected with Augusta Utilities for contingency service.
- The City of Hephzibah operates its own water pumping, treatment and distribution system, obtaining all of its water supply from groundwater sources. Three elevated tanks have a combined capacity of 285,000 gallons. The City worked with Augusta Utilities and can connect to the regional water supply in emergencies; in a recent drought Hephzibah supplied South Richmond County with approximately 1 million gallons per day.
- Augusta – Richmond County operates Shelter in Place programs for extreme heat events.

2.3.7 Drought – Extreme Heat HRV Summary

Sustained drought conditions adversely affect agricultural and forestry interests, lead to loss of horticultural and decorative plantings, and contribute to increased risk of wildfires. An overall summary of vulnerability to drought is relatively straightforward because drought is assumed to uniformly affect the area and because most of the planning area is served by public water delivered by Augusta Utilities. The relative risk ranking of droughts was determined to be "moderate" (see Table 2.5 for a summary of relative risks).

2.4: Natural Hazard D – Winter Storms

Heavy snowfall and severe icing events are anticipated by emergency planners across the United States during the winter season. However, these events can cause considerable disruptions to society, as they distress transportation systems, utilities infrastructure, and general commerce. A large snowfall or icing event can cause billions of dollars, in lost business productivity and retail sales revenue, as

workers and consumers are forced to stay home. Travel by road, rail, and air often becomes much slower and dangerous, particularly in regions that do not commonly deal with extreme winter weather. To help quantify the socioeconomic impact of snowstorm events, NOAA has developed the Northeast Snowfall Impact Scale (NESIS). This scale uses an algorithm to characterize and rank the severity of Northeastern U.S. snowstorms based on snowfall depth, snowfall area and the mean population affected.

Airports heavily rely on information from NOAA for improved decision making regarding air travel safety. A report by (Adams et al., 2004) indicates that the potential benefits from better forecasting of snow and icing diagnostics at U.S. airports, exceeds $600 million/year. Another report (NOAA, 2002) has shown that an enhanced satellite imager and sounder will improve max and min temperature predictions $504 million/year, as derived from load forecasting efficiency for electric utility providers in the US electric, gas, and sanitary services.

Improved max and min temperature predictions would also enhance the accuracy of winter weather-type forecasting (e.g. snow, ice, freezing rain), which would offer additional economic benefits for transportation, engineering, and agriculture.

NOAA historic snowfall data and weekly snow depth maps represent sources of winter snowfall data that is collected via NOAA's climate observing systems. The NOAA-sponsored National Snow and Ice Data Center (NSIDC) is also a central resource for a variety of the datasets and models pertaining to snow, ice, glaciers, and the implications of climate change to the Earth's cryosphere. These data are important for additional scientific research, government policy decision-makers, and emergency managers. This near-real time information provides invaluable benefits for public safety and well-being, as it allows individuals to make wise decisions to care for themselves, family, and property during extreme winter events (NOAA, NOAA Economics, 2011).

2.4.1 Winter Storm Identity

Severe winter storms bring the threat of freezing rain, ice and snow accumulation. Heavy accumulations of ice, especially when accompanied by high winds, can result in extensive damage to trees and above-ground electric transmission lines. The most significant and widespread effects are due to ice and snow covered roads which pose hazardous conditions for traffic and can complicate response and recovery efforts.

Building damage may result if snow loads become significant. Severe winter storms could result in the loss of utilities, expected increase in traffic accidents impassable roads, debris clean-up from downed trees and limbs, and short-term lost income and productivity if normal commuting is hindered. Critical facilities are exposed to the effects of severe winter storms, but vulnerability is a function of the potential disruption of services (primarily electricity) and transportation systems.

Winter storms can vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms and blowing and drifting snow conditions.

Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death. A variety of phenomena and conditions occur during winter storms. The National Weather Service uses the following terminology:

- Heavy snowfall - the accumulation of six or more inches of snow in a 12-hour period or eight or more inches in a 24-hour period.
- Blizzard - the occurrence of sustained wind speeds in excess of 35 miles per hour accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- Ice storm - an occurrence where rain falls from warmer upper layers of the atmosphere to the colder ground, freezing upon contact with the ground and exposed objects near the ground.
- Freezing drizzle/freezing rain - the effect of drizzle or rain freezing upon impact on objects that have a temperature of 32° Fahrenheit or below.
- Sleet - solid grains or pellets of ice formed by the freezing of raindrops or the refreezing of largely melted snowflakes; this ice does not cling to surfaces.
- Wind chill - an apparent temperature that describes the combined effect of wind and low air temperatures on exposed skin.

NOAA Economics reports the following information related to Winter Storms in the U.S.:

- Research by (Adams et al., 2004) report that the annual economic costs of snowfall in the U.S. include:
    1. Road closures, which results in lost retail trade, wages, and tax revenue (exceeds **$10 billion/day** for closures in eastern U.S.);
    2. Snow removal (exceeds **$2 billion/year**);

    - Flight delays (**$3.2 billion** annually for U.S. carriers)
    - Damage to utilities infrastructure (up to **$2 billion** per storm event);
    - Flooding from snowmelt (**$4.3 billion** for 1997 floods)
    - Costs to agriculture and timber from frost and ice (as much as **$1.6 billion** per ice storm)
    - Each year, **$6 billion** is lost in economic efficiencies, as a result of air traffic delays, of which 70 percent **($4.2 billion)** is attributed to weather (Air Transport Association, 2002), Source: (NOAA, NOAA Economics, 2011).

Table 2.23 below reveals the deaths, injuries, property, and crop damage in the U.S. during the period of 2000 to 2010. The highest incidence of deaths was reported in the year 2009 while the highest reported property and crops damages were reported in the year 2000.

Table 2.23: Table Annual U.S. Winter Storm Summary *Normalized to 2010 Dollars using Bureau of Labor Statistics Consumer Price Index [CPI]*					
Year	**Fatalities**	**Injuries**	**Property Damage (million $)**	**Crop Damage (million $)**	**Total Damage (million $)**
2000	41	182	1314.83	0.00	1314.83
2001	18	173	129.50	0.13	129.63
2002	17	105	940.00	0.00	940.00
2003	28	112	599.28	10.32	609.60
2004	28	190	214.70	0.23	214.93
2005	34	72	331.99	0.11	332.10
2006	17	109	628.10	0.00	628.10
2007	9	159	108.07	0.25	108.32
2008	21	121	969.17	20.49	989.66
2009	21	394	349.75	0.52	350.27
2010	20	33	333.31	15.00	348.31
(NOAA, NOAA Economics, 2011)					

Additional information supplied by NOAA give a regional and state context to Winter Storm hazard effects on the southeast region of the U.S. and the state of Georgia:

- Weather-related crashes cost an average of **$42 billion** annually in the United States from personal injury, loss of life, and property damage (Lombardo 2000).
- Spring Freeze, April 2007. Widespread severe freeze over much of the east and midwest (AL, AR, GA, IL, IN, IA, KS, KY, MS, MO, NE, NC, OH, OK, SC, TN, VA, WV), causing significant losses in fruit crops, field crops (especially wheat), and the ornamental industry. Temperatures in the teens to 20's accompanied by rather high winds nullified typical crop-protection systems. Over **$2.0 billion in damage/costs**; no deaths reported (Lott et al., 2010).
- Southeast Ice Storm, February 1994. Intense ice storm with extensive damage in portions of TX, OK, AR, LA, MS, AL, TN, GA, SC, NC, and VA; approximately **$3.0 (4.2)* billion in damage/costs**; **9 deaths** (Lott et al., 2010).
- Storm/Blizzard, March 1993. "Storm of the Century" hits entire eastern seaboard with tornadoes (FL), high winds, and heavy snows (2-4 feet); **$5.0-$6.0 (7.2-8.6)* billion in damage/costs**; approximately **270 deaths** (Lott et al., 2010), Source: (NOAA, NOAA Economics, 2011).

Table 2.24 below reveals the deaths, injuries, property, and crop damage from ice storms during the period of 2000 to 2010.

Table 2.24: Annual U.S. Ice Summary
Normalized to 2010 Dollars using Bureau of Labor Statistics [BLS] Consumer Price Index [CPI]

Year	Fatalities	Injuries	Property Damage (million $)	Crop Damage (million $)	Total Damage (million $)
2000	0	0	0.38	0.00	0.38
2001	0	0	0.50	0.00	0.50
2002	0	0	0.13	0.00	0.13
2003	0	0	0.00	0.00	0.00
2004	0	0	0.00	0.00	0.00
2005	0	0	0.00	0.00	0.00
2006	0	0	0.00	0.00	0.00
2007	7	11	1476.40	0.00	1476.40
2008	0	0	108.31	0.00	108.31
2009	7	5	1206.09	0.00	1206.09
2010	1	1	29.74	0.00	29.74

(NOAA, NOAA Economics, 2011)

2.4.2: Winter Storm Events, Frequency & Probability

The 2003 International Building Code© includes a map of the United States showing "ground snow loads" associated with the 2%-annual probability of being exceeded (50-year recurrence interval). This information is used in design and construction so that buildings will withstand reasonably anticipated snow loads in order to minimize property damage (Source: ASCE, 07/05). The City falls within the area where the "ground snow load" is five pounds per square foot. In comparison, buildings and roofs in extreme northern Georgia must be designed to resist twice that snow load.

Records maintained by the State Climatologist's office (http://climate.engr.uga.edu) indicate that Augusta is in the region that usually receives less than 3-inches of snow per year. Although six winter storms in Georgia have prompted federal disaster or emergency declarations between 1976 and 2000, none of those events affected Augusta. Online records available from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/climate/severeweather/extremes.html) indicate that six recent winter events affected the Augusta area, although the hardest hit areas were nearby counties.

The January 2002 storm was centered over Lincoln County north of Augusta and the January 2004 ice storm affected the Augusta area but was reported to be most severe in Lincoln, Columbia, and McDuffie counties just north of Augusta. There is no evidence that these storms should be characterized as "severe." The ice storm caused scattered power outages that affected about 100,000 homes for several days.

On 26 December, 2004, an ice storm produced 1/4 to 3/4 inch of ice and sleet taking down trees and power lines. Several power outages were reported along with numerous traffic accidents.

On 29 January, 2005, an ice storm started late Friday night and continued intermittently through Saturday night. Most areas received a quarter of an inch of ice on trees and other structures. Some areas received a quarter to a half an inch of ice. These areas experienced power outages of short duration. Overpasses and bridges iced, but ground temperatures on roadways prevented rain from freezing. There were many accidents due to drivers losing control when driving over the bridges and overpasses.

On 12 February, 2010, Emergency Management reported 2-4 inches of snow across the county. EPISODE NARRATIVE: A low pressure system tracked across Northern Florida which produced heavy snow on the north side of the storm system. Snow fell from the Florida panhandle northeast to Virginia. Amounts in the CSRA ranged from 4-7 inches.

On 10 January, 2011, Augusta Fire Department reported total snow accumulation of 2 to 3 inches in the northern portion of the county with 1 to 2 inches in the southern part. The snow was followed by freezing rain and drizzle with ice accumulations of 1/4 to 1/2 inch. Some power outages were also reported. A low pressure system moved through the Gulf of Mexico and across northern Florida producing snow, sleet and freezing rain across the southeast U.S. Heavy snow fell across the CSRA and lower Midlands of South Carolina with accumulations of 1 to 6 inches. Burke County had mainly sleet and freezing rain with ice accumulations of 1/2 inch. Power outages were reported throughout the area, but it wasn't widespread, (NOAA, National Oceanic and Atmospheric Administration, 2011).

Winter weather affects the Augusta area nearly every year although there is a low probability of winter storms of such magnitude and severity that widespread property damage and power outages will occur. For the state as a whole, it appears that major severe winter storms occur, on average, every three years. For 24 years of record, 12 winter storms have been noted in the historical records suggesting a frequency of 0.5 storms per year.

Table 2.25 below displays Winter Storm events in the planning area from the period of 1950 to 2011. The data reveals there were 4 injuries and no reports of damage during the ten year span.

Table 2.25: 6 SNOW & ICE Event(s) reported in Richmond County 01/01/1950 and 03/31/2011.								
County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**	**CrD**
1 GAZ040 - 063>065	01/02/2002	09:25 PM	Winter Storm	N/A	0	0	0	0
2 GAZ040 - 063>065 - 077	01/26/2004	06:45 AM	Ice Storm	N/A	0	4	0	0
3 GAZ063>065 - 077	12/26/2004	05:00 AM	Ice Storm	N/A	0	0	0	0
4 GAZ040 - 063>065 - 077	01/29/2005	12:28 PM	Ice Storm	N/A	0	0	0	0
5 GAZ040 - 063>065 - 077	02/12/2010	17:00 PM	Winter Storm	N/A	0	0	0K	0K
6 GAZ063 - 065	01/10/2011	04:00 AM	Winter Storm	N/A	0	0	0K	0K
TOTALS:					0	4	0	0

2.4.3 Inventory of Assets Exposed to Winter Storms

All buildings and above ground utilities are exposed to the effects of winter storms. Because most damage is associated ice accumulation that result in falling tree limbs and downed electric lines, it is not feasible to estimate the cost of building damage. The License & Inspection Department reported no building damage due to heavy snow or ice loads. The Fire Department indicates the number of structure fires increases when winter storms cause power outages due to 'creative' ways that people attempt to warm their homes.

Emergency Response equipment and personnel experience increased exposure during Winter Storm events when roads and bridges are more difficult to navigate and access to buildings is hazardous due to ice buildup on exposed surfaces.

2.4.4 Estimation of Losses Due to Winter Storms

Backup power is available for the jails, the 911 Center, the Court House and the newer fire stations. Some older fire stations have emergency generators. City recreation facilities that are designated as emergency shelters do not have backup power.
Severe winter storms, especially those with heavy icing, generate a lot of downed trees and limbs, requiring cleanup of the resulting debris. The costs of managing debris are not included in regular budgets. When events prompt massive debris cleanup, staff from the Engineering & Environmental Services, Public Services, and Recreation & Parks departments are diverted from other work, often causing delays in scheduled projects.

In recent years, events with large quantities of debris have prompted the City to waive landfill fees, thus reducing potential income. The January 2004 ice storm cost the City $322,354 (excludes estimate of lost income due to waiver of landfill fees). Icing of roads and bridges affects traffic but is not considered a major factor in physical damage to roads. A growing problem associated with periods of freezing weather is road icing due to automatic outdoor sprinkler systems.

2.4.5 Land Use and Development Trends related to Winter Storms

All new buildings must be designed and constructed to meet current building code requirements, including snow loads. The effects of winter storms are not influenced by land use and development trends.

2.4.6 Multi-jurisdictional Differences related to Winter Storms

There are no differences in exposure to winter storms associated with jurisdictional boundaries between Augusta, Blythe and Hephzibah.

2.4.7 Winter Storm HRV Summary

Most winter storms are tracked and predicted with reasonable accuracy and advance warning. When roads are covered with snow and ice, the traveling public is adversely affected. Other than damage due to falling tree limbs, building damage due to severe winter storms is rare.

An overall summary of vulnerability to winter storms is relatively straightforward because every building and above-ground utilities in the planning area are equally likely to be exposed. The relative risk ranking of winter storm was determined to be "moderate" (see Table 2.5 for a summary of relative risks).

2.5: Natural Hazard E – Wildfires

A wildfire is an uncontrolled fire spreading through vegetative fuels, such as brush, marshes, grasslands or field lands, exposing and possibly consuming structures. They often begin unnoticed in sparsely populated areas and may spread quickly. The risk of wildfire, and the nature fire behavior, is associated with a combination of several factors, notably stands of timber and open areas of vegetative fuels, prolonged dry weather, sloping topography, and development within the zone commonly referred to as the 'urban-wildland interface'.

Within this zone, buildings become additional fuel for fires and prompt fire-fighting efforts. The causes of urban-wildland fires include lightning, human carelessness and arson. Wildland fires can occur during any month of the year, and the season length and peak months may vary appreciably from year to year. Generally, fires are more likely when seasonal precipitation levels are low, ambient humidity is low, and vegetation is dry.

The potential for property damage increases as development continues to take place in the interface. In areas with active forest-based economy, including tourism, extensive wildfires can have adverse economic impacts. If burned-out woodlands, grasslands, and farmlands do not quickly re-vegetate, increased erosion may contribute to reduced water quality or increased downstream flooding.

2.5.1: Wildfire Identity

Each year **tens of thousands of natural and manmade wildfires** across the United States burn millions of acres. The height of the wildfire season occurs in the late summer months, particularly across the western states. The conditions for wildfire development are very dependent on climatic variables such as antecedent moisture, humidity-levels, windspeed, and high temperature extremes. Lightning often starts a number of brush or forest fires, but the majority are started by humans through accidents or intentionally.

U.S. fire fighters regularly use NOAA climate data and products such as Firedetect or smoke observation summaries, to make decisions in regard to fire suppression strategies and safety issues. This data are critical for fire fighters and emergency managers to monitor before, during and after a wildfire has developed, as the intensity of wildfires and the rate at which they spread is directly related to the aforementioned climatic variables.

There are several ecological benefits of wildfires, as old brush is burned away and more space and fertilized soil is then available for new forest growth. However, the economic benefits in protecting homes, businesses, lives, and valuable infrastructure are even greater. NOAA's climate data and fire weather forecasts are valuable resources to society, as watches and warnings are issued in areas subject to a hazardous combination of high temperatures, high winds, and low-humidity over an extended period. Severe drought conditions are often correlated with high risks for wildfire development.

Numerous other NOAA data and products are also used in monitoring wildfire and drought conditions, including: weather forecasts, COOP data, the U.S. drought monitor, and GOES satellite imagery. Each of these sources of information enhances critical decision making to protect life and property from wildfire (NOAA, NOAA Economics, 2011). Table 2.26 below lists the U.S. Fire Summary for the period 2000 to 2010.

Table 2.26 Annual U.S. Fire Weather Summary *(Normalized to 2010 Dollars using Bureau of Labor Statistics [BLS] Consumer Price Index [CPI]*					
Year	**Fatalities**	**Injuries**	**Property Damage (million $)**	**Crop Damage (million $)**	**Total Damage (million $)**
2000	3	100	2678.68	9.02	2687.70
2001	5	46	56.50	0.00	56.50
2002	1	138	251.00	2.50	253.50
2003	0	2	2797.92	0.00	2797.92
2004	0	0	19.77	0.00	19.77
2005	0	0	45.99	0.00	45.99
2006	0	0	211.64	0.00	211.64
2007	19	225	1466.10	46.66	1512.76
2008	3	35	246.05	2.14	248.19
2009	2	109	114.14	1.42	115.57
2010	1	24	244.89	1.93	246.82
(NOAA, NOAA Economics, 2011)					

2.5.2: Wildfire Events, Frequency & Probability

Data from the Georgia Forestry Commission indicates that over 3,800 incidents of forest or brush fire (i.e., all non-structural fires) were reported in the Augusta area between 1957 and mid-2004, with over 16,000 acres burned. In 1998, a large woods fire on Bobby Jones came close to several houses.

These fires were attributed to various causes, including lightning, campfire, debris burning (residential, agricultural fields, household garbage, construction land clearing, etc.), incendiary, and the use of machines. With an average acreage per fire of just over 4 acres, the HMPC considers that forest and wildland fires do not represent a major hazard to the built environment – and the small areas affected also suggest effective response on behalf of local and state agencies.

Although an average of about 80 incidents per year were reported, the general wildland fire risk in the Augusta area is considered to be relatively low; very few occur in locations where buildings could be threatened. Because the risk is seasonal and changes with many factors, the Georgia Forestry Commission produces a Fire Danger Map each day using the National Fire Danger Rating System that is based on weather data obtained from stations across the State. The probability of wildland fires may be influenced by other events, such as drought or the build-up of underbrush and fallen trees and limbs following severe wind storms or ice storms.

State law restricts outdoor burning between May 1 and September 31, except for certain agricultural practices. The Commission and the Fire Department may issue warnings and tickets.

Table 2.27 reports FEMA data on fires in Georgia with nine events declared during the period 2007 to 2011.

Table 2.27:FEMA Fire Management Assistance Declarations – Georgia			
Year	**Date**	**Incident**	**Disaster Number**
2011	06/16	Sweat Farm Again Fire	2921
2011	06/15	Racepond Fire	2920
2011	03/25	Mosley Road Fire	2876
2011	03/25	Elan Church Road Fire	2875
2007	05/31	Harveytown Fire	2697
2007	05/09	Bugaboo Scrub Fire	2693
2007	05/05	Roundabout Fire	2688
2007	04/26	Kneeknocker Swamp Fire	2686
2007	04/17	Sweat Farm Road Fire	2685
(FEMA, 2011)			

There are three classes of fires understory fires, crown fires, and ground fires. Naturally-induced wildfires burn at relatively low intensities, consuming grasses, woody shrubs, and dead trees.

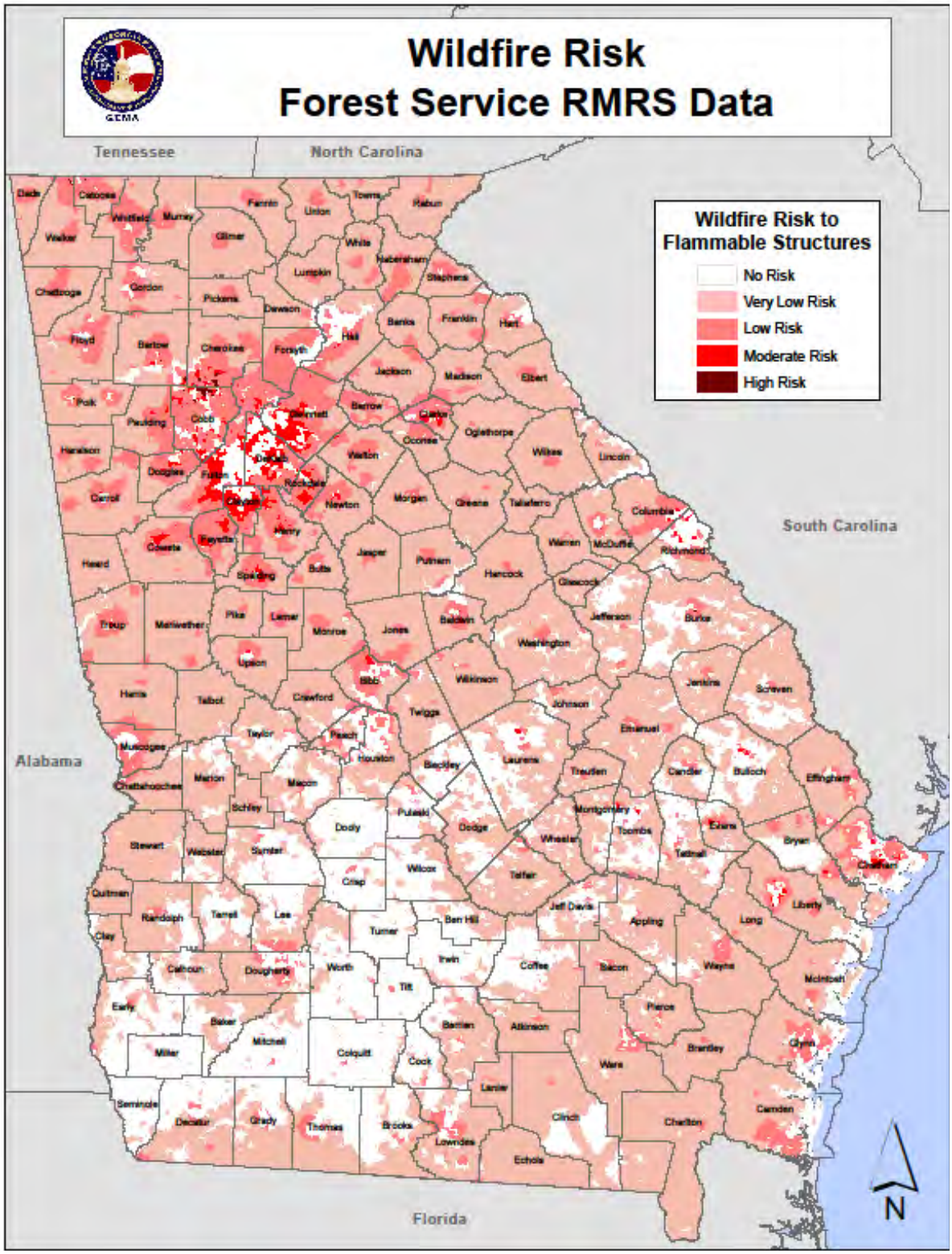
Crown fires, which consists fires consuming whole living tress, are low probability but high consequence type events. Crown fires typically match perceptions of wildfires. None of the counties listed in the SHELDUS data correspond with the federally recognized fire events except for the Bugaboo Scrub Fire in Ware County.

The most notable wildfire events are most likely the most recent 2007 fires that affected the southeast quadrant of Georgia. Essentially, these models take into account surface fuel, canopy closure, historic fire occurrences, topography, weather influence, fire suppression effectiveness, urban interfaces, and infrastructure areas in order to calculate the "Level of Concern".

Because the Southern Wildfire Risk Assessment is currently incomplete, this section includes another risk assessment based on the USDA Forest Service's Rocky Mountain Research Station (RMRS) Fire Sciences Laboratory's "Wildland Fire Risk to Flammable Structures, V 1.0" map. These data includes variables such as housing density, potential fire exposure, and extreme fire weather potential. The hazard scores are illustrated in the wildfire hazard risk Table 2.28 and Map 12 below, (GEMA, 2011).

Table 2.28: RMRS Wildland Fire Risk to Flammable Structures	
Hazard Score	Description
4 3 2 1 0	High Risk Moderate Risk Low Risk Very Low Risk No Houses: Agriculture Bodies of Water Dense Urban Development
(GEMA, 2011)	

MAP 12



The map reveals the fire risk for the planning area ranges from moderate to very low risk and is ranked as Low Risk.

2.5.3 Inventory of Assets Exposed to Wildfires

Map 13 below produced in GMIS reveals a number of structures are vulnerable to wildfire in the planning area.

MAP 13: GMIS Map of Wildfire Critical Facility Exposure

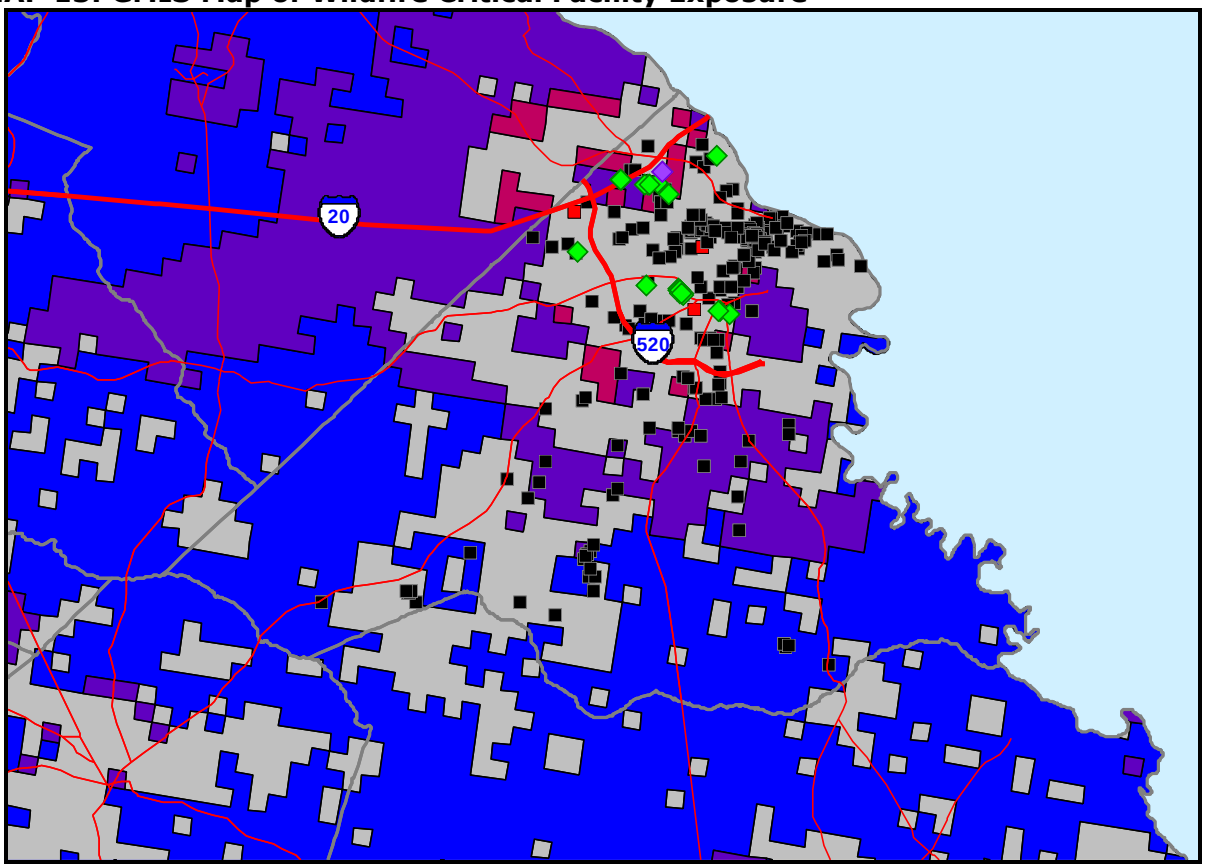
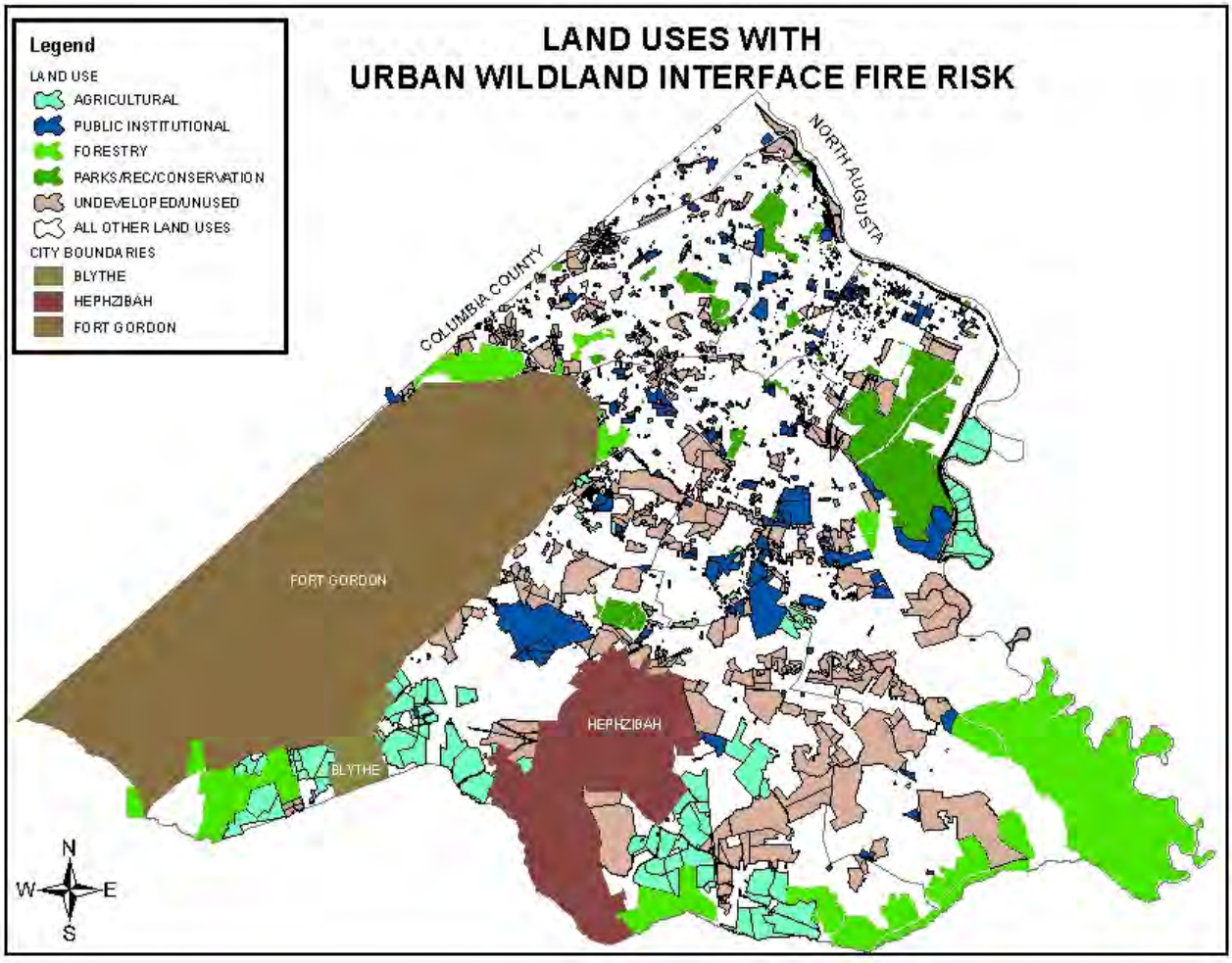


Table A-2 on land use indicates that only about 10 percent of Augusta is zoned for forested land use. When added to other categories of land use that likely are subject to wildland fires (public/institutional, park/recreation/conservation, agriculture, undeveloped/unused and Fort Gordon,), nearly 60% of the area could experience a non-structural type fire that could be characterized as "wildland urban interface" fire; Fort Gordon accounts for nearly one third (see Figure 2-11).

Approximately 2,200 structures are located in these land use zones and thus have some risk in the event wildland fires are not controlled. The Georgia Forestry Commission has indicated that nearly 60 percent of the Augusta area is forested lands.

Figure 2.11



2.5.4 Estimation of Losses Due to Wildfires

It is unreasonable to approximate the characteristics of just 2,200 buildings by applying area-wide percentages, although it is likely that most of the interface buildings are residential, recreational, or used for farming and forestry purposes. More information about specific properties in or near wooded areas would be necessary to estimate the potential damage and losses associated with interface wildland fire (this level of detail is not available through the City's GIS data layers). The more significant economic impact of a large wildfire would be on the forest-based industries; however, given the efficiency of fire suppression (based on small acreage of the average fire), it is unlikely that any single fire would affect a large area.

Figure 2.11 was prepared using the reported locations of critical facilities fifteen facilities are located in areas where the land use suggests that wildland fires may occur(forested, agricultural, conservation/recreational and undeveloped). While no single wildfire incident would likely affect more than one of these facilities, the total value of these at-risk critical and essential facilities is reported to be over $200 million:

- Richmond County Board of Education (transportation)
- Freedom Park Elementary
- Fort Gordon Fire Department
- Augusta Water Pump Station
- Riverwalk Marina
- Julian Smith Bar-B-Que Pit
- Sue Reynolds Park
- Augusta Aquatic Center
- Eastview Park
- Augusta Municipal Golf Course
- Dyess Park
- Augusta Fire Department (#16)
- Julian Smith Casino
- Warren Road Community Center
- Gracewood Park

The GEMA online tool described in Appendix B-2 uses a different methodology to characterize urban wildland fire risk. The method, developed by the USDA Forest Service, was intended for a state-wide analysis, but has been offered by GEMA as a source of data on wildfire risk.

Application of the GEMA online tool to the critical and essential facilities database yields 10 facilities that are located in areas identified as having a 'moderate' wildfire risk (hazard score of 3). Those facilities are: Fleming Athletic Office; Merry Elementary School; National Hills Elementary School; AFD- Engine Co #5; Richmond County Alter. & Opportunity Magnet School; Jeff Maxwell Branch Library; Bernie Ward Community Center; Carrie Mays; Westminster Schools Maintenance Shop; and Westminster Schools Prep School Gym. While no single wildfire incident would likely affect more than one of these facilities, the total value of these at-risk critical and essential facilities reported to be $12.4 million. Another 22 facilities are noted as having a "low" risk.

Blythe exposure to wildfire reveals the potential loss as zero. Hephzibah exposure to wildfire reveals the potential loss as 145429 sq. ft. of building exposure, $5,940,000 in replacement costs and 1,288 persons affected by the event.

2.5.5 Land Use and Development Trends related to Wildfires

Development migration moving outward from the urban areas reveals considerable growth in the southern part of Augusta, GA. There has been an increase in the number of subdivisions and single family homes built in forested areas. This trend increases the likelihood that wildland fires may affect buildings.

The Fire Department anticipates building new stations in the future in order to serve increases in population and to maintain response times as more growth occurs. The Department reviews subdivision plans primarily for the number and location of hydrants and to determine if access roads have adequate width and

turning radius for the newer, large apparatus. Some roads in the rural part of the City and some driveways are very narrow for the current tanker trucks.
The Georgia Forestry Commission undertakes some preventive, pre-suppression work, including plowing pre-defined fire breaks. Importantly, the Forestry Commission staff can work with local governments and private land owners (fee based) to develop prevention plans to improve forest health. The Forestry Commission views public education as an important part of its mission and provides booths for local fairs and events and speakers for homeowner associations and schools.

2.5.6 Multi-jurisdictional Differences related to Wildfires

Blythe and Hephzibah are surrounded by and include agricultural and forested lands. Therefore, the risk of urban wildland interface fire is the same in the two cities as it is in similar land uses elsewhere in Augusta.

2.5.7 Wildfire HRV Summary

An overall summary of vulnerability to wildfire is determined by examining the land use map for those land uses assumed to have a higher risk of such fires: over 60% of Augusta's area and about 2,200 buildings are located in those land uses. Any given outbreak of wildland fire is suppressed rapidly, and single incident is likely to cause severe damage. The HMPC determined the relative risk ranking of wildfire as 'low' (see Table 2.5 for a summary of relative risks).

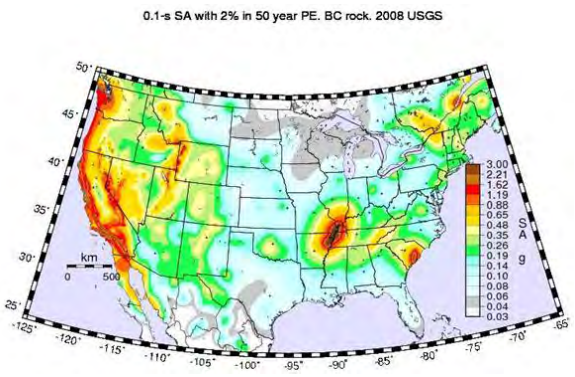
2.6: Natural Hazard F – Earthquakes

"Earthquakes are generally defined as the sudden motion or trembling of the Earth's surface caused by an abrupt release of slowly accumulated strain.

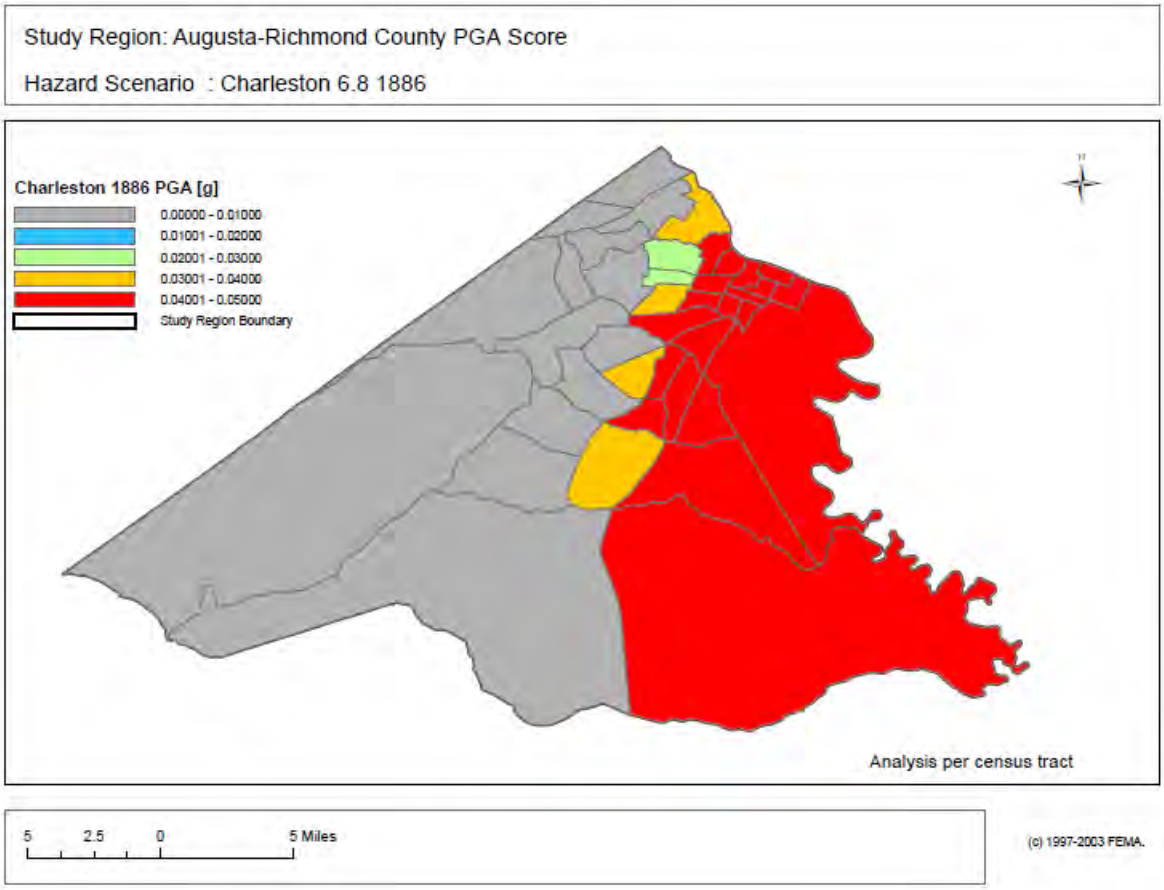
This release typically manifests on the surface as ground shaking, surface faulting, tectonic uplifting and subsidence, or ground failures, and tsunamis. Because the seismic waves have different frequencies of vibration, the waves disseminate differently through subsurface materials. The second manifestation of earthquakes is surface faulting. Structures built across active faults tend to sustain damage regularly. The third earthquake phenomenon that causes damage is tectonic uplift and subsidence. The fourth earthquake damage-causing phenomena are earthquake-induced ground failures, including liquefaction and landslides. Landslides form when earthquake shaking or seismic activity dislodges rock and debris on steep slopes triggering rock falls, avalanches, and slides (GEMA, 2011).

2.6.1: Earthquakes Identity

The graphic below depicts the various earthquake hazard zones in the U.S. and the corresponding probability rankings for the nation.



The Earthquake PGA Score for Augusta – Richmond County is: PGA=0.19410, as reflected in the map below.



2.6.2: Earthquakes Events, Frequency & Probability

The USGS estimates that several million earthquakes occur in the world each year. Many go undetected because they hit remote areas or have very small magnitudes. The NEIC now locates about 50 earthquakes each day, or about 20,000 a year.

As more and more seismographs are installed in the world, more earthquakes can be and have been located. However, the number of large earthquakes (magnitude 6.0 and greater) has stayed relatively constant as revealed in Table 2.29 and Picture below (USGS, 2011).

Table 2.29: Average Annual Earthquakes Worldwide By Magnitude	
Magnitude	**Average Annually**
8 and higher	1 [1]
7 - 7.9	15 [1]
6 - 6.9	134 [2]
5 - 5.9	1319 [2]
4 - 4.9	13,000(estimated)
3 - 3.9	130,000(estimated)
2 - 2.9	1,300,000(estimated)

[1] Based on observations since 1900. These numbers have been recently updated, based on data from theCentennial catalog (from 1900 to 1999) and the PDE (since 2000).
[2] Based on observations since 1990

.

Picture 3

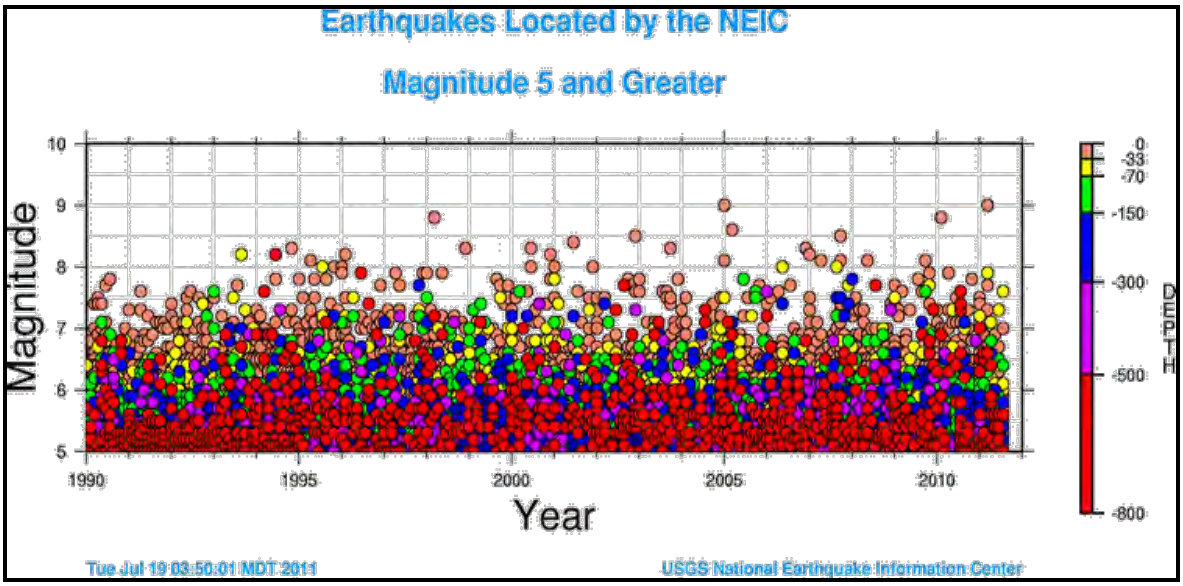


Table 2.30: Magnitude vs. Ground Motion and Energy		
Magnitude Change	**Ground Motion Change (Displacement)**	**Energy Change**
1.0	10.0 times	about 32 times
0.5	3.2 times	about 5.5 times
0.3	2.0 times	about 3 times
0.1	1.3 times	about 1.4 times

Table 2:30 above reveals that a magnitude 7.2 earthquake produces 10 times more ground motion than a magnitude 6.2 earthquake, but it releases about 32 times more energy. The energy release best indicates the destructive power of an earthquake (USGS, 2011). See: How much bigger is a magnitude 8.7 earthquake than a magnitude 5.8 earthquake?

Georgia Earthquake History

The first earthquakes reported felt in Georgia were the great New Madrid series of 1811 - 1812.These shocks were felt over almost all of the eastern United States. In Georgia that series of shocks reportedly shook some bricks from chimneys.
The great Charleston, South Carolina,earthquake of 1886 caused severe shaking experienced in Georgia. On August 31 at 9:25 p.m., preceded by a low rumble, the shock waves reached Savannah. People had difficulty remaining standing. One woman died of fright as the shaking cracked walls, felled chimneys, and broke windows. Panic at a revival service left two injured and two more were injured in leaping from upper story windows. Several more were injured by falling bricks. Ten buildings in Savannah were damaged beyond repair and at least 240 chimneys damaged. People spent the night outside.

At Tybee Island light station the 134 foot lighthouse was cracked near the middle where the walls were six feet thick, and the one-ton lens moved an inch and a half to the northeast.
In Augusta the shaking was the most severe (VIII on the Modified Mercalli scale) in the State. An estimated 1000 chimneys and many buildings were damaged. The business and social life was paralyzed for two days. Brunswick and Darien were alarmed.

An earthquake on June 17, 1872, at Milledgeville, and had an intensity of at least V on the Modified Mercalli scale, the lowest intensity in which some damage may occur. It was reported as a sharp shock, jarring brick buildings and rattling windows.

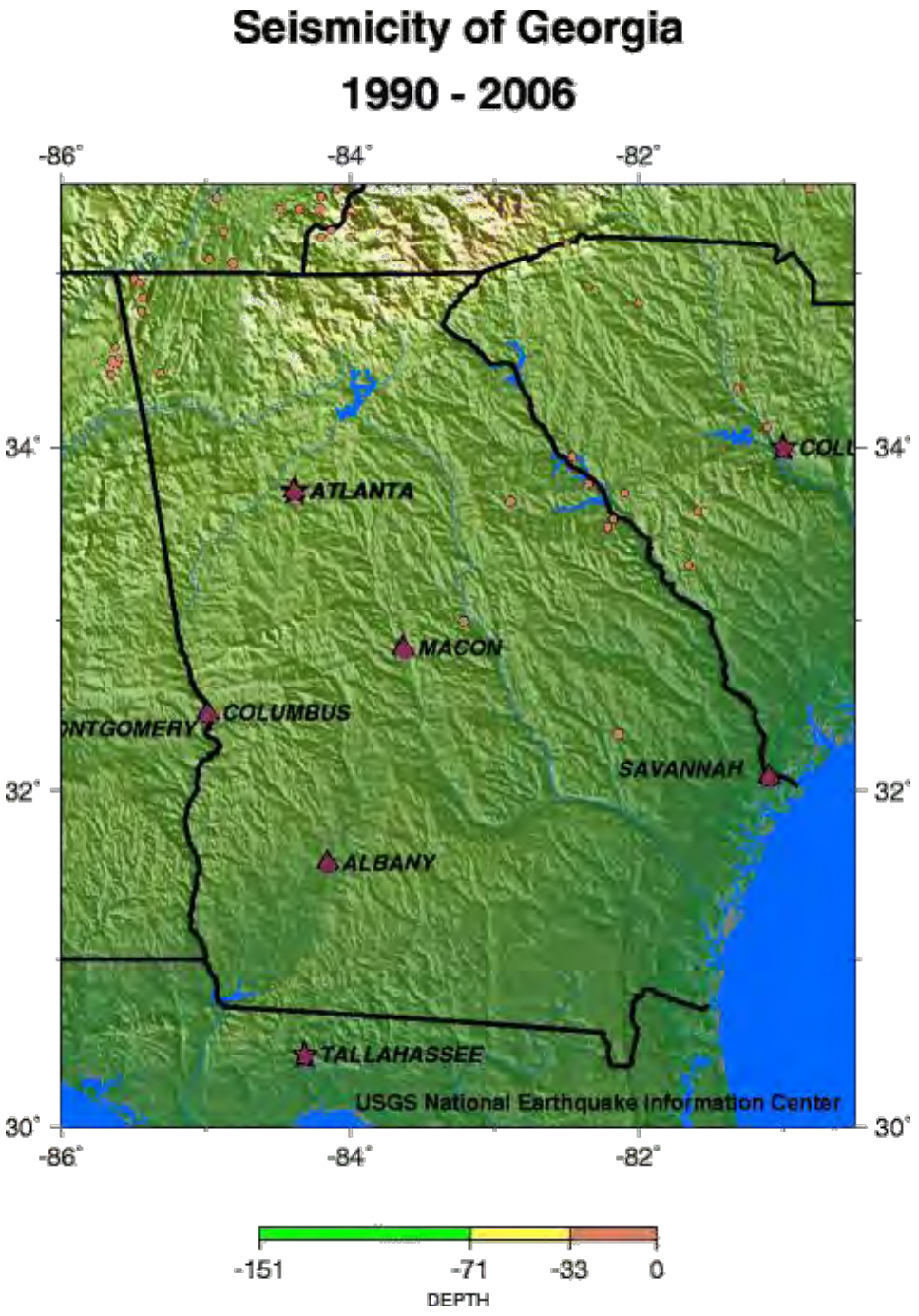
On November 1, 1875, at 9:55 in the evening, an intensity VI earthquake occurred near the South Carolina border. It was felt from Sparatansburg and Columbia, South Carolina, to Atlanta and Macon, Georgia, from Gainesville to Augusta, and generally over an area of 25,00 square miles.
A more local event occurred on October 18, 1902, with a sharp shock felt along the east face of Rocky Face Mountain west of Dalton with intensity VI and at La Fayette with intensity V. The felt area was about 1500 square miles, and included Chattanooga, Tennessee.

The Savannah area was shaken with an intensity VI earthquake on January 23, 1903. Centering near Tybee Island, it was felt over an area of 10,000 square miles including Savannah (intensity VI), Augusta (intensity III), Charleston (intensity IV-V), and Columbia (intensity III-IV). Houses were strongly shaken. Another shock was felt on June 20, 1912, at Savannah with intensity V.

On March 5, 1916, an earthquake centered 30 miles southeast of Atlanta was felt over an area of 50,00 square miles, as far as Cherokee County, North Carolina, by several people in Raleigh, and in parts of Alabama and Tennessee.

An earthquake of intensity V or over occurred on March 12, 1964, near Haddock, less than 20 miles northeast of Macon. Intensity V was recorded at Haddock while shaking was felt in four counties over a 400-square-mile area (USGS, 2011).

The Map below depicts the seismicity for Georgia.



The USGS database shows that there is a 0.07.5% chance of a major earthquake within 50 kilometers of Augusta, Georgia within the next 50 years. The largest earthquake within 100 miles of Augusta, Georgia was a 4.9 Magnitude in 1974. Table 2.10 reveals the earthquake probabilities for the planning area.

Table 2.10 Probability of Earthquakes in the next 50 years Within 31 Miles / 50km of Augusta

Magnitude	Probability	Magnitude	Probability
5.0	2.114%	6.4	0.234%
5.1	1.710%	6.5	0.186%
5.2	1.710%	6.6	0.160%
5.3	1.383%	6.7	0.145%
5.4	1.121%	6.8	0.108%
5.5	0.909%	6.9	0.086%
5.6	0.842%	7.0	0.075%
5.7	0.685%	7.1	0.047%
5.8	0.601%	7.2	0.035%
5.9	0.491%	7.3	0.027%
6.0	0.456%	7.4	0.012%
6.1	0.365%	7.5	0.004%
6.2	0.317%	7.6	0.002%
6.3	0.254%	7.7	0.000%
Source: (NOAA, 2011)			

Table 2.11 Historical Earthquake Data (Within 100 Miles)

Date	Distance	Magnitude	Depth
03/25/2010	31.17	2.5	15
04/04/2009	74.06	3.1	7
07/13/2003	79.35	3.6	5
03/18/2003	54.82	3.5	5
01/18/2000	78.70	3.5	5
08/08/1993	24.26	3.2	5
01/03/1992	43.32	3.2	5
12/12/1987	65.14	3	5
01/26/1983	96.06	3.5	5
08/25/1977	74.30	3.1	10
12/27/1976	90.84	3.7	5
08/02/1974	40.51	4.9	1
Source: USGS			

The **Richter Magnitude Scale** describes the typical effects of earthquakes of various magnitudes near the epicenter. The values are typical only and should be taken with extreme caution, since intensity and thus ground effects depend not

only on the magnitude, but also on the distance to the epicenter, the depth of the earthquake's focus beneath the epicenter, and geological conditions (certain terrains can amplify seismic signals).

Table: 2.12 Richter Magnitude Scale

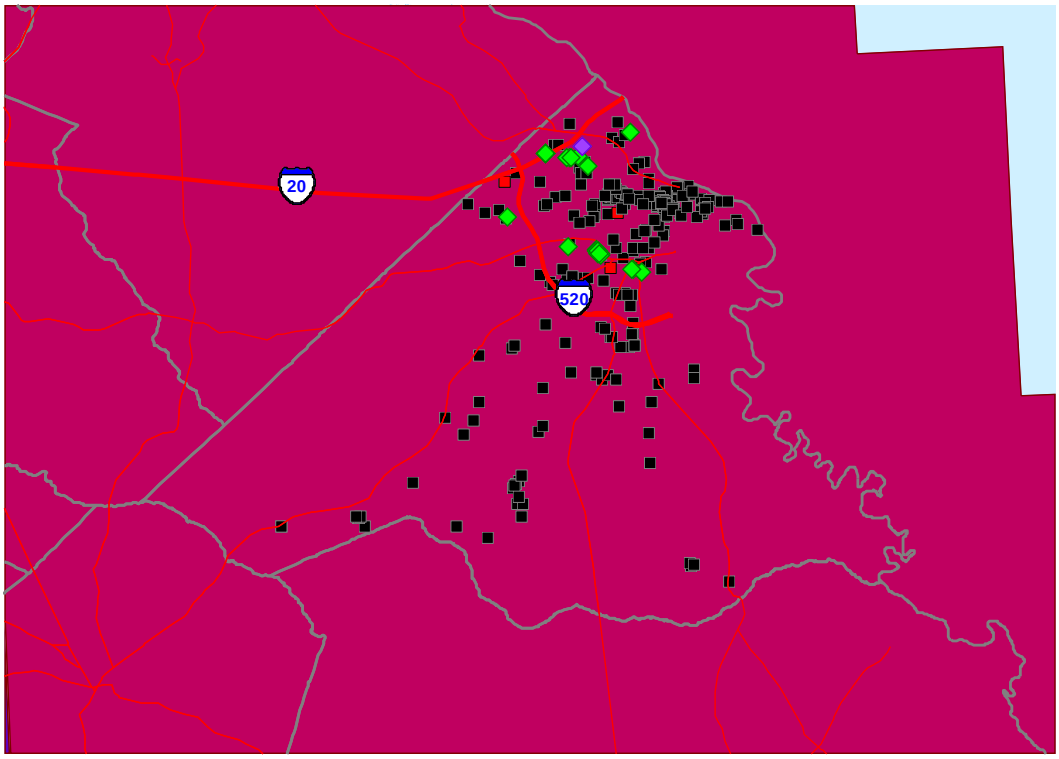
Magnitude	Description	Earthquake effects	Frequency of occurrence
Less than 2.0	Micro	Micro earthquakes, not felt.[12]	About 8,000 per day
2.0–2.9	Minor	Generally not felt, but recorded.	About 1,000 per day
3.0–3.9		Often felt, but rarely causes damage.	49,000 per year (est.)
4.0–4.9	Light	Noticeable shaking of indoor items, rattling noises. Significant damage unlikely.	6,200 per year (est.)
5.0–5.9	Moderate	Can cause major damage to poorly constructed buildings over small regions. At most slight damage to well-designed buildings.	800 per year
6.0–6.9	Strong	Can be destructive in areas up to about 160 kilometers (100 mi) across in populated areas.	120 per year
7.0–7.9	Major	Can cause serious damage over larger areas.	18 per year
8.0–8.9	Great	Can cause serious damage in areas several hundred kilometers across.	1 per year
9.0–9.9		Devastating in areas several thousand kilometers across.	1 per 20 years
10.0+	Massive	Never recorded, widespread devastation across very large areas; see below for equivalent seismic energy yield.	Extremely rare (Unknown)

(*Based on U.S. Geological Survey documents.*)[13]

2.6.3 Inventory of Assets Exposed to Earthquakes

The geographical size of the region is 328.51 square miles and contains 40 census tracts. There are over 73 thousand households in the region and has a total population of 199,775 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.
There are an estimated 77 thousand buildings in the region with a total building replacement value (excluding contents) of 12,743 (millions of dollars). Approximately 92.00 % of the buildings (and 70.00% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be 2,285 and 273 (millions of dollars), respectively.

Map of Earthquake Exposure produced in GMIS

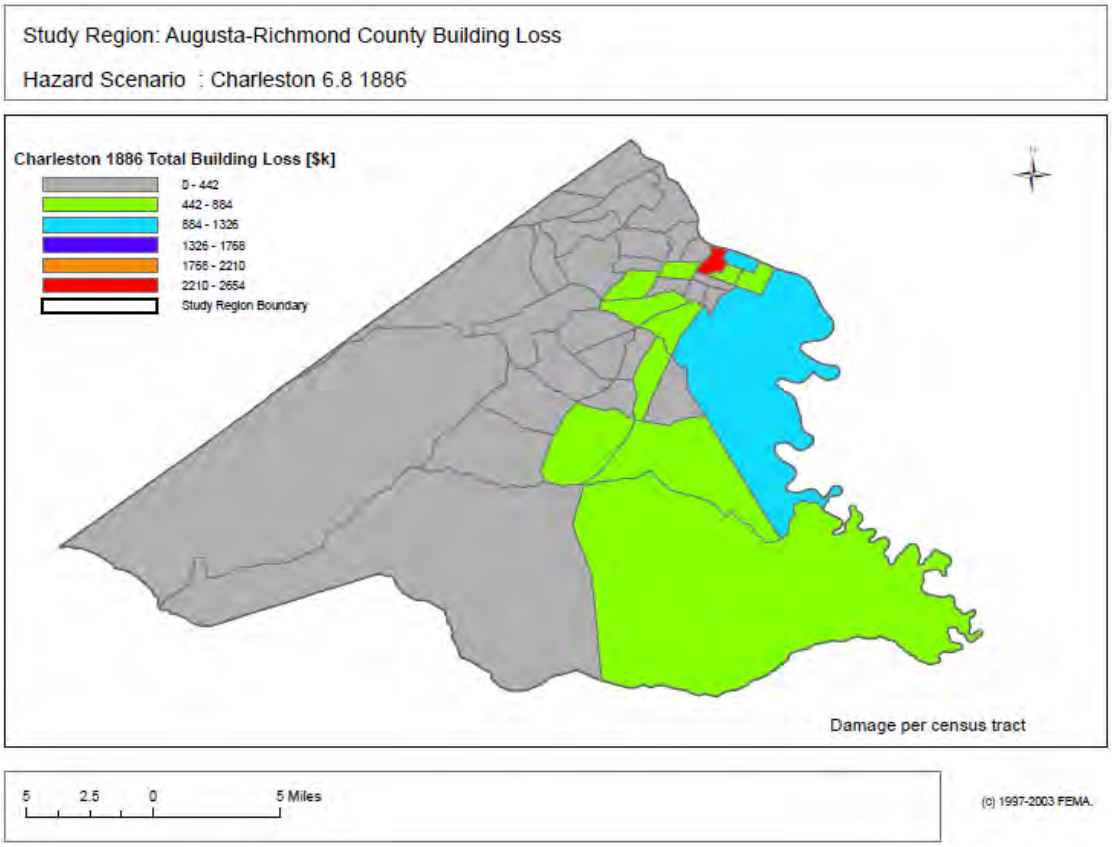


Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 77 thousand buildings in the region which have an aggregate total replacement value of 12,743 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 74% of the building inventory. The remaining percentage is distributed between the other general building types.
Critical Facility Inventory HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites. For essential facilities, there are 8 hospitals in the region with a total bed capacity of 2,353 beds. There are 75 schools, 2 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 30 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 106 hazardous material sites, 0 military installations and 0 nuclear power plants.



Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2.13 and 2.14.

The total value of the lifeline inventory is over 2,558.00 (millions of dollars). This inventory includes over 260 kilometers of highways, 134 bridges, and 5,737 kilometers of pipes.

Table 2.13: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	134	270.40
	Segments	130	1,707.10
	Tunnels	0	0.00
		Subtotal	**1,977.40**
Railways	Bridges	0	0.00
	Facilities	5	13.30
	Segments	104	119.30
	Tunnels	0	0.00
		Subtotal	**132.60**
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
		Subtotal	**0.00**
Bus	Facilities	2	1.90
		Subtotal	**1.90**
Ferry	Facilities	0	0.00
		Subtotal	**0.00**
Port	Facilities	0	0.00
		Subtotal	**0.00**
Airport	Facilities	2	21.30
	Runways	4	151.90
		Subtotal	**173.20**
		Total	**2,285.10**

Table 2.14: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	57.40
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**57.40**
Waste Water	Distribution Lines	NA	34.40
	Facilities	3	175.80
	Pipelines	0	0.00
		Subtotal	**210.20**
Natural Gas	Distribution Lines	NA	23.00
	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**23.00**
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
		Subtotal	**0.00**
Electrical Power	Facilities	1	96.80
		Subtotal	**96.80**
Communication	Facilities	9	0.80
		Subtotal	**0.80**
		Total	**388.20**

Earthquake Scenario Building Damage

HAZUS estimates that about 122 buildings will be at least moderately damaged. This is over 0.00 % of the total number of buildings in the region. There are an estimated 0 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 2.15 below summaries the expected damage by general occupancy for the buildings in the region. Table 2.16 summaries the expected damage by general building type. The following map illustrates building loss.

Table 2.15: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	64	0.09	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	2,134	2.95	0	0.00	0	0.00	0	0.00	0	0.00
Education	4	0.01	0	0.00	0	0.00	0	0.00	0	0.00
Government	30	0.04	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	305	0.42	0	0.00	0	0.00	0	0.00	0	0.00
Other Residential	16,120	22.32	250	39.87	89	72.95	0	0.00	0	0.00
Religion	292	0.40	0	0.00	0	0.00	0	0.00	0	0.00
Single Family	53,268	73.76	377	60.13	33	27.05	0	0.00	0	0.00
Total	**72,217**		**627**		**122**		**0**		**0**	

Table 2.16: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	56,609	78.39	302	48.17	15	12.30	0	0.00	0	0.00
Steel	1,329	1.84	0	0.00	0	0.00	0	0.00	0	0.00
Concrete	267	0.37	0	0.00	0	0.00	0	0.00	0	0.00
Precast	29	0.04	0	0.00	0	0.00	0	0.00	0	0.00
RM	587	0.81	0	0.00	0	0.00	0	0.00	0	0.00
URM	6,279	8.69	79	12.60	18	14.75	0	0.00	0	0.00
MH	7,117	9.86	246	39.23	89	72.95	0	0.00	0	0.00
Total	**72,217**		**627**		**122**		**0**		**0**	

Essential Facility Damage

Before the earthquake, the region had 2,353 hospital beds available for use. On the day of the earthquake, the model estimates that only 2,153 hospital beds (92.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 97.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 2.17: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	8	0	0	8
Schools	75	0	0	75
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	2	0	0	2

Transportation and Utility Lifeline Damage

Table 2.18 provides damage estimates for the transportation system.

Table 2.18: Expected Damage to the Transportation Systems

System	Component		Number of Locations			
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	130	0	0	130	130
	Bridges	134	0	0	134	134
	Tunnels	0	0	0	0	0
Railways	Segments	104	0	0	104	104
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	5	0	0	5	5
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	2	0	0	2	2
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	2	0	0	2	2
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

The tables below provide information on the damage to the utility lifeline systems. Table 2.19 provides damage to the utility system facilities. Table 2.20 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 2.21 provides a summary of the system performance information.

Table 2.19 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	3	0	0	3	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	1	0	0	1	1
Communication	9	0	0	9	9

Table 2.20 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,869	6	1
Waste Water	1,721	5	1
Natural Gas	1,148	5	1
Oil	0	0	0

Table 2.21: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	73,920	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris. The model estimates that a total of 0.010 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 72.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 320 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 9 households to be displaced due to the earthquake. Of these, 8 people (out of a total population of 199,775) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 2.22 provides a summary of the casualties estimated for this earthquake.

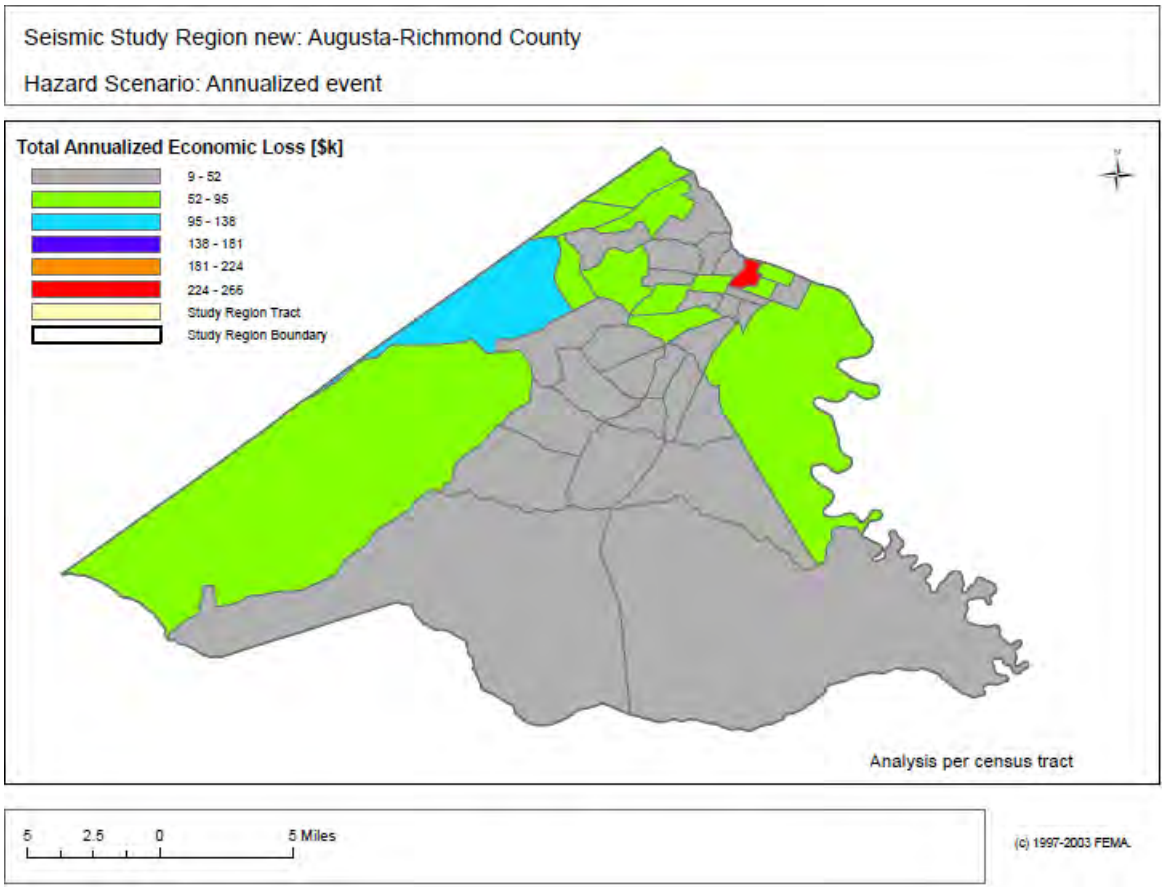
Table 2.22: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	2	0	0	0
	Single Family	2	0	0	0
	Total	**4**	**0**	**0**	**0**
2 PM	Commercial	4	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	**6**	**1**	**0**	**0**
5 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	**4**	**0**	**0**	**0**

2.6.4 Estimation of Losses Due to Earthquakes

Economic Losses

The total economic loss estimated for the earthquake is 2.65 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses. The following map depicts economic losses.



Building-Related Losses

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

The total building-related losses were 2.10 (millions of dollars); 33% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 38%

of the total loss. Table 2.23 below provides a summary of the losses associated with the building damage.

Table 2.23: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.02	0.17	0.00	0.01	0.20
	Capital-Related	0.00	0.01	0.13	0.00	0.00	0.14
	Rental	0.01	0.04	0.07	0.00	0.00	0.12
	Relocation	0.04	0.03	0.13	0.01	0.03	0.24
	Subtotal	**0.05**	**0.10**	**0.49**	**0.02**	**0.04**	**0.70**
Capital Stock Loses							
	Structural	0.05	0.07	0.12	0.02	0.02	0.28
	Non_Structural	0.20	0.22	0.29	0.05	0.05	0.81
	Content	0.06	0.04	0.13	0.03	0.02	0.29
	Inventory	0.00	0.00	0.00	0.01	0.00	0.01
	Subtotal	**0.32**	**0.34**	**0.54**	**0.11**	**0.10**	**1.39**
	Total	**0.37**	**0.44**	**1.03**	**0.12**	**0.14**	**2.10**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 2.24 & 2.25 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 2.26 presents the results of the region for the given earthquake.

Table 2.24: Transportation System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	1,707.07	$0.00	0.00
	Bridges	270.36	$0.03	0.01
	Tunnels	0.00	$0.00	0.00
	Subtotal	**1977.40**	**0.00**	
Railways	Segments	119.30	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	13.32	$0.15	1.11
	Subtotal	**132.60**	**0.10**	
Light Rail	Segments	0.00	$0.00	0.00
	Bridges	0.00	$0.00	0.00
	Tunnels	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Bus	Facilities	1.92	$0.02	1.05
	Subtotal	**1.90**	**0.00**	
Ferry	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Port	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**0.00**	
Airport	Facilities	21.30	$0.13	0.60
	Runways	151.86	$0.00	0.00
	Subtotal	**173.20**	**0.10**	
	Total	**2285.10**	**0.30**	

Table 2.25: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	57.40	$0.03	0.04
	Subtotal	**57.38**	**$0.03**	
Waste Water	Pipelines	0.00	$0.00	0.00
	Facilities	175.80	$0.16	0.09
	Distribution Lines	34.40	$0.02	0.06
	Subtotal	**210.25**	**$0.18**	
Natural Gas	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Distribution Lines	23.00	$0.02	0.09
	Subtotal	**22.95**	**$0.02**	
Oil Systems	Pipelines	0.00	$0.00	0.00
	Facilities	0.00	$0.00	0.00
	Subtotal	**0.00**	**$0.00**	
Electrical Power	Facilities	96.80	$0.00	0.00
	Subtotal	**96.80**	**$0.00**	
Communication	Facilities	0.80	$0.00	0.04
	Subtotal	**0.79**	**$0.00**	
	Total	**388.17**	**$0.23**	

Table 2.26. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of $)

LOSS		Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	0.00
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.01
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.01

Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Georgia	Richmond	199,775	8,967	3,775	12,743
Total State		**199,775**	**8,967**	**3,775**	**12,743**
Total Region		**199,775**	**8,967**	**3,775**	**12,743**

An additional Seismic Scenario was run using Charleston, SC data and is available at this link.

2.6.5 Land Use and Development Trends related to Earthquakes

Augusta – Richmond County governments and planning entities currently have no land use trends related to earthquakes.

2.6.6 Multi-jurisdictional Differences related to Earthquakes

There are no multi-jurisdictional differences related to earthquakes in the August-Richmond County planning area.

2.6.7 Earthquakes HRV Summary

Georgia is not the first state mentioned when discussing earthquakes. Events in Georgia are rare, particularly when compared to the long history of damaging earthquakes associated with California's active San Andrea fault zone and other fault zones bounding the tectonic plates of the Earth's crust.

Movement of the Earth's crust along these plate boundaries explains most earthquakes. Georgia, like all the other states east of the Rocky Mountains, does not have active faults, and is not on a tectonic plate boundary. Nonetheless, damaging earthquakes do occur in the interior of tectonic plates and these intra-plate earthquakes can be an important consideration for emergency managers and government officials.

Total economic loss estimated for the HAZUS earthquake in the planning area is 2.65 million dollars and includes building and lifeline related losses based on available inventory information. Given the relatively low risk factor for the planning area, Earthquakes were ranked in the 'low risk' category.

CHAPTER 3: LOCAL TECHNOLOGICAL HAZARD, RISK, and VULNERABLITY* (HRV)

Chapter 3 of the HMP describes the Technological and Manmade Hazard*, Risk, and Vulnerability (HRV) summary undertaken by Augusta - Richmond County and participating municipalities. This section consists of the following subsections:

- CHEMICAL LEAK/SPILL
- CHEMICAL RELEASE (AIRBORNE)**
- TERRORISM
- NUCLEAR PLANT INCIDENT
- DAM/LEVEE FAILURE

Notes: * Technological and Manmade Hazards referred to as Technological Hazards throughout the HMP.
**Chemical Leak/Spill – Chemical Release (Airborne) referred to as Chemical Hazard throughout HMP.

INTRODUCTION AND UPDATE SUMMARY

A key step in the mitigation of disaster losses in Augusta - Richmond County lies in developing a comprehensive understanding of the hazards posing risks to its communities. The following terms define the process of Hazard Identification and Risk Assessment and are found throughout the Plan.

Hazard: Event or physical conditions that have the potential to cause fatalities, injuries, agricultural loss, property damage, infrastructure damage, damage to the environment, interruption of business, other types of harm.
Risk: Product of a hazard's likelihood of occurrence and its consequences to society.
Vulnerability: Degree of susceptibility and resilience of the community and environment to hazards. **(Source:** Federal Emergency Management Agency, 2001).

The Local Hazard, Risk, and Vulnerability (HRV) summary process methodology evaluates risk defined by probability and frequency of occurrence. An assessment of each hazard event, human and property exposure to the hazard, and the consequences of that exposure form the basis of community hazard investigation. Distinct methodologies used to record community exposure include qualitative and quantitative data.

Augusta - Richmond County and its communities are vulnerable to a broad range

of technological and manmade hazards that threaten life and property. The Augusta Richmond County Hazard Mitigation Planning Committee (HMPC) identified hazards to include in the HRV summary were determined to pose actual, potential threat to Augusta - Richmond County and its incorporated jurisdictions. Hazards identified are consistent with those identified by the Georgia Emergency Management Agency (GEMA) and the Federal Emergency Management Agency (FEMA) for the Northeast region of the state and this region of the country. The technological hazards for this 2011 Plan update include:

- CHEMICAL LEAK/SPILL
- CHEMICAL RELEASE (AIRBORNE)**
- TERRORISM
- NUCLEAR PLANT INCIDENT
- DAM/LEVEE FAILURE

Technological hazards can be potentially interrelated to natural hazards, (Ex: a chemical spill could exacerbate response and recovery efforts during a flood event or hazardous chemicals could be used in an act of terrorism), therefore an assessment of those hazards identifies commonalities during the HRV process. Where specific hazard risk and exposure categories intersect, risk hazard categories are not duplicated to control data skewing.

Table 3.1 below provides a summary of the changes made to the effective HMP.

Table 3.1: Evaluation of Technological and Manmade Hazards to Include in 2011 HRV Summary

2006 HAZARD	STATUS	NOTES	2011 HAZARD
Hazardous Materials	Changed	Renamed	Chemical
N/A	Added	New Hazard Identified	Terrorism
N/A	Added	New Hazard Identified	Nuclear Plant Incident
N/A	Added	New Hazard Identified	Dam/Levee Failure

Figure 3.2: HAZARD IDENTIFICATION RANKING SURVEY RESULTS

NATURAL HAZARD RANKING

Where 1 = Highest Risk and 6 = Lowest Risk)

1 TORNADO WIND STORM HAIL
2 FLOODING
3 DROUGHT EXTREME HEAT
4 WINTER STORM
5 WILDFIRE
6 EARTHQUAKE

MANMADE/TECHNOLOGICAL HAZARD RANKING

Where 1 = Highest Risk and 4 = Lowest Risk

1 CHEMICAL LEAK/SPILL CHEMICAL RELEASE (AIRBORNE)
2 TERRORISM
3 NUCLEAR PLANT INCIDENT
4 DAM/LEVEE FAILURE

Raw numeric data for the Hazard Identification Ranking Survey is reported below in Table 2.2:

TABLE 3.2: HAZARD IDENTIFICATION RANKING SURVEY

RANK	NATURAL HAZARDS	RAW NUMBER	# RESPONDENTS
1	Tornado/Windstorm/Hail	50	31
2	Flood	75	31
3	Drought/Extreme Heat	105	31
4	Winter Storm	111	31
5	Wildfire	135	31
6	Earthquake	175	31
RANK	MANMADE/TECHNOLOGICAL HAZARDS		31
1	Chemical Leak/Spill	44	31
2	Terrorism	82	31
3	Nuclear Incident	94	31
4	Dam/Levee Failure	95	31
Notes: Respondent numeric results are assigned value with the Hazards in each category ranked where the raw lowest score = the highest risk.			

In the Natural Hazards category respondents ranked Tornado/Windstorm Hail as the highest community risk, followed by Flooding, Drought/Extreme Heat, Winter Storms, Wildfires, and Earthquakes.

In the Manmade/Technological Hazards category respondents ranked Chemical Leak/Spill as the highest community risk, followed by Terrorism, Nuclear Incident, and Dam/Levee Failure.

The HMPC Risk Assessment element of the plan is predicated on a Risk Factor (RF) formula where the HMPC Hazard Identification Questionnaire, Hazard Identification Ranking Survey, and HMPC Qualitative Commentary Report are assigned a 30% (.30) weighted RF value in the overall HMP risk analysis. The HI - RA RF formula for the HMP Update is:

HMPC RA = (.30) + Historic Hazard Event - Declarations (.30) + FEMA HAZUS® - MH and other Risk Analysis Processes (.40).

The HI – RA results were forwarded to the HMPC for review, input, and adoption on 14 July, 2011 at the HMPC – Stakeholders Meeting, 9:00 AM – Noon, Augusta Municipal Building. The HMPC Hazard Ranking Subcommittee incorporated appropriate revisions, clarifications, and community input, and the final HMPC HI - RA was adopted on 17 July, 2011.

Hazards were ranked in order to provide structure, prioritization, and feasibility of proposed mitigation goals and actions. Ranking was both quantitative and qualitative. First, the quantitative analysis considered data from EPA, Department of Homeland Security (DHS), FEMA, GEMA, and local EMA Emergency Operation Plans (EOP), and EOP information from Federal, State, and Local Agencies, businesses, and individuals available. The Risk Factor (RF), qualitative approach, was used to provide additional insights on the specific risks and exposure associated with each hazard. This process is a valuable crosscheck or validation of the quantitative analysis performed.

The RF approach combines historic hazard data, local knowledge, and consensus risk assessment evaluations to produce numerical values to compare identified hazards in determining community vulnerability. During the planning process, the Augusta - Richmond County HMPC contrasted the results of the hazard profiles with local knowledge to generate the ranking criteria. The criteria were used to evaluate the hazards in order to determine the degree of risk for each.

The process produces numerical values, allowing identified hazards to be ranked against one another (higher RF values = greater hazard risk). RF values are obtained by assigning degrees of risk in five categories for each hazard: probability, impact, spatial extent, warning time, and duration. Each degree of risk is assigned a value range of 1 to 4 and a weighting factor for each category agreed upon by the HMPC. The HMPC may adjust the RF weighting scheme based on unique concerns or circumstances within the planning area. To calculate RF value for each hazard, risk values are multiplied by the weighting factor. The sum of the five categories equals the final RF value, as demonstrated in the equation and Chart 2-1 below:

RF Value = [(Probability x .30) + (Impact x .30) + (Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

Chart 2-1:

Chart 2-1: AUGUSTA HMPC HAZARD, RISK AND VULNERABILITY (HRV) RISK FACTOR CRITERIA				
RISK ASSESSMENT CATEGORY	**LEVEL**	**DEGREE OF RISK LEVEL**	**INDEX**	**WEIGHT**
PROBABILITY What is the likelihood of a hazard event occurring in a given year?	UNLIKELY	LESS THAN 1% ANNUAL PROBABILITY	1	30%
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	2	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	3	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	4	
IMPACT *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	MINOR	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION ON QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	1	30%
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	2	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	3	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	4	
SPATIAL EXTENT *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	NEGLIGIBLE	LESS THAN 1% OF AREA AFFECTED	1	20%
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	2	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	3	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	4	
WARNING TIME *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	MORE THAN 24 HRS	SELF DEFINED	1	10%
	12 TO 24 HRS	SELF DEFINED	2	
	6 TO 12 HRS	SELF DEFINED	3	
	LESS THAN 6 HRS	SELF DEFINED	4	
DURATION *How long does the hazard event usually last?*	LESS THAN 6 HRS	SELF DEFINED	1	10%
	LESS THAN 24 HRS	SELF DEFINED	2	
	LESS THAN 1 WEEK	SELF DEFINED	3	
	MORE THAN 1 WEEK	SELF DEFINED	4	

In applying the default weighting scheme, the highest possible RF value is 4.0. The methodology illustrated above contains the categories used to calculate the variables for the RF value.

Additional Sources of Risk Assessment Data

HMPC data sources by hazard included:

Chemical Hazard. EPA's Risk-based Prioritizations of High Production Volume (HPV) Chemicals are screening-level documents that:

- Summarize basic hazard and exposure information available to EPA on HPV chemicals;
- Identify potential risks;
- Note scientific issues and uncertainties; and
- Indicate the initial priority being assigned by the Agency for potential future appropriate action.

The documents are primarily based on hazard, use, and exposure data available to the Agency through the HPV Challenge Program and on EPA's examination of chemical use and exposure information collected from the 2006 Inventory Update Reporting (IUR) as well as data from readily available sources of hazard and exposure information.

These screening-level documents will be used by EPA to evaluate chemicals and assign initial priority for future potential action based on the risk concerns presented by these chemicals in comparison with other HPV chemicals and in light of any uncertainties presented by gaps in the available data. The Agency intends to follow-up with voluntary or regulatory actions for HPV chemicals of concern focusing initially on cases presenting special concern. These characterizations and prioritizations do not constitute definitive determinations regarding either risk or the sufficiency of available information for any regulatory purpose, but are rather initial evaluations based upon HPV Challenge Program and IUR data received by EPA.
For a given chemical or chemical category, each Risk-based Prioritization presents an initial recommended level of concern and contains supporting documents, including:

- Hazard Characterization;
- Exposure Characterization; and
- Risk Characterization (EPA, 2011).

Nuclear Plant Incident. The GEMA Radiological Programs Section is responsible for the Radiological Emergency Preparedness (REP) Program, the Waste Isolation Pilot Plant (WIPP) Program, and Local Emergency Planning Committee (LEPC) Program. The mission of the REP Program is to ensure the health and safety of the public living in the vicinity of Georgia's nuclear power facilities in the event of an accident. The primary emphasis of the program is on nuclear power plants; however plans also address other fixed nuclear facilities and radiological incidents. The REP program is responsible for plan development, plan reviews, responder training, and exercises to ensure that state and local governments are ready to respond in the unlikely event of an accident.

GEMA information on Local Emergency Planning Committees (LEPCs) work to understand chemical hazards in the community, develop emergency plans in case of an accidental release, and look for ways to prevent chemical accidents. LEPCs also serve as a repository for regional hazardous materials information, and perform outreach functions to increase hazardous materials awareness. LEPC membership consists of local professionals representing occupational categories

such as firefighting, law enforcement, emergency management, health, and/or transportation (GEMA, 2011).

Terrorism. The Counter Terrorism Task Force (CTTF) is a state-wide multi-disciplinary task force aimed at serving as the state's rapid-response security force. The CTTF's primary goal is to protect Georgia's citizens, critical infrastructure, and key resources from terrorist attacks, major disasters, and other emergencies.

In 2004, the Georgia Office of Homeland Security Director tasked GISAC with creating a task force capable of performing specialized and hazardous missions to protect the state of Georgia. GISAC developed the concept for this taskforce and the following agencies committed to provide staff and support:

- Georgia Bureau of Investigation (GBI)
- Georgia Emergency Management Agency (GEMA)
- Georgia Information Sharing & Analysis Center (GISAC)
- Georgia State Patrol (GSP)
- Georgia Department of Natural Resources (DNR), (GEMA, 2011).

Dam/Levee Failure. For 30 years, the Federal Government has been working to protect Americans from dam failure through the National Dam Safety Program (NDSP). The NDSP, which is led by FEMA, is a partnership of the states, federal agencies, and other stakeholders to encourage individual and community responsibility for dam safety.

Information Needs

Under the leadership of FEMA, state assistance funds have enabled all participating states to better their programs through increased inspections, emergency action planning, and the purchase of needed equipment. Visit Information Needs for Dam Safety for more information.

Research

There is now a national research program in dam safety that is focusing on priorities, producing products for both the layperson and the expert, and developing technological tools that drive data collection and analysis toward a better understanding of risk and remediation needs. Visit Dam Safety Research for more information.

Training

In the training arena, FEMA has been able to expand existing training programs and begin new training programs to enhance the sharing of expertise between the federal and state sectors. Visit Dam Safety Training for more information (FEMA, 2011).

RANKING RESULTS

The technological hazard with the highest risk potential based on the RF analysis is Chemical, with a value of 3.0; followed by Terrorism, with a value of 2.9; Nuclear Plant Incident, with a value of 2.1, and Dam/Levee Failure, with a value of 1.3.

Conclusions drawn from the qualitative and quantitative assessments, combined with the final RF determinations by the HMPC, were categorized into 3 risk designations (High, Moderate or Low) to produce a summary of hazard risks. Table 3.3 below reveals the analysis results and ranking.

Table 3.3 Augusta – Richmond County HMPC RF

TECHNOLOGICAL HAZARDS	PROBABILITY	IMPACT	SPATIAL EXTENT	WARNING TIME	DURATION	RF RATING (PRIORITY)
Hazard A: Chemical	1.2	.9	.4	.4	.4	3.3
Hazard B: Terrorism	.6	.6	.4	.4	.4	2.8
Hazard C: Nuclear Plant Incident	.3	.6	.4	.4	.4	2.1
Hazard D: Dam Levee Failure	.6	.3	.4	.3	.4	2.0
HIGH RISK (3.0 or higher)						

Table 3.4 below reveals community ranked hazards and lists them in the three categories of High, Moderate, and Low.

Table 3.4: HMPC RF Technological Hazard Risk Conclusions

HIGH RISK (3.0 or higher)	**Chemical Spill/Leak**
MODERATE RISK (2.0 – 2.9)	**Terrorism, Nuclear Plant Incident**
LOW RISK (0.1 – 1.9)	**Dam/Levee Failure**

3.1 Technological Hazard A: Chemical Hazard

For the purposes of mitigation planning, hazardous materials are defined as any materials that may have negative impacts on human health, animal health, or the environment. Hazardous materials vary widely in their toxicity to humans. Exposure to hazardous materials may result in injury, illness, or death. The impacts of a hazardous materials exposure may be short-term immediate negative effects, defined as a few seconds, minutes or hours, or long-term negative effects within days, weeks, or years after exposure.

Hazardous chemicals are widely used in heavy industry, manufacturing, agriculture, mining, oil and gas industries, high tech industries, forestry operations, transportation, medical facilities and commercial, public and residential buildings. There are virtually hundreds of thousands of chemicals that are potentially hazardous to human health, at varying extent.

A single family home typically contains dozens of potentially hazardous materials including fuels, paints, solvents, cleaning chemicals, pesticides, herbicides, medicines and others. However, for mitigation planning purposes, the focus of interest is primarily on larger quantities of hazardous materials in industrial use and transported hazardous materials, where the potential for accidental spills or releases is greater.

The severity of a hazardous material spill or release incident for the affected community is dependent on multiple factors, including:

- Toxicity of the hazardous material;
- Quantity of the hazardous material spilled or released;
- Dispersal characteristics of the hazardous material;
- Local conditions including wind direction and topography;
- Location of the spill or release relative to sensitive environmental areas, including watersheds that provide community potable water, and;
- Efficacy of response and recovery actions.

3.1.1 Chemical Hazard Identity

A chemical hazard arises from contamination with harmful or potentially harmful chemicals that impact humans, the environment and water supply. Examples include burning of fossils, materials and chemicals used in construction and industry, chemical spillages, industrial accidents, and deliberate releases.

The Environmental Protection Agency (EPA) established the High Production Volume Information System (HPVIS), for a given chemical or chemical category, where each Risk-based Prioritization presents an initial recommended level of concern and supporting documents, including:

- Hazard Characterization;
- Exposure Characterization; and
- Risk Characterization.

EPA screening-level Risk Characterization documents summarize EPA's current thinking regarding the potential risks of HPV chemicals or categories by evaluating and integrating hazard and exposure information available to EPA.

The purpose of the qualitative screening-level risk characterizations is to:

- Support an risk-based prioritization which will inform risk management options; and

- Identify potential data needs for individual chemicals or chemical categories.

EPA risk characterizations consider three main aspects of chemicals or categories:

- Hazard (human health and environment);
- Exposure (general population and environment, workers, commercial workers and consumers, and children); and
- Physical chemical properties and environmental fate (persistence and bioaccumulation).

Evaluation of these three dimensions occurs during the risk-based prioritization process (Source: EPA, High Production Volume Information System (HPVIS), http://www.epa.gov/hpvis/aboutrbd.htm, 2011.)

The principal modes of human exposure to hazardous materials include:

1. Inhalation of gaseous or particulate materials via the respiratory (breathing) process,
2. Ingestion of hazardous materials via contaminated food or water,
3. Direct contact with skin or eyes.

The following definitions are helpful in understanding chemical exposure sources:

- **Flammable materials** are substances where fire is the primary threat, although explosions and chemical effects listed below may also occur. Common examples include gasoline, diesel fuel, and propane.
- **Explosives** are materials where explosion is the primary threat, although fires and chemical effects listed below may also occur. Common examples include dynamite and other explosives used in construction or demolition.
- **Irritants** are substances that cause inflammation or chemical burns of the eyes, nose, throat, lungs, skin or other tissues of the body in which they come in contact. Examples of irritants are strong acids such as sulfuric or nitric acid.
- **Asphyxiates** are substances that interfere with breathing. Simple asphyxiates cause injury or death by displacing the oxygen necessary for life. Nitrogen is a good example. Nitrogen is a normally harmless gas that constitutes about 78% of the atmosphere. However, nitrogen releases in a confined space may result in asphyxiation by displacing oxygen. Chemical asphyxiates are substances that prevent the body from using oxygen or otherwise interfere with the breathing process. Common examples are carbon monoxide and cyanides.
- **Anesthetics and Narcotics** are substances which act on the body by depressing the central nervous system. Symptoms include drowsiness, weakness, fatigue, and un-coordination, which may lead to unconsciousness, paralysis of the respiratory system and death. Examples include numerous hydrocarbon and organic compounds.

Hazardous materials may also have a wide variety of more specialized impacts on human health. Other types of toxic effects are briefly summarized in Table 3.5.

Table 3.5: Other Types of Hazardous Materials	
Type of Hazardous Material	**Effects on Humans**
Hepatotoxin	Liver damage
Nephrotoxin	Kidney damage
Neurotoxin	Neurological (nerve) damage
Carcinogen	May result in cancer
Mutagen	May produce changes in the genetic material of cells
Teratogen	May have adverse affects on sperm, ova, or fetal tissue
Radioactive materials	May result directly in radiation sickness at high exposure levels or act as carcinogen, mutagen, or teratogen
Infectious substances	Biological materials such as bacteria or viruses that may cause illness or death

Much of the information above was summarized from Chapter Six of the Handbook of Chemical Hazard Analysis Procedures[3]. The first chapters of the handbook contain a concise summary of the technical aspects of hazardous materials. These chapters are useful to readers seeking a more technical introduction to the classification and science of hazardous materials.

Hazardous materials are chemical substances, which, if released or misused, can pose threats to the environment or to the health of people who are exposed to the materials. Chemicals of this nature are used in industry, agriculture, medicine, research, and the manufacture of some consumer goods. Hazardous materials come be explosives, flammable and combustible substances, poisons, and radioactive materials. Since their chemical properties vary significantly, an incident could be obvious (e.g., airborne plume, spill on the ground, bad smell) or not readily apparent (e.g., beneath the surface of the ground, no odor or color).

Hazardous material incidents are among the most common technological threats to public health and the environment. Most incidents of release result from transportation accidents or accidents in manufacturing facilities that use the materials. Hazardous materials are transported on railroads, state roads, interstate highways, as well as local roads, during delivery. A hazardous materials accident is usually a localized event and response is managed locally. The Emergency Planning and Community Right-to-Know Act of 1986 establishes requirements for Federal, State and local governments, Indian Tribes, and industry regarding emergency planning and "Community Right-to-Know" reporting on hazardous and toxic chemicals. The Act's provisions help increase the public's knowledge and access to information on chemicals used at individual facilities and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment.

[3] **Handbook of Chemical Analysis Procedures**, Federal Emergency Management Agency, U.S. Department of Transportation, and U.S. Environmental Protection Agency, U.S. Government Printing Office, 1988.

Reports on hazardous materials are prepared by handlers and submitted to and maintained by the Local Emergency Planning Committee (staffed by the Augusta Emergency Management Agency). Twenty-one facilities make or store sufficient quantities of chemicals to require preparation of risk management plans mandated by the U.S. Environmental Protection Agency. A risk management plan is a detailed analysis of risk that includes a 5-year history of actual incidents, the likely consequences of a "worst case" scenario, and strategies for improving safety.

3.1.2. Inventory of Assets Exposed to Chemical Hazard

Incidents involving releases of hazardous materials (HazMat) are not assigned a probability of recurrence as are natural hazards. However, past data can be used to characterize the likelihood of future incidents. The Environmental Protection Division of the Georgia Department of Natural Resources is the state's lead agency in regulating public and private facilities that use hazardous substances. The agency maintains a database of reported spill incidents and releases, which are declining, probably because manufacturers, users, and transporters of hazardous materials are becoming more aware of the financial and political costs of hazardous materials incidents.

In the City of Augusta, transportation of hazardous materials poses a daily threat, given that the Railroad and U.S. Routes 20 and 520 that run through the City are major transportation routes.

A general spatial analysis can be performed to estimate general impacts associated with accidental releases of hazardous materials. In the Augusta area, sites with reported materials are concentrated in four clusters (Figure 3-2).

Using the GIS building footprints, the concentration of development (and thus number of people) located within a given distance around the sites can be determined. The analysis takes into account only the geographic distribution of buildings with respect to the manufacturers, users, and storage facilities, and does not characterize specific types of hazardous materials and the potential effects should a release occur. Different types of hazardous material have different potential impacts, and in all cases the total effects would be influenced by weather and the efficiency of response and containment.

The American Society for Testing and Materials (ASTM) develops standards for regulated facilities that manufacture, use, store or are disposal sites for hazardous or potentially hazardous materials and waste. According to these standards, the 1.5 mile radial distance was considered in evaluating each of the clusters' potential influence on surrounding properties.

Considering the clusters of HazMat sites and applying a 1.5-mile radius, over 25% of all buildings in Augusta are within areas broadly characterized as 'potential impact areas'. This estimate is extraordinarily high, given several simplifying assumptions made in the analysis, and certainly does not represent the potential impact of any single incident.

Using the reported locations of the critical facilities, fifty-nine are located in areas delineated by applying the 1.5-mile buffer to clusters of sites where hazardous materials are used or stored (see Figure 3-3).

Figure 3.2: Hazardous Material Sites

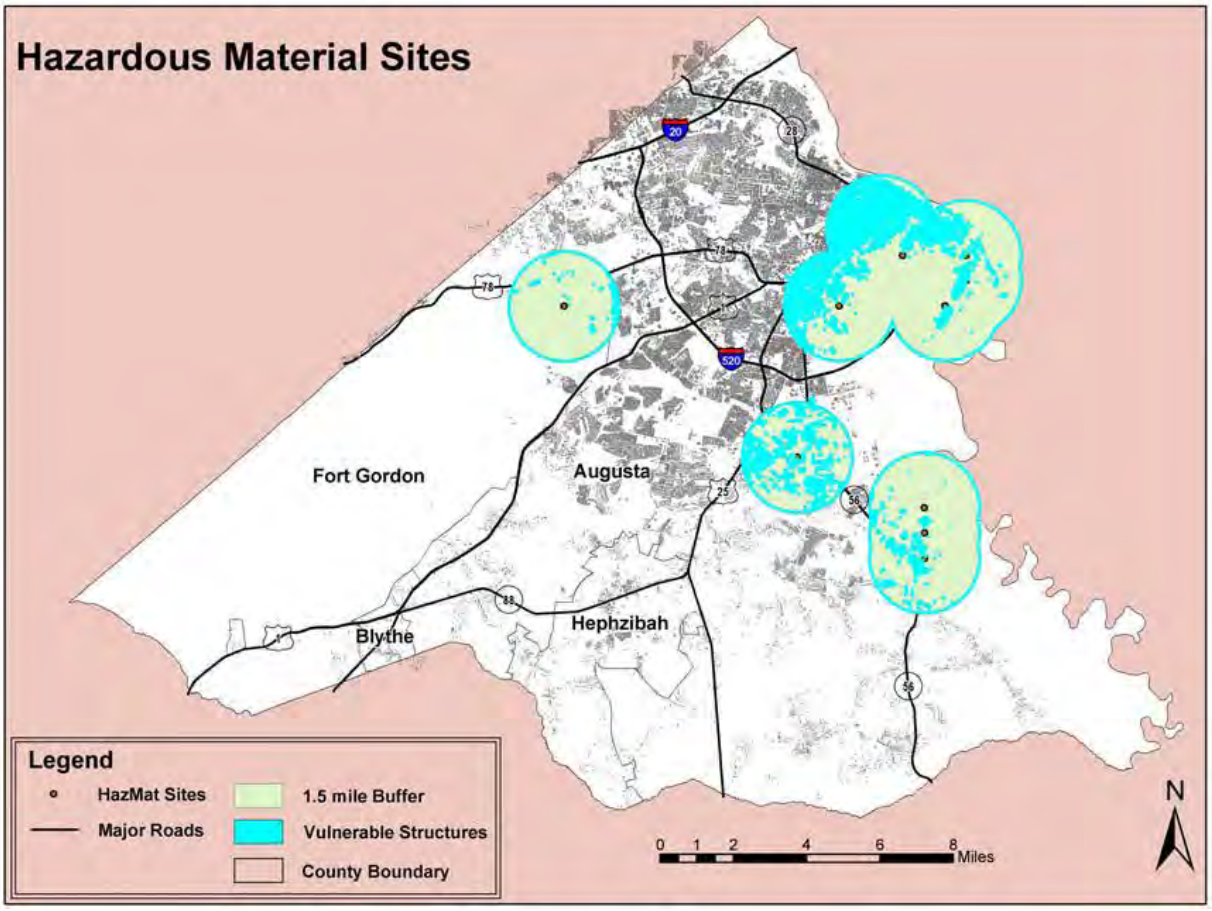
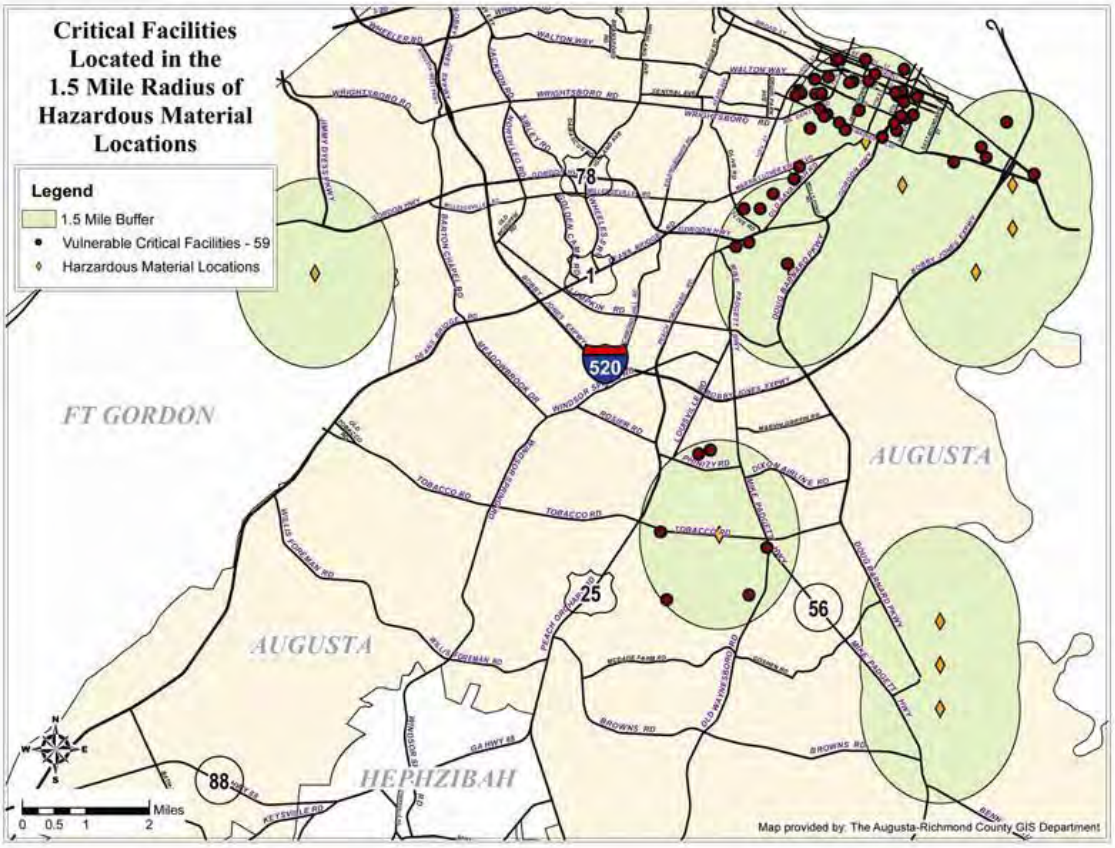


Figure 3.3: Hazardous Material Sites



Sources of potential hazards for the planning area are best understood with hazard site location and chemical hazard identification information. EPA databases contain community specific exposure data and maps related to chemical hazards as detailed below.

The EPA National Priorities List (NPL) is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories.

Sites are listed on the National Priorities List (NPL) upon completion of Hazard Ranking System (HRS) screening, public solicitation of comments about the proposed site, and after all comments have been addressed. More information about these steps in the process can be found here:

- Introduction to the HRS
- How Sites are Placed on the NPL
- Public Comment Process
- How Sites are Deleted from the NPL
- Notice of Policy Change for Partial Deletion from the NPL

The Hazard Ranking System (HRS) is the principal mechanism EPA uses to place uncontrolled waste sites on the National Priorities List (NPL). It is a numerically based screening system that uses information from initial, limited investigations - the preliminary assessment and the site inspection - to assess the relative potential

of sites to pose a threat to human health or the environment. Any person or organization can petition EPA to conduct a preliminary assessment using the Preliminary Assessment Petition (PDF) (4 pp, 485 K, About PDF).

The NPL primarily serves as an information and management tool. It is a part of the Superfund cleanup process. The NPL is updated periodically. The Federal Register Notices for NPL Updates page provides a list of Federal Register Notices for proposed and final NPL Updates. The list is ordered by year and provides the rule type, rule date, FR citation, and a short content description for each FR.
Section 105(a)(8)(B) of CERCLA (CERCLA Overview) as amended, requires that the statutory criteria provided by the HRS be used to prepare a list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. This list, which is Appendix B of the National Contingency Plan, is the NPL.

The identification of a site for the NPL is intended primarily to guide EPA in:

- Determining which sites warrant further investigation to assess the nature and extent of the human health and environmental risks associated with a site;
- Identifying what CERCLA-financed remedial actions may be appropriate;
- Notifying the public of sites EPA believes warrant further investigation; and
- Serving notice to potentially responsible parties that EPA may initiate CERCLA-financed remedial action.

Inclusion of a site on the NPL does not in itself reflect a judgment of the activities of its owner or operator, it does not require those persons to undertake any action, nor does it assign liability to any person. The NPL serves primarily informational purposes, identifying for the States and the public those sites or other releases that appear to warrant remedial actions (Source: EPA, National Priorities List (NPL), Basic Information. http://www.epa.gov/superfund/sites/npl/npl_hrs.htm.)
The HRS uses a structured analysis approach to scoring sites. This approach assigns numerical values to factors that relate to risk based on conditions at the site. The factors are grouped into three categories:

- Likelihood that a site has released or has the potential to release hazardous substances into the environment;
- Characteristics of the waste (e.g. toxicity and waste quantity); and
- People or sensitive environments (targets) affected by the release.

Table 3.6 below contains NPL sites for Georgia, including sites in the Augusta – Richmond County planning area. Site narrative analysis documents are contained in links in the far right column of the table.

Table 3.6: EPA NPL List for Georgia Sites

Table 3.6: EPA NPL List for Georgia Sites* Augusta – Richmond County Sites Highlighted in Gray						
Site Name	**City**	**CERCLIS ID**	**Final Listing Date**	**Site Score**	**Federal Facility Indicator**	**Additional Information**
Alternate Energy Resources	Augusta	GAD033582461	04 / 19 / 2006	50.00	No	Site Listing Narrative
Brunswick Wood Preserving	Brunswick	GAD981024466	04 / 01 / 1997	54.49	No	Site Listing Narrative
Camilla Wood Preserving Company	Camilla	GAD008212409	07 / 28 / 1998	50.00	No	Site Listing Narrative
Diamond Shamrock Corp. Landfill	Cedartown	GAD990741092	08 / 30 / 1990	35.60	No	Site Listing Narrative
Firestone Tire & Rubber Co. (Albany Plant)	Albany	GAD990855074	10 / 04 / 1989	30.08	No	Site Listing Narrative
Hercules 009 Landfill	Brunswick	GAD980556906	09 / 21 / 1984	52.58	No	Site Listing Narrative
LCP Chemicals Georgia	Brunswick	GAD099303182	06 / 17 / 1996		No	Site Listing Narrative
Marine Corps Logistics Base	Albany	GA7170023694	11 / 21 / 1989	44.65	Yes	Site Listing Narrative
Marzone Inc./Chevron Chemical Co.	Tifton	GAD991275686	10 / 04 / 1989	30.26	No	Site Listing Narrative
Mathis Brothers Landfill (South Marble Top Road)	Kensington	GAD980838619	03 / 31 / 1989	30.78	No	Site Listing Narrative
Peach Orchard Road PCE Ground Water Plume	Augusta	GAN000407449	09 / 14 / 2005	50.00	No	Site Listing Narrative
Robins Air Force Base (Landfill #4/Sludge Lagoon)	Houston County	GA1570024330	07 / 22 / 1987	51.66	Yes	Site Listing Narrative
T.H. Agriculture & Nutrition Co. (Albany Plant)	Albany	GAD042101261	03 / 31 / 1989	40.93	No	Site Listing Narrative
Woolfolk Chemical Works, Inc.	Fort Valley	GAD003269578	08 / 30 / 1990	42.24	No	Site Listing Narrative

EPA Toxics Release Inventory (TRI)

In 1984, a deadly cloud of methyl isocyanate killed thousands of people in Bhopal, India. Shortly thereafter, there was a serious chemical release at a sister plant in

West Virginia. These incidents underscored demands by industrial workers and communities in several states for information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information on toxic chemicals being released "beyond the fence line" -- outside of the facility. Against this background, the Emergency Planning and Community Right-to-Know Act (EPCRA) was enacted in 1986.

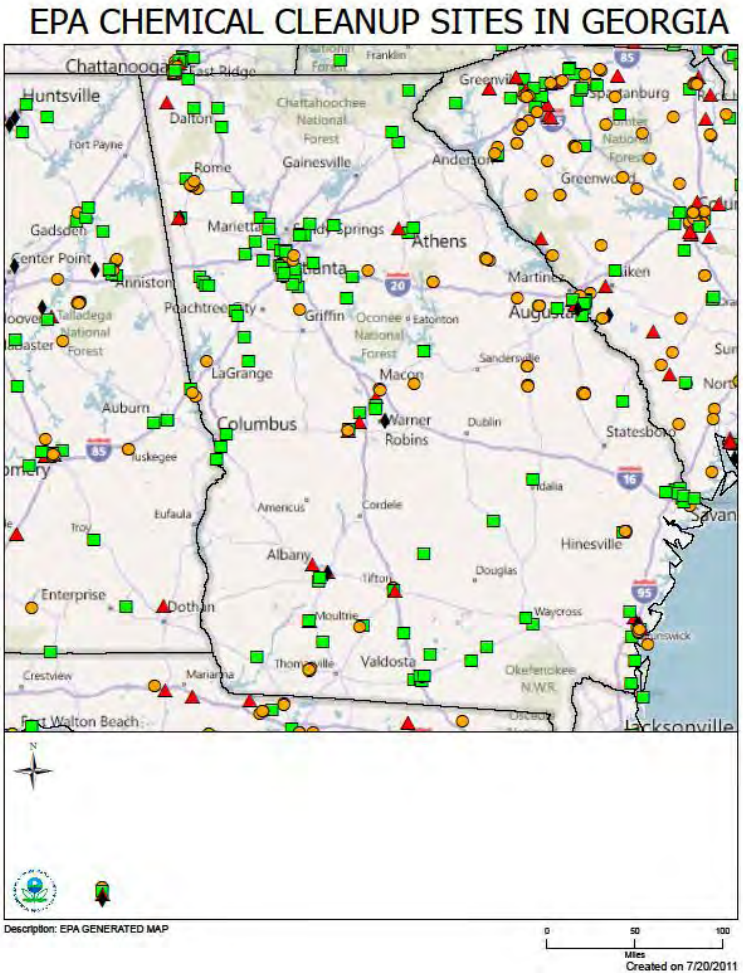
One of EPCRA's primary purposes is to inform citizens of toxic chemical releases in their areas. EPCRA Section 313 requires EPA and the States to collect data annually on releases and transfers of certain toxic chemicals from industrial facilities and make the data available to the public through the Toxics Release Inventory (TRI). TRI is a database containing data on disposal or other releases of over 600 toxic chemicals from thousands of U.S. facilities and information about how facilities manage those chemicals through recycling, energy recovery, and treatment. One of TRI's primary purposes is to inform communities about toxic chemical releases to the environment.

In 1990 Congress passed the Pollution Prevention Act which requires facilities to report additional data on waste management and source reduction activities to EPA under TRI. The goal of the Toxics Release Inventory Program is to provide communities with information about toxic chemical releases and waste management activities and to support informed decision making at all levels by industry, government, non-governmental organizations, and the public.

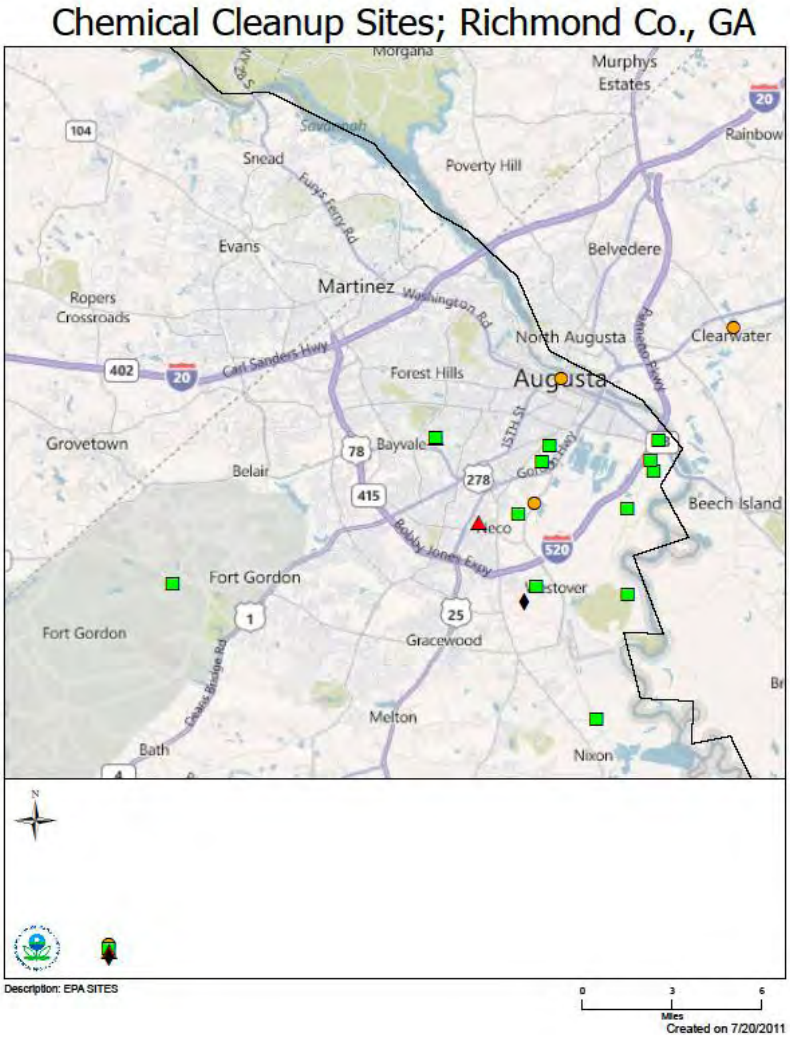
The Toxics Release Inventory Program compiles the TRI data submitted by regulated facilities each year and makes the data available through the TRI Data Files and Tools webpage (Source: EPA, Toxics Release Inventory (TRI) Program. http://www.epa.gov/tri/triprogram/whatis.htm.)

The TRI mapping platform contains information in data and graphical form for Chemical Hazard Cleanup Sites for all U.S. states including Georgia. Regional, county, and municipal location information can be produced as well. Map production for the state of Georgia and the Augusta − Richmond County planning area produced the following maps.

Map 1: EPA TRI Map of Chemical Cleanup Sites in Georgia



Map 2: EPA TRI Map of Chemical Cleanup Sites in Richmond, County

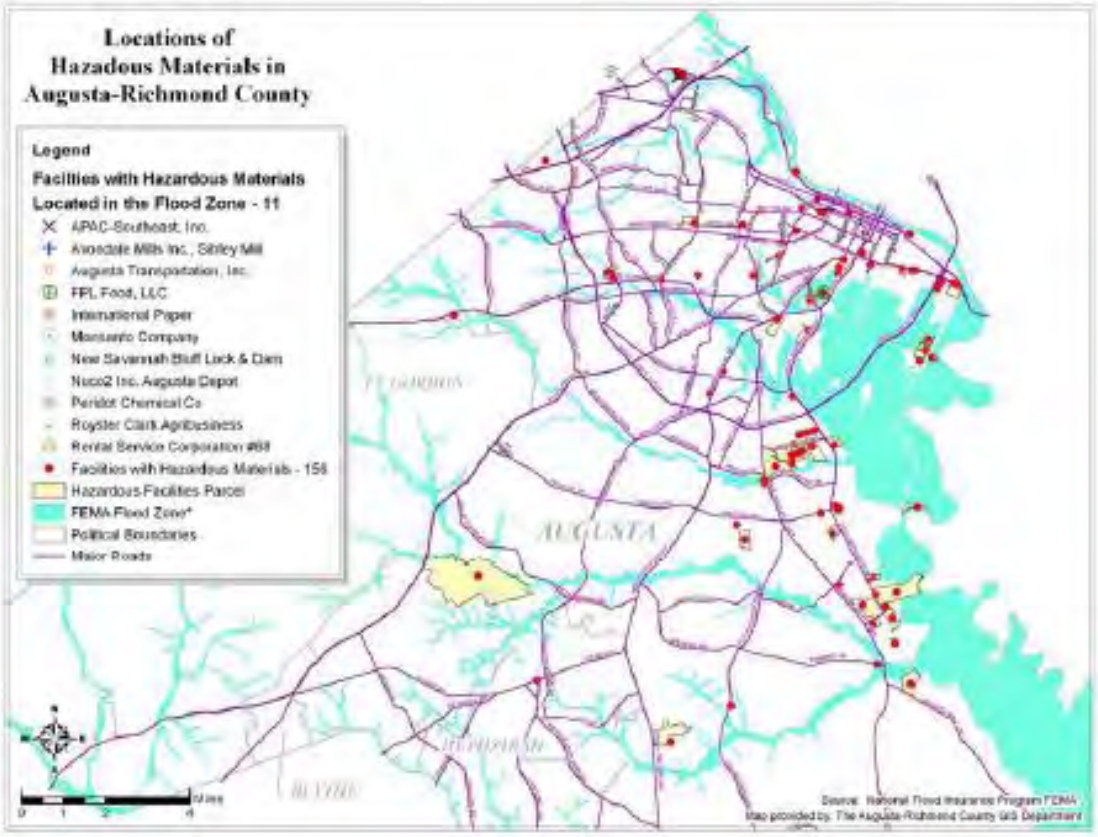


Flood Risks – Chemical Hazards.

Extensive flood-prone areas are found on Augusta's east side and are associated with Butler Creek, Rocky Creek, and drainage from all streams in the urban district (former City). The area, also known as Phinizy Swamp, is generally flat and is predicted to experience relatively shallow flooding. Industries in the area are familiar with flood hazards and containment areas (around chemical storage tanks) that are located in floodplain areas are sized to protect against flooding up to the predicted level of the base flood (100-year).

Figure 3-4 below uses the best available location data for hazardous materials (which may be represented by office address rather than physical location of material handling facility). Of the 156 locations, eleven plot as falling within the mapped flood hazard area. This determination does not imply that these facilities are subject to flooding or transport offsite during a flood event.

Figure 3-4: Locations of Hazardous Materials (flood map).



3.1.4. Estimate of Losses Due to Chemical Hazard

There is no information available for past or future losses due to Chemical Hazard exposure. Important to note is the staggering costs of hazardous site cleanup. The potential for parcel condemnation, government or personal acquisition of a toxic site and the resulting costs of environmental remediation are a genuine community concern. Human impact, State and Federal fines, enforcement costs, and impact to the environment are difficult to quantify. Chemical contamination of buildings may require demolition, site contamination may eliminate development potential, and emergency response operations after an event can economically cripple communities.

First responders are generally local fire service personnel or Hazardous Material (HazMat) Teams that are trained in basic procedures for the initial (first) response to hazardous materials incidents. The responsibilities of first responders including securing the incident scene and making a preliminary assessment of the potential severity of the hazardous material incident and the level of threat, if any, to persons at and outside of the immediate incident area. In Richmond County, most fire service personnel are trained to either the "Awareness" Level or "Operations" Level.

HazMat Teams are specialized teams, composed primarily of fire service personnel, with higher-level training and specialized equipment for dealing with hazardous

materials. For Richmond County, the HazMat Team with primary responsibility is the Augusta EMA ESF Team.

The hazardous materials services function is the primary responsibility of the Augusta Fire Department, while support for this function is the responsibility of CHEMTREC, Radiological Assist Program DOE, and Richmond County Health Department (Source: Augusta Local Emergency Operations Plan [LEOP], http://appweb.augustaga.gov/ema/docs/LEOP_public.pdf.

The EMA plan for hazardous materials incidents is characterized as Preparedness, Response, Recovery, and Mitigation. The response methodology is dependent on the following factors:

- Class of hazardous material
- Size of container
- Fire/explosion potential
- Leak severity and container integrity, and
- Threat to life safety.

Hazardous Materials Transport: Truck, Rail Shipments and Pipelines

Truck Shipments

Hazardous materials are transported once or many times during their "life cycle" of raw materials, manufacturing, incorporation into other products, wholesale and retail trade, use, waste disposal, and recycling. For Richmond County, transportation accidents present the highest risk for hazardous material incidents.

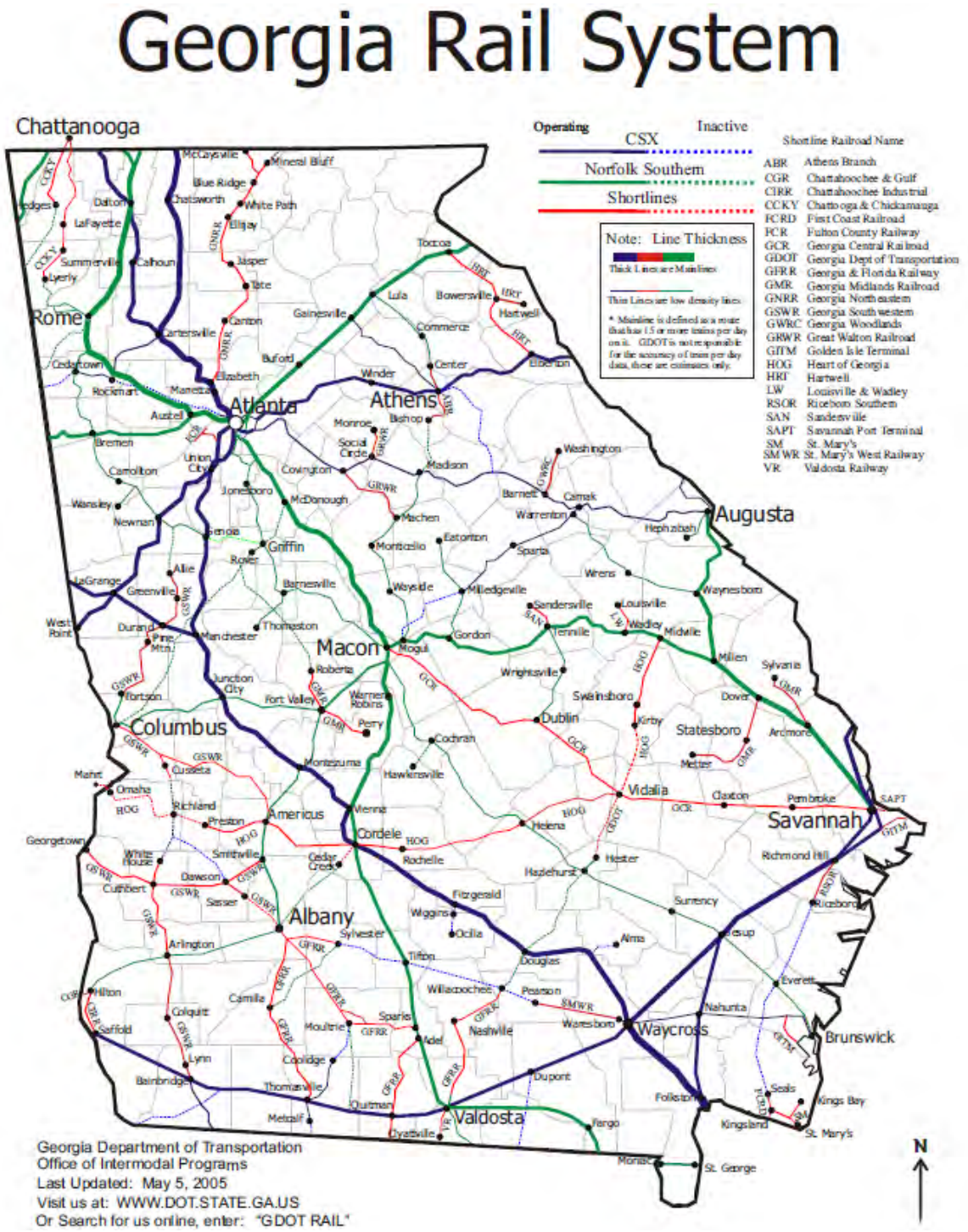
Rail Shipments

There are 2 major rail freight carriers operating in Richmond, according to 2011 data from the GDOT Department of Transportation (GDOT) website (http://www.dot.state.ga.us/maps/Documents/railroad/Georgia_Rail_Map_plain.pdf). GDOT has responsibility for state transit safety oversight. Map 3 below illustrates the rail lines operating in the Georgia. The main railroads serving Richmond County are CSX and Norfolk Southern.

Hazard Events in Richmond County

At approximately 0300 on January 6, 2005 a Norfolk Southern Train collided with a parked train in the town of Graniteville, SC. Four hazardous materials tank cars derailed (three chlorine, one sodium hydroxide). One chlorine car was breached, releasing approximately 40 tons of chlorine; 50 tons remained in tank car. Nine fatalities occurred and hundreds of victims reported respiratory affects. A one mile radius was evacuated (5,400 people) and a 2 mile radius shelter−in−place zone established (Environmental Protection Agency, 2005).

Map 3: Georgia Rail Lines



Natural Gas Pipelines

The natural gas pipeline systems of local gas utilities, including the systems in Richmond County, almost always follow road and street patterns because of established utility rights of way and because of the need to connect with each building served. Thus, for areas served by natural gas, the local street network is essentially identical to the natural gas distribution pipe network.

Overall, the safety record of natural gas distribution pipelines is good with relatively few significant accidents. Natural gas is not toxic (i.e., not poisonous). However, natural gas can be an asphyxiant if it displaces oxygen in an enclosed space. Natural gas burns readily when ignited, but only when gas concentrations are between 4% and 15% in air. In its pure state, natural gas is both colorless and odorless. The strong odor normally associated with natural gas is an odorant deliberately introduced at low concentrations to serve as a warning of the presence of natural gas. The strong odorant is generally added to natural gas at the local distribution level, by local gas utilities, and is readily detectible in concentrations well below the explosive range.

Fires and/or explosions from natural gas leaks in pipelines are rare. In part, the rarity of fires and/or explosions is due to the fact that natural gas is about 1/3rd less dense than ordinary air. Thus, leaking natural gas does not accumulate near the ground or "pond" in low-lying areas (as heavier gases such as liquefied natural gas or gasoline fumes may do). Instead, leaking natural gas rises rapidly and is dissipated by dilution in the atmosphere. The fires and /or explosions that do occur from natural gas leaks are generally in buildings where the confined space allows leaking gas to accumulate until ignited.

Pipeline breaks from natural causes may occur due to landslides or earthquakes. Earthquake induced pipe breaks for natural gas transmission lines are most likely to occur in areas of soft soils subject to liquefaction and/or lateral spreading which cause significant pipe displacements. The most likely locations for such breaks during an earthquake are on slopes of soft ground near where pipelines cross rivers or streams.

The most common man-made cause of pipeline breaks is pipeline rupture due to pipes breaking when heavy construction equipment is used to excavate for construction projects. Most such breaks occur in local distribution lines. Pipeline breaks can also be caused by deliberate actions of sabotage or terrorism. Although pipelines are not symbolic targets with political, historical, and cultural significance, they are potential targets for terrorist actions. Major pipeline breaks could disrupt gas service over wide areas with resulting significant economic impacts.

Natural gas utilities and local emergency responders are generally well prepared to deal with natural gas breaks, because such incidents occur frequently enough to have well-standardized response procedures. Evacuations for natural gas distribution system pipeline ruptures are generally limited to the immediate area of the break.

More than 60 miles of transmission pipelines run across Richmond County. Atlanta Gas Light owns eight miles of pipe, while Southern Natural Gas Co. owns a loop of 56 miles. The Atlanta Gas Light line, consisting of 8 and 10 inch pipe, was installed in 1960; the other line dates back to 1953.

As reviewed above in Sections 11.5 to 11.7, there are many fixed locations in Richmond County with inventories of hazardous materials and a considerable volume of hazardous materials being transported to, from, within, or through Richmond County. For both fixed and in transit hazardous materials, there is a wide variety of types and quantities of materials.

Historically, the safety record for hazardous materials has been good, with relatively few, hazmat incidents. Nevertheless, there is a potential for larger hazmat incidents in Richmond County. A brief synopsis of the probable impacts of hazmat incidents on Richmond County is given below in Table 3.7 below.

Table 3.7: Probable Impacts of Hazmat Incidents in Richmond County

Inventory	Potential Impacts
Area Affected	Most HazMat incident are localized near source of spill; major spills could have extensive evacuation zones and affect significant portion of community
Buildings	Negligible impact with exception of explosion incidents near structures
Streets	Temporary street closure likely
Roads	Temporary road closure likely
Interstate	Slow down of traffic; temporary road closure possible
Electrical Power	Negligible impact with exception of explosion incidents near transmission lines, power grid, poles
Other Utilities	Minor to major impact; chemical release near water supply intakes or recharge areas could limit or contaminate water supply
Casualties	Potential for injuries and deaths dependent on spatial extent and type of hazardous material

3.1.5. Land use and development trends related to Chemical Hazard

The Augusta Zoning Ordinance specifies that certain uses are prohibited in the Savannah River Corridor Protection District (plus 100-foot buffer), including "handling areas for the receiving and storage of hazardous wastes and disposal facilities for hazardous or solid wastes" (Sec. 25- D-5).

Augusta's Groundwater Protection Standards (Title 8) requires that in certain significant groundwater recharge areas:

- No land disposal of hazardous waste shall be permitted;
- The handling, storage and disposal of hazardous materials shall take place on an impermeable surface having spill and leak protection approved by the

Georgia Department of Natural Resources, Environmental Protection Division; and

- New above-ground chemical or petroleum storage tanks larger than 660 gallons must have secondary containment for 110 percent of tank volume or 110 percent of the largest tanks in a cluster of tanks.

3.1.6 Multi-Jurisdictional differences in Chemical Hazard Events

For the purposes of this Plan, the only technological hazards considered are those risks associated with hazardous materials locations that are also subject to flood hazards. Many facilities in Augusta's industrial area use hazardous materials and the transport of materials via highway and railroad poses considerable threat, therefore a relative risk ranking of 'high' was assigned to the likelihood of a HazMat incident occurring (see Table 3.4 for a summary of relative risks). This assessment in no way minimizes the seriousness of impacts due to HazMat incidents, especially transportation-related incidents.

3.1.7 Chemical Hazard HRV Summary

Effective mitigation planning and effective emergency response planning can help reduce the number or frequency of hazardous materials incidents and also reduce the severity of incidents that do occur. In combination, these benefits can significantly reduce the negative impacts of hazardous materials incidents on affected communities. The general principles of mitigation planning, emergency response planning (and training) is well standardized and practiced by Richmond County in concert with its local partners, GEMA and FEMA.

Perhaps the single most critical factor in enhancing both mitigation planning and emergency response planning is **specific inventory awareness** for major hazardous materials sites within each jurisdiction. Specific inventory awareness means detailed knowledge of the types of hazardous materials, quantities of hazardous materials and locations of every location in a jurisdiction with significant quantities of hazardous materials. In this context, what constitutes a significant quantity varies depending on the toxicity of the material, the dispersal characteristics and the nature and population of nearby areas likely to be affected by hazardous materials incidents.

Augusta Emergency Management has access to the state database information which contains a vast amount of information on the inventories of hazardous materials at fixed locations in Richmond County. This detailed inventory information along with data hazardous materials being transported within or through Richmond County, provides the basic data for specific inventory awareness. In combination, with the chemical data and emergency response information provided in the **2000 Emergency Response Guide** and in other sources, these are the basic data necessary for effective planning and effective emergency response.

3.2 Technological Hazard B: Terrorism

After the September 11 attacks, the Georgia Information Sharing & Analysis Center (GISAC) was created to solve the information / intelligence sharing challenges between federal, state, and local agencies. GISAC's primary mission is to serve as the state's focal point for the collection, assessment, analysis, and dissemination of terrorism intelligence relating to Georgia.

GISAC was not intended to replace or duplicate the counter-terrorism functions of the Federal Bureau of Investigation (FBI), but rather to enhance and facilitate the collection of information from local and state sources, and to integrate that information into a system that would benefit homeland security and counter-terrorism intelligence programs at all levels. GISAC is composed of personnel representing the following agencies and organizations:

Georgia Office of Homeland Security / Georgia Emergency Management Agency (GOHS/GEMA)

Georgia Bureau of Investigation (GBI)
Georgia Department of Public Safety / Georgia State Patrol (GSP)
Georgia Sheriff's Association (GSA)
Georgia Association of Chiefs of Police (GACP)
Georgia Association of Fire Chiefs (GAFC)
Georgia Department of Corrections

The GISAC produces The Open Source Report, which is a weekly summary of open-source information concerning terrorism and infrastructure issues of interest to the Georgia homeland security community.

3.2.1 Terrorism Identity

FEMA defines terrorism as any "activity that involves an act that is dangerous to human life or potentially destructive of critical infrastructure or key resources; is a violation of the criminal laws of the United States or of any State or other subdivision of the United States; and appears to be intended to intimidate or coerce a civilian population, to influence the policy of a government by intimidation or coercion, or to affect the conduct of a government by mass destruction, assassination, or kidnapping," (FEMA, 2011)

Terrorism is the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom.

Terrorists often use threats to:

- Create public fear;
- Convince citizens the government is unable to prevent terrorism.
- Gain publicity for their causes.

Acts of terrorism include threats of terrorism; assassinations; kidnappings; hijackings; bomb scares and bombings; cyber attacks (computer-based); and the use of chemical, biological, nuclear and radiological weapons.

High-risk targets for acts of terrorism include military and civilian government facilities, international airports, large cities, and high-profile landmarks. Terrorists might also target large public gatherings, water and food supplies, utilities, and corporate centers. Further, terrorists are capable of spreading fear by sending explosives or chemical and biological agents through the mail (FEMA, 2011).

3.2.2 Terrorism Profile

Pre-9/11 (September 11, 2001) attacks on New York and U.S. Pentagon, terrorist incidents in the U.S. were primarily bombing attacks, involving detonated and undetonated explosive devices, tear gas, and pipe or fire bombs. Terrorist incidents in the U.S. largely involved small extremist groups using acts of terrorism to achieve a specific objective. Monitoring suspected terrorist activities by Local, state and federal law enforcement officials serves to prevent or protect against an attack. Other nations work with the U.S. government to limit political and financial support efforts for terrorism.

The United States Attorney General in consultation with the Homeland Security Secretary assigns a National Terrorism Threat Level, predicated on an ongoing threat analysis. The Counterterrorism Division of the Federal Bureau of Investigation (FBI) maintains continual contact with the U.S. Office of Homeland Security and the intelligence community to exchange, monitor, and share threat information.

Several factors are considered when assigning a specific Threat Level, including:

- Threat credence;
- Threat independent corroboration;
- Threat specificity and/or imminence;
- Gravity of the threat.

Terrorist tactics include:

Explosive Hazards

Terrorists frequently use explosive devices as the most common weapon. Information is readily available in books and other information sources on constructing explosive devices. Materials needed for explosive devices are found in variety, hardware, and auto supply stores. The devices are highly portable in vehicles and hidden on humans as the mode of transport. Explosives are readily detonated from remote locations or by suicide bombers.

Conventional bombs are used to damage and destroy financial, political, social, and religious institutions. Attacks occurred around the world in public places and on city streets injuring and killing thousands of people.

Biological Hazards

Biological agents are organisms or toxins that can kill or incapacitate people, livestock, and crops. The three basic groups of biological agents that would likely be used as weapons are bacteria, viruses, and toxins. Most biological agents are difficult to grow and maintain. Many break down quickly when exposed to sunlight and other environmental factors, while others, such as anthrax spores, are very long lived. Biological agents can be dispersed by spraying them into the air, by infecting animals that carry the disease to humans and by contaminating food and water.

Delivery methods include:

- Aerosols - biological agents dispersed into the air, form a fine mist that can drift for miles. Inhaling the agent may cause disease in people or animals;
- Animals - some diseases are spread by insects and animals, such as fleas, mice, flies, mosquitoes, and livestock;
- Food and water contamination - some pathogenic organisms and toxins may persist in food and water supplies. Most microbes can be killed, and toxins deactivated, by cooking food and boiling water. Most microbes are killed by boiling water for one minute, but some require longer. Follow official instructions;
- Person-to-person - spread of a few infectious agents is also possible. Humans have been the source of infection for smallpox, plague, and the Lassa viruses.

Chemical Threats

Chemical agents are poisonous vapors, aerosols, liquids, and solids that have toxic effects on people, animals, or plants. They can be released by bombs or sprayed from aircraft, boats, and vehicles. They can be used as a liquid to create a hazard to people and the environment. Some chemical agents may be odorless and tasteless. They can have an immediate effect (a few seconds to a few minutes) or a delayed effect (2 to 48 hours). While potentially lethal, chemical agents are difficult to deliver in lethal concentrations. Outdoors, the agents often dissipate rapidly. Chemical agents also are difficult to produce.

A chemical attack could come without warning. Signs of a chemical release include people having difficulty breathing; experiencing eye irritation; losing coordination; becoming nauseated; or having a burning sensation in the nose, throat, and lungs. Also, the presence of many dead insects or birds may indicate a chemical agent release.

Nuclear Blast

A nuclear blast is an explosion with intense light and heat, a damaging pressure wave, and widespread radioactive material that can contaminate the air, water, and ground surfaces for miles around. A nuclear device can range from a weapon carried by an intercontinental missile launched by a hostile nation or terrorist organization, to a small portable nuclear devise transported by an individual. All

nuclear devices cause deadly effects when exploded, including blinding light, intense heat (thermal radiation), initial nuclear radiation, blast, fires started by the heat pulse, and secondary fires caused by the destruction.

Hazards of Nuclear Devices

The extent, nature, and arrival time of these hazards are difficult to predict. The geographical dispersion of hazard effects will be defined by the following:

- Size of the device. A more powerful bomb will produce more distant effects.
- Height above the ground the device was detonated. This will determine the extent of blast effects.
- Nature of the surface beneath the explosion. Some materials are more likely to become radioactive and airborne than others. Flat areas are more susceptible to blast effects.
- Existing meteorological conditions. Wind speed and direction will affect arrival time of fallout; precipitation may wash fallout from the atmosphere.

Radiological Dispersion Device

Terrorist use of an RDD—often called "dirty nuke" or "dirty bomb"—is considered far more likely than use of a nuclear explosive device. An RDD combines a conventional explosive device—such as a bomb—with radioactive material. It is designed to scatter dangerous and sub-lethal amounts of radioactive material over a general area. Such RDDs appeal to terrorists because they require limited technical knowledge to build and deploy compared to a nuclear device. Also, the radioactive materials in RDDs are widely used in medicine, agriculture, industry, and research, and are easier to obtain than weapons grade uranium or plutonium.
The primary purpose of terrorist use of an RDD is to cause psychological fear and economic disruption. Some devices could cause fatalities from exposure to radioactive materials. Depending on the speed at which the area of the RDD detonation was evacuated or how successful people were at sheltering-in-place, the number of deaths and injuries from an RDD might not be substantially greater than from a conventional bomb explosion.

The size of the affected area and the level of destruction caused by an RDD would depend on the sophistication and size of the conventional bomb, the type of radioactive material used, the quality and quantity of the radioactive material, and the local meteorological conditions—primarily wind and precipitation. The area affected could be placed off-limits to the public for several months during cleanup efforts.

3.2.3 Inventory of Assets exposed to Terrorism

All assets in the Augusta – Richmond County planning area are exposed to terrorism. The insidious nature of attacks, covert construction and transportation of devices used, and the domestic and foreign political and financial support of terroristic acts are inhibiting factors in mitigation planning. The proximity of Fort

Gordon, location of major rail and truck transportation lines, and the concentration of population heighten the risk for the planning area.

Future development is considered at risk. According to GDOT Population Projections to 2030, the projected population in Richmond County will increase by 15.02 percent from 2000 to 2030. This increase in population will result in an increase in housing and facilities that may be at risk from terrorism.

Tables 3.7 and 3.8 below contain terrorism hazard event profiles compiled by FEMA.

Table 3.7:

Event Profiles for Terrorism and Technological Hazards

Hazard	Application Mode	Hazard Duration	Extent of Effects; Static/Dynamic	Mitigating and Exacerbating Conditions
Conventional Bomb/ Improvised Explosive Device	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile.	Instantaneous; additional "secondary devices" may be used, lengthening the time duration of the hazard until the attack site is determined to be clear.	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Overpressure at a given standoff is inversely proportional to the cube of the distance from the blast; thus, each additional increment of standoff provides progressively more protection. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to target; lack of barriers/shielding; poor construction; and ease of concealment of device.
Chemical Agent *	Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists.	Contamination can be carried out of the initial target area by persons, vehicles, water and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperature can affect evaporation of aerosols. Ground temperature affects evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazard. Precipitation can dilute and disperse agents but can spread contamination. Wind can disperse vapors but also cause target area to be dynamic. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects.
Arson/ Incendiary Attack	Initiation of fire or explosion on or near target via direct contact or remotely via projectile.	Generally minutes to hours.	Extent of damage is determined by type and quantity of device/accelerant and materials present at or near target. Effects generally static other than cascading consequences, incremental structural failure, etc.	Mitigation factors include built-in fire detection and protection systems and fire-resistive construction techniques. Inadequate security can allow easy access to target, easy concealment of an incendiary device and undetected initiation of a fire. Non-compliance with fire and building codes as well as failure to maintain existing fire protection systems can substantially increase the effectiveness of a fire weapon.
Armed Attack	Tactical assault or sniping from remote location.	Generally minutes to days.	Varies based upon the perpetrators' intent and capabilities.	Inadequate security can allow easy access to target, easy concealment of weapons and undetected initiation of an attack.
Biological Agent *	Liquid or solid contaminants can be dispersed using sprayers/aerosol generators or by point or line sources such as munitions, covert deposits and moving sprayers.	Biological agents may pose viable threats for hours to years depending on the agent and the conditions in which it exists.	Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infection can be spread via human or animal vectors.	Altitude of release above ground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate wind will disperse agents but higher winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents.

Table 3.8 Event Profiles for Terrorism and Technological Hazards

Event Profiles for Terrorism and Technological Hazards (continued)

Hazard	Application Mode	Hazard Duration	Extent of Effects; Static/Dynamic	Mitigating and Exacerbating Conditions
Cyber-terrorism	Electronic attack using one computer system against another.	Minutes to days.	Generally no direct effects on built environment.	Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.
Agriterrorism	Direct, generally covert contamination of food supplies or introduction of pests and/or disease agents to crops and livestock.	Days to months.	Varies by type of incident. Food contamination events may be limited to discrete distribution sites, whereas pests and diseases may spread widely. Generally no effects on built environment.	Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.
Radiological Agent **	Radioactive contaminants can be dispersed using sprayers/aerosol generators, or by point or line sources such as munitions, covert deposits and moving sprayers.	Contaminants may remain hazardous for seconds to years depending on material used.	Initial effects will be localized to site of attack; depending on meteorological conditions, subsequent behavior of radioactive contaminants may be dynamic.	Duration of exposure, distance from source of radiation, and the amount of shielding between source and target determine exposure to radiation.
Nuclear Bomb **	Detonation of nuclear device underground, at the surface, in the air or at high altitude.	Light/heat flash and blast/shock wave last for seconds; nuclear radiation and fallout hazards can persist for years. Electromagnetic pulse from a high-altitude detonation lasts for seconds and affects only unprotected electronic systems.	Initial light, heat and blast effects of a subsurface, ground or air burst are static and are determined by the device's characteristics and employment; fallout of radioactive contaminants may be dynamic, depending on meteorological conditions.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat and blast energy decrease logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.
Hazardous Material Release (fixed facility or trans-portation)	Solid, liquid and/or gaseous contaminants may be released from fixed or mobile containers.	Hours to days.	Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination may be carried out of the incident area by persons, vehicles, water and wind.	As with chemical weapons, weather conditions will directly affect how the hazard develops. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects. Non-compliance with fire and building codes as well as failure to maintain existing fire protection and containment features can substantially increase the damage from a hazardous materials release.

* Source: *Jane's Chem-Bio Handbook*
** Source: FEMA, *Radiological Emergency Management* Independent Study Course

3.2.4 Estimation of potential losses to Terrorism

Man-made and technological hazards are by definition non-quantifiable. Calculating or estimating monetary losses from terrorism hazards can only be identified in that all assets are at risk. As such, they cannot be compared and prioritized in the same

manner as risks from natural hazards. The HMPC recognizes the inability to quantify assets exposed to terrorism beyond those stated above.

The Augusta – Richmond County EOP plan recognizes and incorporates the various jurisdictional and functional authorities of departments and agencies; municipal governments; and private-sector organizations in incident management. The EOP details the specific incident management roles and responsibilities of the departments and agencies involved in incident management. Further, the plan establishes the multi-agency organizational structures and processes required to implement the authorities, roles, and responsibilities for incident management. The plan is applicable to all departments and agencies that may be requested to provide assistance or conduct operations in the context of actual or potential disasters or emergencies.

Terrorism induced disasters or emergencies are high-impact events that require a coordinated and effective response by an appropriate combination of County, municipal, private-sector, and nongovernmental entities in order to save lives, minimize damage, and provide the basis for long-term community recovery and mitigation activities.

3.2.5 Land use and development trends related to Terrorism

There are several contributing land uses related to the threat of terrorism. The first is the location of major transportation corridors from East to West on Interstates 20 and 520 and the CSX and Norfolk Southern rail lines. The second is the concentration of industrial uses and rail lines in close proximity to the City of Augusta. The third is the location of the Fort Gordon Military Base adjacent to Richmond County.

3.2.6 Multi-Jurisdictional Terrorism Differences

There are no multi-jurisdictional differences related to the terrorism hazard. All communities in Richmond County are at risk.

3.2.7 General overall HRV summary of Terrorism

There are an extensive range of potential impacts from terrorism. A terrorist attack could be a minor, localized event or a catastrophic event. Terrorism is a threat to facilities, infrastructure and human life.

The HMPC provided qualitative information and comments, and damage/loss estimations, using a Low – Moderate – High range, based on their knowledge of community facilities. Committee members considered potential risk to people (loss of life or injury), risk to buildings and critical facilities (primarily structural damage or loss of use) and risk to infrastructure (utilities, communications, and roads).

Data collected and shared with the HMPC for the assessment included:

- Critical Facilities List
- Infrastructure Inventory
- Hazard Identification Questionnaire
- Hazard Ranking Survey
- Hazard Identification − Risk Assessment Qualitative Summary
- EMA LEOP

The terrorism risk was ranked using the following criteria:

- Human Risk − High
- Buildings − High
- Infrastructure - High.

This RF ranking applies to all jurisdictions. The HMPC reviewed the EMA LEOP for guidance in completing the HVR.

3.3 Technical Hazard C: Nuclear Plant Incident

GEMA's Radiological Programs Section is responsible for the Radiological Emergency Preparedness (REP) Program, the Waste Isolation Pilot Plant (WIPP) Program, and Local Emergency Planning Committee (LEPC) Program.

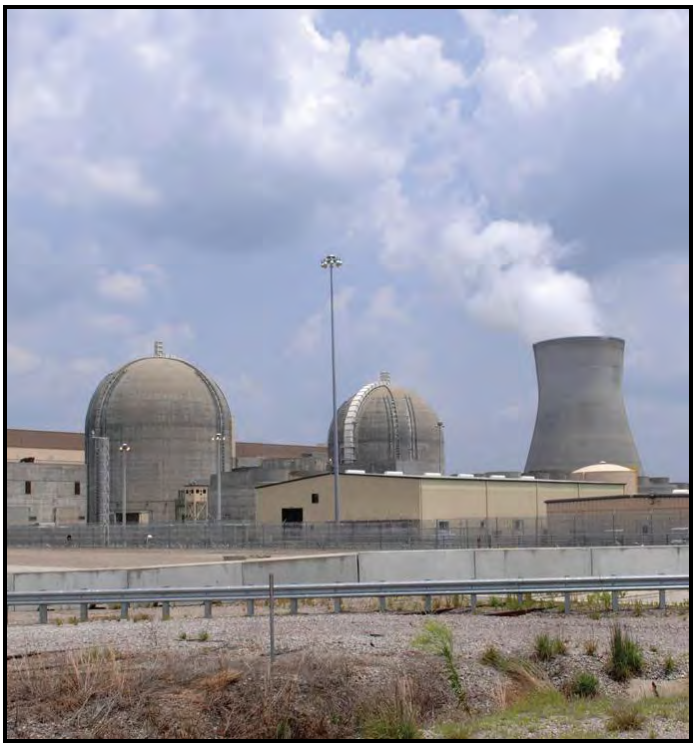
The mission of the REP Program is to ensure the health and safety of the public living in the vicinity of Georgia's nuclear power facilities in the event of an accident. The primary emphasis of the program is on nuclear power plants; however plans also address other fixed nuclear facilities and radiological incidents. The REP program is responsible for plan development, plan reviews, responder training, and exercises to ensure that state and local governments are ready to respond in the unlikely event of an accident.

Public Warning/Notification Warning to the public within the 10-mile emergency planning zones of Georgia's nuclear facilities is primarily provided by tone alert radios. These tone alert radios are similar to NOAA weather radios and are provided to all residences, businesses, schools and other facilities within 10 miles of each plant. This warning system can be activated by GEMA within minutes of the decision by local and state official notification of a nuclear emergency.

Sirens supplement the tone alert radios at Plant Vogtle and local television and radio broadcasts supplement the above mentioned systems at all sites. Emergency preparedness information is distributed annually to the public by the utility. This information contains maps of evacuation planning zones and instructions for what to do when notified of an emergency at the plant (GEMA, 2011).

3.3.1 Nuclear Plant Incident Identity

The Alvin W. Vogtle Nuclear Plant is located in Waynesboro, GA, approximately 25 miles south of Augusta in Burke County.



Picture 4: Alvin W. Vogtle Electric Generating Plant

3.3.2 Profile of Nuclear Plant Incident

The Alvin W. Vogtle Electric Generating Plant provides the following information in the 2011 Emergency Information Calendar distributed in the Augusta – Richmond County planning area:

Kinds of Emergencies

- **Unusual Event.** A minor problem has occurred. No release of radioactive matter has taken place or is expected. There is no danger to the public. Citizens do not have to take any action.
- **Alert.** Small amounts of radioactive material could be released inside the plant. An alert gets emergency workers ready if the event becomes more serious. There is no danger to the public. It is unlikely residents will need to do anything.
- **Site Area Emergency.** There has been a serious problem. Small amounts of radioactive material could be released into the area right around the plant. Government officials may order evacuation or sheltering of the public as a

precaution. Emergency workers would be ready to take actions if needed. Citizens should tune local radio or television stations.

- **General Emergency.** This is the most serious type of emergency at a nuclear power plant. Radioactive material could be released outside the plant site. Citizens may need to take protective actions discussed below. Citizens will be notified by your tone alert radio or through the media. Stay tuned to the radio or television stations listed in this calendar. County officials will guide citizen actions.

Emergency Actions

The two actions citizens may be asked to take for protection are "take shelter" or "evacuate." These two actions are described in the 2011 Emergency Information Calendar, (Source: Southern Company, 2011. Alvin W. Vogtle Electric Generating Plant Information Calendar. http://www.southerncompany.com/nuclearenergy/pdf/Vogtle_2011_calendar.pdf.)

3.3.3 Inventory assets exposed to Nuclear Plant Incident

The Alvin W. Vogtle Electric Generating Plant, also known as Plant Vogtle, is a 2-unit nuclear power plant located in Burke County, near Augusta and Waynesboro, Georgia. It is named after the Birmingham, Alabama-born war hero and, Alabama Power and Southern Company board chairman, Alvin Vogtle. Each unit has a Westinghouse pressurized water reactor (PWR), with a General Electric turbine and electric generator. Units 1 and 2 were completed in 1987 and 1989, respectively. Each of Vogtle's units is capable of producing approximately 1,200 MW of electricity when online, for a combined capacity of 2,400 MW. Southern Nuclear lists the capacity as 1,215 MW each, for a combined output of 2,430 MW.[1] The twin cooling towers are 548 ft (167 m) tall.

During Vogtle's construction, costs skyrocketed from an estimated $660 million to $8.87 billion. This was typical of the time due to increased regulations after the Three Mile Island accident. In 2009, the NRC renewed the licenses for both units for an additional 20 years, to the 2040s.[4] Groundwork for two additional reactors is well underway[5]

Power Uprate 2008

In 2008, both reactors were increased in power by 1.7% by an "Appendix K" uprate,[10] also called a Measurement Uncertainty Recapture uprate. "Measurement uncertainty recapture power uprates are less than 2 percent and are achieved by implementing enhanced techniques for calculating reactor power. This involves the use of state-of-the-art feedwater flow measurement devices to more precisely measure feedwater flow, which is used to calculate reactor power. More precise measurements reduce the degree of uncertainty in the power level, which is used by analysts to predict the ability of the reactor to be safely shutdown under postulated accident conditions."[11]

Because the reactor power can be calculated with much greater accuracy now than with the old venturi type measurement, the plant can safely run within a tighter margin of error to their limit. The new flow meter works by comparing the time it takes ultrasonic sound pulses to travel upstream versus downstream inside the pipe, and uses that time difference to figure the flow rate of the water in the pipe.

The NRC approved Vogtle's License Amendment Request (LAR) in March 2008. "The NRC staff determined that Southern Nuclear could safely increase the reactor's output primarily through more accurate means of measuring feedwater flow. NRC staff also reviewed Southern Nuclear's evaluations showing the plant's design can handle the increased power level."[12] Unit 1 was uprated during its spring 2008 defueling outage, and Unit 2 was uprated in the fall outage of the same year.

Units 3 and 4

On August 15, 2006, Southern Nuclear formally applied for an Early Site Permit (ESP) for two additional units. The ESP will determine whether the site is appropriate for additional reactors, and this process is separate from the Combined Construction and Operating License (COL) Application process.[14] On March 31, 2008, Southern Nuclear announced that it had submitted an application for a COL, a process which will take at least 3 to 4 years.[15]

On April 9, 2008, Georgia Power Company reached a contract agreement for two AP1000 reactors designed by Westinghouse (owned by Toshiba) and the Shaw Group (Baton Rouge, LA).[16] The contract represents the first agreement for new nuclear development since the Three Mile Island accident in 1979, and received approval from the Georgia Public Service Commission (PSC) on March 17, 2009.[17] As stated by a Georgia Power spokesperson Carol Boatright: "If the PSC approves, we are going forward with the new units."[16]

On August 26, 2009 the U.S. Nuclear Regulatory Commission issued an Early Site Permit and a Limited Work Authorization. Construction activities have begun.

The Nuclear Regulatory Commission defines two emergency planning zones around nuclear power plants: a plume exposure pathway zone with a radius of 10 miles (16 km), concerned primarily with exposure to, and inhalation of, airborne radioactive contamination, and an ingestion pathway zone of about 50 miles (80 km), concerned primarily with ingestion of food and liquid contaminated by radioactivity.[6]

Site area emergency

On March 20, 1990 at 9:20 a.m. a truck carrying fuel and lubricants in the plant's low voltage switchyard backed into a support column for the feeder line supplying power to the Unit 1-A reserve auxiliary transformer (RAT). This set off a complicated chain of events that was exacerbated both by planned maintenance (in which some back-up systems were off-line) and by equipment failures in some back-up systems.

The resulting loss of electrical power in the plant's "vital circuits" shut down the residual heat removal (RHR) pump that was cooling Unit 1 (which was nearing the end of a refueling outage) and prevented the back-up RHR from activating. Even though Unit 1 was not operating at full-power, residual heat from the natural decay of the radioactive fuel needed to be removed to prevent a dangerous rise in core temperature. At 9:40 a.m. the plant operators declared a site area emergency (SAE) per existing procedures which called for an SAE whenever "vital" power is lost for more than 15 minutes. At 9:56 a.m., plant operators performed a manual start of the A-train emergency diesel generator (EDG), which bypassed most of the EDG's protective trips that had prevented it from coming on-line. RHR-A was then started using power from EDG-A. With core cooling restored the SAE was downgraded to an alert at 10:15 a.m. The temperature of the Unit 1 core coolant increased from 90 °F to 136 °F during the 36 minutes required to re-energize the A-side bus.

Ironically, throughout the event, non-vital power was continuously available to Unit 1 from off-site sources. However, the Vogtle electrical system was not designed to permit easy interconnection of the Unit 1 vital busses to non-vital power or to the Unit 2 electrical busses.[13] Since this incident, Plant Vogtle has implemented changes to the plant that allow power to be transferred from one side to the other from an off-site source.

The 2010 U.S. population within 10 miles (16 km) of Vogtle was 5,845, a decrease of 16.3 percent in a decade, according to an analysis of U.S. Census data for msnbc.com. The 2010 U.S. population within 50 miles (80 km) was 726,640, an increase of 8.8 percent since 2000. Cities within 50 miles include Augusta (26 miles to city center).[7]

The Nuclear Regulatory Commission's estimate of the risk each year of an earthquake intense enough to cause core damage to the reactor at Vogtle was 1 in 140,845, according to an NRC study published in August 2010.[8][9]

3.3.4 Estimation of Potential Losses to Nuclear Plant

One of the worst nuclear accidents to date was the Chernobyl disaster which occurred in 1986 in Ukraine. That accident killed 56 people directly, and caused an estimated 4,000 additional cases of fatalities related to cancer, as well as damaging approximately $7 billion of property.[14] Radioactive fallout from the accident was concentrated in areas of Belarus, Ukraine and Russia. Approximately 350,000 people were forcibly resettled away from these areas soon after the accident.[14]

Benjamin K. Sovacool has reported that worldwide there have been 99 accidents at nuclear power plants from 1952 to 2009 (defined as incidents that either resulted in the loss of human life or more than US $50,000 of property damage, the amount the US federal government uses to define major energy accidents that must be reported), totaling US $20.5 billion in property damages.[4]

Fifty-seven accidents have occurred since the Chernobyl disaster and almost two-thirds (56 out of 99) of all nuclear-related accidents have occurred in the USA. There have been comparatively few fatalities associated with nuclear power plant accidents.[4]

Table 3.9: U.S. Nuclear power plant accidents with multiple fatalities and/or more than US $100 million in property damage, 1952-2011

Date	Location	Description	Deaths	I-131 Release in 1,000	Cost (millions 2006 $US)	INES level
January 3, 1961	Idaho Falls, Idaho,	Explosion at SL-1, National Reactor Testing Station. All 3 operators killed when rod was removed too far causing criticality surge and steam explosion.	3	0.08	22	4
October 5, 1966	Frenchtown Charter Township, Michigan,	Partial core meltdown of the Fermi 1 Reactor at the Enrico Fermi Nuclear Generating Station. No radiation leakage into the environment.	0			
March 28, 1979	Middletown, Pennsylvania	Loss of coolant and partial core meltdown, see Three Mile Island accident and Three Mile Island accident health effects	0	0.017	2,400	5
September 15, 1984	Athens, Alabama,	Safety violations, operator error, and design problems force six year outage at Browns Ferry Unit 2	0		110	
March 9, 1985	Athens, Alabama,	Instrumentation systems malfunction during startup, which led to suspension of operations at all three Browns Ferry Units	0		1,830	
April 11, 1986	Plymouth, Massachusetts,	Recurring equipment problems force emergency shutdown of Boston Edison's Pilgrim Nuclear Power Plant	0		1,001	
March 31, 1987	Delta, Pennsylvania,	Peach Bottom units 2 and 3 shutdown due to cooling malfunctions and unexplained equipment problems	0		400	
December 19, 1987	Lycoming, New York,	Malfunctions force Niagara Mohawk Power Corporation to shut down Nine Mile Point Unit 1	0		150	
March 17, 1989	Lusby, Maryland,	Inspections at Calvert Cliff Units 1 and 2 reveal cracks at pressurized heater sleeves, forcing extended shutdowns	0		120	
February 20, 1996	Waterford, Connecticut	Leaking valve forces shutdown Millstone Nuclear Power Plant Units 1 and 2, multiple equipment failures found	0		254	
September 2, 1996	Crystal River, Florida	Balance-of-plant equipment malfunction forces shutdown and extensive repairs at Crystal River Unit 3	0		384	
February 16, 2002	Oak Harbor, Ohio	Severe corrosion of control rod forces 24-month outage of Davis-Besse reactor	0		143	3

Table 3.9 lists U.S. Nuclear power plant accidents with multiple fatalities and/or more than US $100 million in property damage during the 1952 to 2011.

NRC Site Area Emergencies

Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public. Any releases not expected to exceed EPA Protective Action Guideline exposure levels except near site boundary.

- LaSalle County Nuclear Generating Station Unit 1, Seneca, Illinois, 20-Feb-2006.[50]
- Honeywell International, Metropolis, Illinois, 22-Dec-2003.[51]
- Idaho National Engineering & Environmental Laboratory, Idaho Falls, Idaho, 27-Jul-2000 and 17-Sep-2000.[52][53]
- Idaho National Engineering & Environmental Laboratory, Idaho Falls, Idaho, 12-Jul-1999.[54]
- Nuclear Fuel Services, Erwin, Tennessee, 2-Apr-1996.[55]
- Nine Mile Point Unit 2, Oswego, New York, 13-Aug-1991.[56]
- Vogtle Electric Generating Plant Unit 1, Burke County, Georgia, 20-Mar-1990.[57]
- Davis-Besse, Oak Harbor, Ohio, 09-Jun-1985. Originally declared as an "Unusual Event" but upgraded by NRC findings.[58]
- Ginna, Ontario, New York, 25-Jan-1982.[59][60][61], (Source: Wikipedia, Nuclear and radiation accidents. http://en.wikipedia.org/wiki/Nuclear_and_radiation_accidents).

There is extensive data available on Nuclear Plant Incidents worldwide. The information above, located on the Wikipedia website, reveals a Nuclear Plant Incident at the Vogtle Electric Generating Plant, Unit 1, in Burke County, GA, approximately 26 miles from the City of Augusta and within 30 miles of all residents of Richmond County.

The data further reveals nuclear plant incidents in the U.S. resulted in 3 deaths and 6.814 billion dollars in costs (2006 US Dollars).

3.3.5 Land use and development trends related to Nuclear Plant Incidents

Land Resource Use. The construction of nuclear power plants can destroy natural habitat for animals and plants or contaminate local land with toxic by-products. For example, the storage of radioactive waste may preclude any future re-use of these contaminated lands, (Source: EPA. Nuclear Energy. http://www.epa.gov/cleanenergy/energy-and-you/affect/nuclear.html.)

There are land use and development trends related to Nuclear Plant Incidents including significant impact on crops and farmland and reluctance by developers and residents to locate in proximity to a nuclear site. The recent issuance of a new permit to construct additional units at the plant is a cause of concern, particularly during the handling and installation of the radioactive rods.

3.3.6 Multi-Jurisdictional Nuclear Plant Incident Differences

There are no multi-jurisdictional differences related to nuclear plant incidents.

3.3.7 General overall HRV summary of Nuclear Plant Incidents

There are an extensive range of potential impacts from a nuclear plant incident. An incident could be a minor, localized event or a catastrophic event. Radiological Hazards are a threat to facilities, the environment, and human life.

The HMPC provided qualitative information and comments, and damage/loss estimations, using a Low – Moderate – High range, based on their knowledge of community facilities. Committee members considered potential risk to people (loss of life or injury), risk to buildings and critical facilities (primarily structural damage or loss of use) and risk to infrastructure (utilities, communications, and roads). Additional concerns were related to evacuation and sheltering in place in the event of a nuclear plant incident.

3.4 Technical Hazard D: Dam – Levee Failure

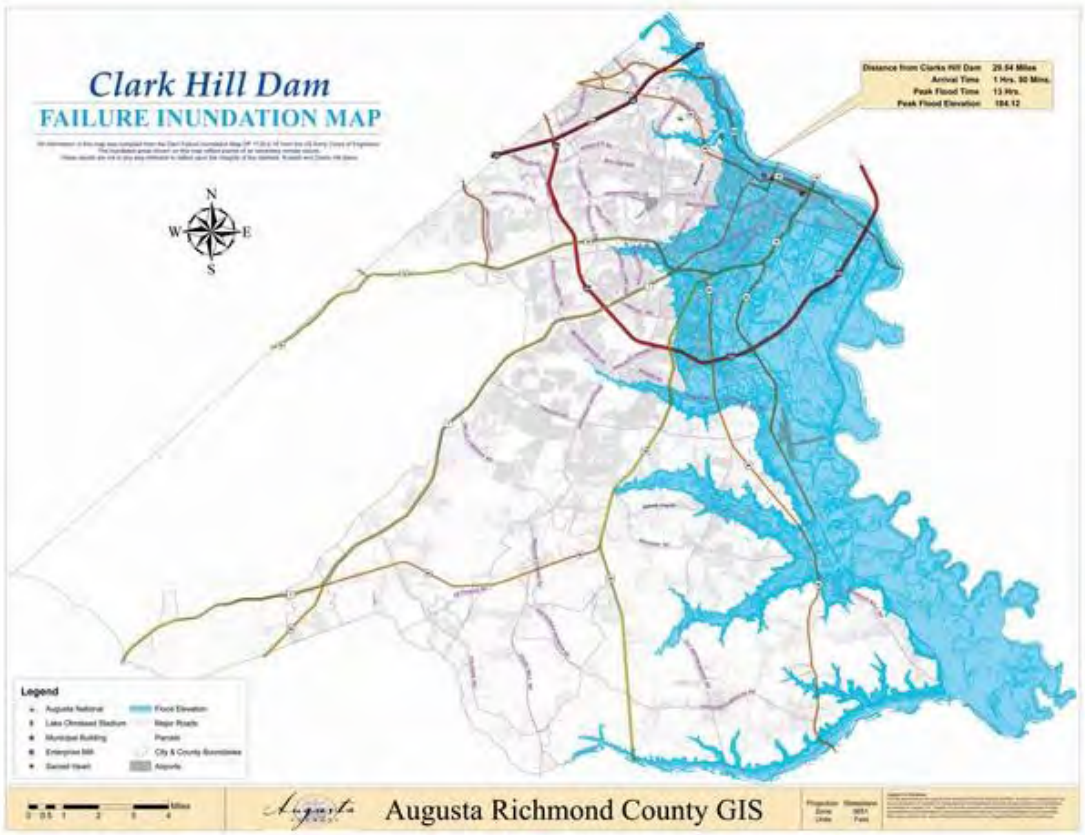
3.4.1 Dam – Levee Failure Identity

Dams and Flooding. FEMA and the U.S. Army Corps of Engineers maintain the National Inventory of Dams (1998), a database of high and significant hazard dams. For the most part, data is provided by state agencies responsible for regulation and inspection of dams or by the Corps of Engineers. Map Series 1 - B is based on that inventory and shows that seven high hazard dams (and 3 significant hazard dams) are located in Augusta and one high hazard dam is located outside the City in the upper portion of Spirit Creek. High hazard dams are those of specific height or volume of impounded water that, if failure occurred, there would be a high likelihood of loss of life and substantial property damage. Table 3-10 lists information on the high hazard dams. There is no requirement for owners to develop emergency action or maintenance plans, although high hazard dams are required to be brought up to state specifications to protect public safety and property.

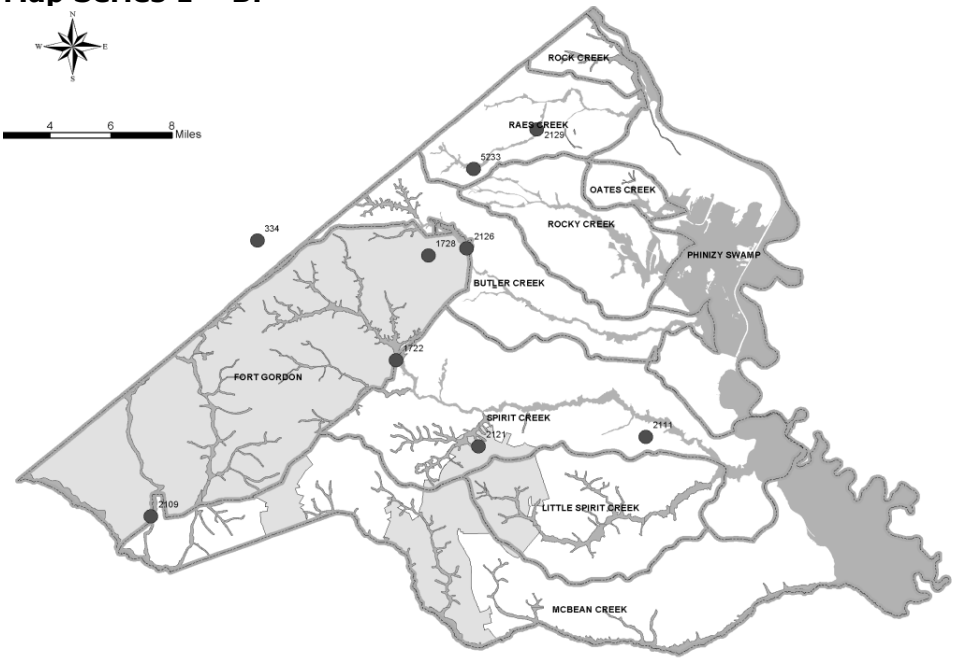
The Augusta Emergency Management Agency reports that the three Savannah River dams are the only high hazard dams for which a response plan and inundation maps are on-file (updated July 1994; DP 1130-2-16). The U.S. Army Corps of Engineers dams, not shown in Map Series 1, are the Hartwell, Richard B. Russell, and J. Strom Thurmond. The Corps document considered several dam failure scenarios and predicts the arrival times ranging from 4.5 to 13 hours, and peak flood elevations at various locations. The Corps' Savannah District operates the dams, monitors flood conditions, and notifies emergency management officials in downstream jurisdictions if flooding is predicted. The Augusta Emergency Management Agency has prepared an Emergency Evacuation Plan based on the Corps' report and maintains a response plan for closing the levee openings. Map Series 1, A & B below are inundation and high hazard dam maps produced by the

Augusta – Richmond County GIS Department and the National Inventory of Dams, (Source: National Inventory of Dams, 1998).

Map Series 1 – A : Clark Hill Dam Inundation Map



Map Series 1 – B:



In recent years, stormwater detention ponds have failed during storms that produce flooding conditions. For this reason, and because the consequence of a dam or pond failure is downstream flooding, such events are considered under the broader category of flood hazards rather than as a separate hazard. Without the benefit of analyses of failures of the high hazard dams shown on Map Series 1 - B, the impacts associated with such events cannot be estimated.

3.4.2 Dam Failure Profile

FEMA working with the Association of State Dam Officials, monitors, inspects, reports and enforces Dam Safety Regulations. The GA Department of Natural Resources, Safe Dams Program serves as the State partner in Georgia.

Dam Failure History

Table 3.10: Dam Failure History

February 26, 1972 - Buffalo Creek Valley, West Virginia
The failure of a coal-waste impoundment at the valley's head took 125 lives, and caused more than $400 million in damages, including destruction of over 500 homes.

June 9, 1972 – Rapid City, South Dakota
The Canyon Lake Dam failure took an undetermined number of lives (estimates range from 33 to 237). Damages, including destruction of 1,335 homes, totaled more than $60 million.

June 5, 1976 – Teton, Idaho
Eleven people perished when Teton Dam failed. The failure caused an unprecedented amount of property damage totaling more than $1 billion.

July 19-20, 1977 – Laurel Run, Pennsylvania
Laurel Run Dam failed, killing over 40 people and causing $5.3 million in damages.

November 5, 1977 – Toccoa Falls, Georgia
Kelly Barnes Dam failed, killing 39 students and college staff and causing about $2.5 million in damages. (Source: Association of State Dam Safety Officials. Historic U.S. Dam Failures. http://www.damsafety.org/news/?p=412f29c8-3fd8-4529-b5c9-8d47364c1f3e#HistoricFailures.)

On May 16, 1874, the Mill River Dam above Williamsburg, Massachusetts failed, killing 139 people, including 43 children under the age of ten. This failure was the worst in U.S. history, up to that time.

Fifteen years later, on May 31, 1889, this tragedy was replayed on a larger scale in Pennsylvania. Over 2,200 people - more than one in five residents of Johnstown - perished in the flood caused by the failure of South Fork Dam, nine miles upstream.

Many more failures - in Arizona, Tennessee, Oregon, North Carolina, Texas, Virginia, West Virginia, and elsewhere across the U.S. - occurred around the turn of the century, and some early state dam safety legislation was passed.

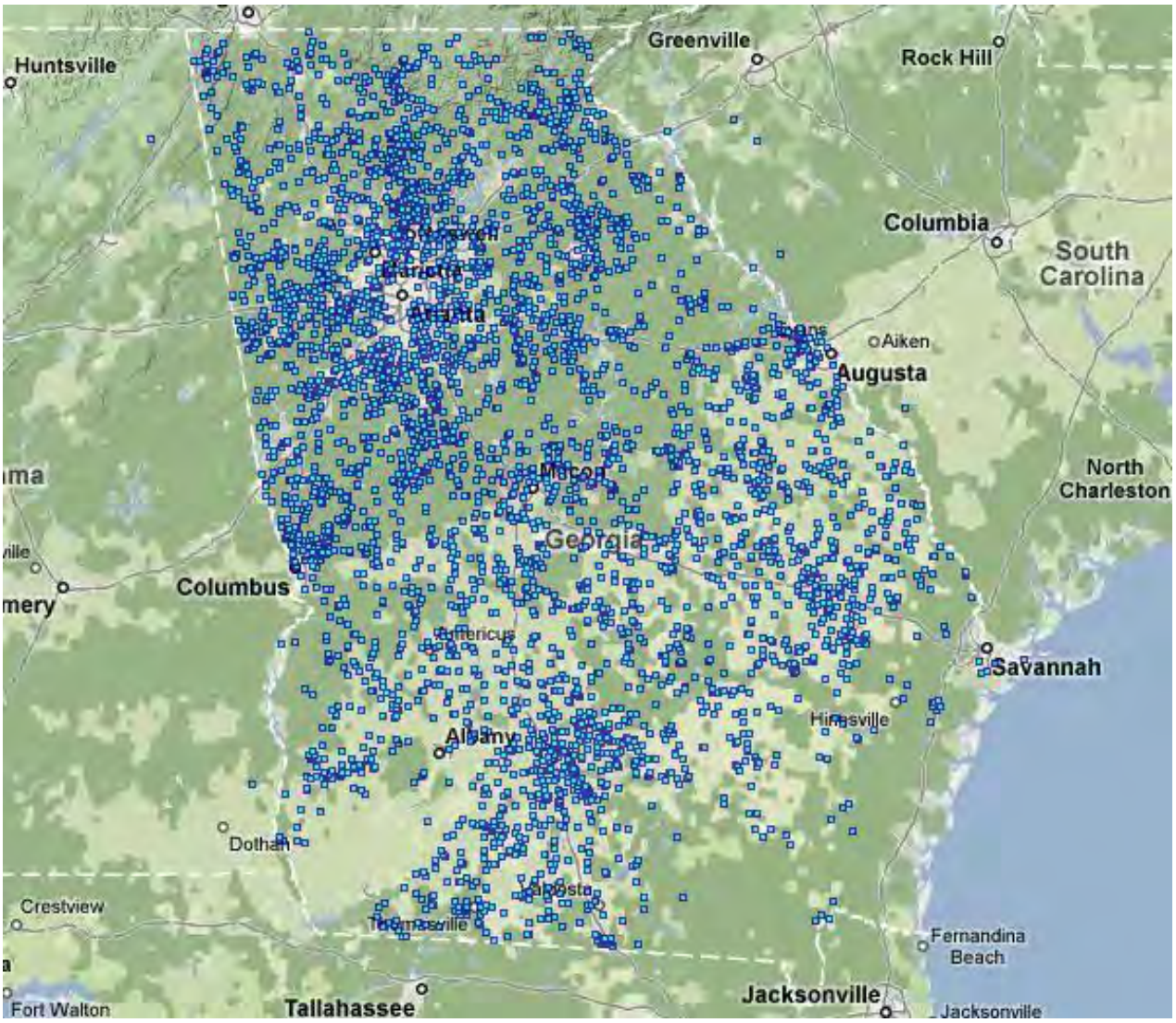
The failure of St. Francis Dam, in March 1928, was a landmark event in the history

of state dam safety legislation, spurring legislation not only in California, but in neighboring states as well. However, most states had no substantive dam safety laws prior to a series of dam failures and incidents that occurred in the 1970s:

Current Status of Dams in Georgia

There are 4,606 dams in Georgia, of that number, 78 are rated as 'Significant Risk' and 484 are rated as 'High Risk' for failure, according to the National Inventory of Dams, reported on the US Corps of Engineers (USACE) National Inventory of Dams Website. Map 4 below illustrates dams in Georgia.

Map 4: National Inventory of Dams - Georgia



Dams listed on the website and reflected in Map 4 above are ranked with the following criteria;

The NID consists of dams meeting at least one of the following criteria:

- High hazard classification - loss of one human life is likely if the dam fails;
- Significant hazard classification - possible loss of human life and likely significant property or environmental destruction;
- Equal or exceed 25 feet in height and exceed 15 acre-feet in storage;
- Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

Dam Failures and Incidents

Hundreds of dam failures have occurred throughout U.S. history. These failures have caused immense property and environmental damages and have taken thousands of lives. As the national dams age and population increases, the potential for deadly dam failures grows and the hazard risk increases.

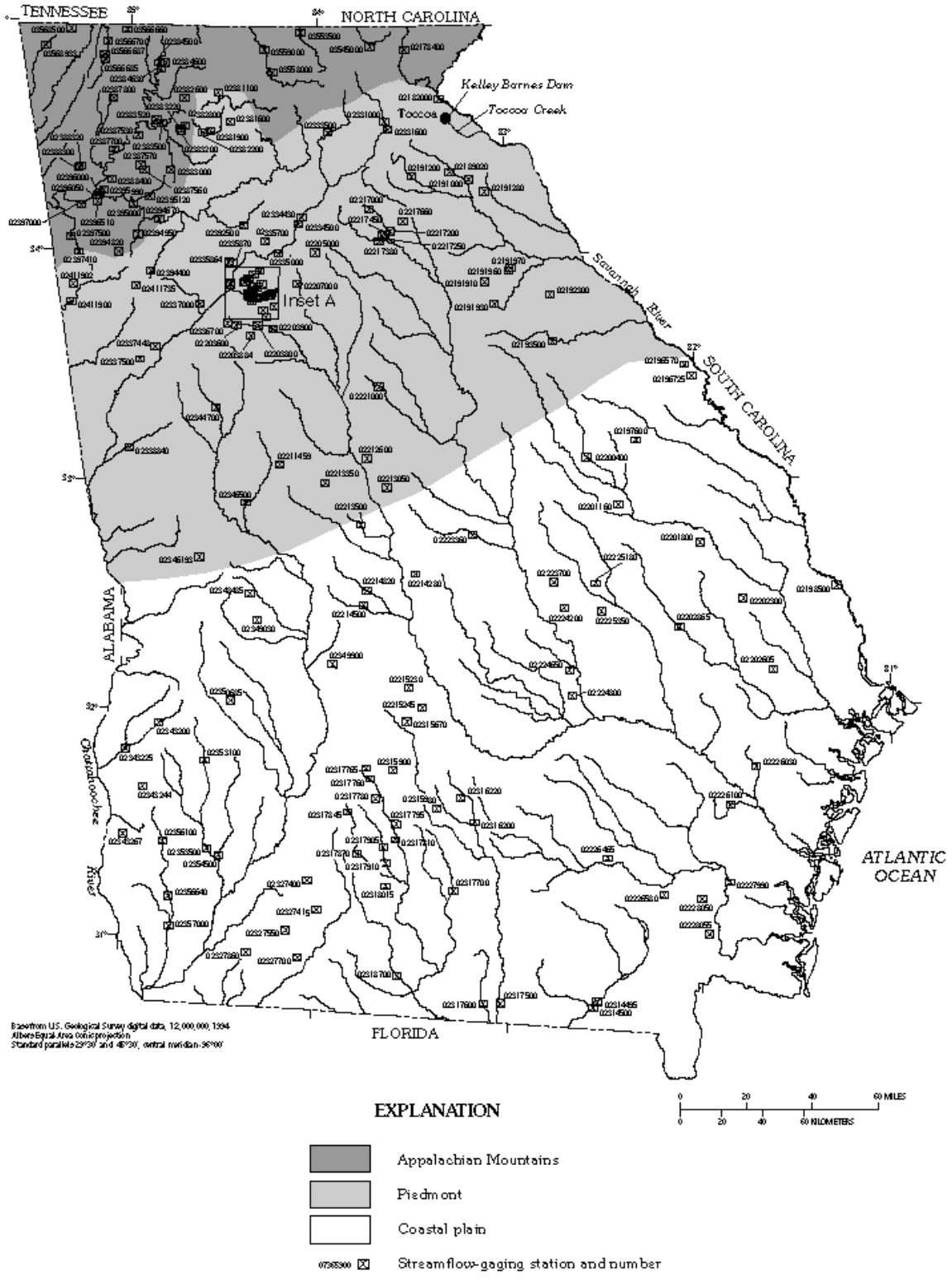
No one knows precisely how many dam failures have occurred in the U.S., but they have been documented in every state. From Jan. 1, 2005 through Jan. 1, 2009, state dam safety programs reported 132 dam failures and 434 'incidents' - episodes that, without intervention, would likely have resulted in dam failure. Of note for the planning area is the failure of the Kelly Barnes Dam in Toccoa Falls, GA.

Rainfall of 5 to 7 in. caused severe flooding on small streams in northern Georgia on November 2-6 and eventually caused the failure of the Kelly Barnes Dam in Toccoa, Georgia. The dam failed at 1:30 a.m. on November 6, resulting in a 25-ft wave of water rushing down the narrow canyon toward the Toccoa Falls Bible College. The campus was inundated within minutes. One dormitory had 8 ft. of water on the ground floor. A trailer park associated with the college was destroyed as 10 ft. of water rushed through it. Thirty-nine deaths and $2.8 million in damages occurred during this flash flood (Paulson and others, 1991).

Picture 5: Kelly - Barnes Dam Failure Site

Richmond County, GA flooded as a result of the dam failure. Map 5 below illustrates the affected counties in Georgia.

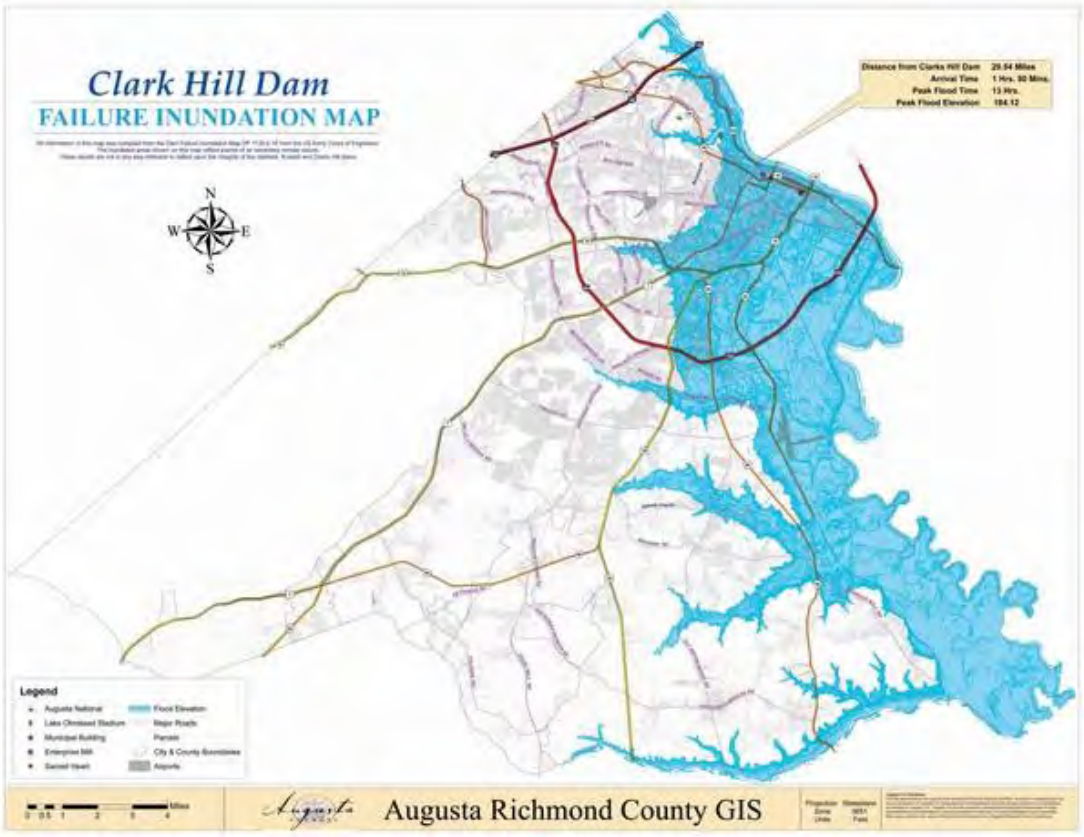
Map 5: Location of Stream flow Gauges with Significant Flooding – Kelly Barnes Dam Failure



3.4.3 Inventory assets exposed to Dam Failure (Totals from worksheets and reports from GMIS On-line tool for each participating jurisdiction) Address any data deficiencies from the original plan or explain why the deficiencies were not addressed. Include proposed development

Army Corps of Engineers releases Augusta Levee rating – (Georgia)

Safety — USACE has rated the condition of the Augusta, Georgia, levee as "Unacceptable," following a physical inspection of the levee completed in March 2010, according to a letter the city received from the Savannah District. The rating is based on the original levee design flood from the 1930s, which is now approximately the 1,000-year flood event (which has a 0.1 percent chance of occurrence in any year). City engineers have been working with USACE staff to resolve these issues. On vegetation, the city submitted a vegetation variance request in September, and its review status is pending. Augusta expects to continue discussions on the details of the vegetation variance, with a goal of reaching an agreement with USACE about what vegetation can remain, what has to be removed, and what remedial actions must be taken. Most of the structural encroachments cited by USACE, such as the Marriott and Riverwalk improvements, were originally made with prior approvals from the Savannah District USACE during the past 30 years. The city plans to repair the other minor deficiencies as necessary. (Source: DHS. Sector Open Source Digest Highlights: Dams February 2011. http://www.learningservices.us/asdso/uploads/Dams%20Sector%20Open%20Source%20Digest%20-%20February%202011.pdf.)



The map above reflects the distance from the planning area to the projected dam failure site as 20.54 miles, the arrival time of floodwaters as 1 hr. 50 min., peak flood time as 13 hours, and the peak flood elevation at 184.12. The area of exposure is primarily the eastern area of the county, with flooding occurring in the downtown and industrial areas. Roads, structures, and infrastructure would likely be impacted. Evacuation of residents, workers, government personnel and medical facilities would occur.

3.4.4 Potential losses related to Dam Failure

Estimation of losses related to Dam Failure is approximate at best. The damages would likely mirror those of a 100 year flood event. Approximately 9% of all structures would experience damage at an estimated cost of 245 million dollars (See Chapter 2.2 Flooding).

Original Plan Deficiencies Related to Dam Failure

The Dam/Levee Failure Hazard was not included in the original HMP except as a contributing hazard to Flooding.

3.4.5 Land use and development trends related to Dam Failure

Augusta – Richmond County has and continues to mitigate properties lying in the flood areas and developed stringent standards to inhibit development in hazard zones. The Flood Mitigation Plan activities include: informing the public about the risk of dam failure, provisions of information and resources to obtain flood insurance, and the removal or mitigation of structures lying in flood hazard zones and areas of high risk. Development in high hazard areas is discouraged.

3.4.6 Multi-Jurisdictional Differences related to Dam Failure.

The inundation map for Clarks Hill Dam reveals that the City of Augusta has a greater exposure to dam failure and because of the concentration of population in the inundation area would experience significantly higher structure damage and losses than Blythe or Hephzibah.

3.4.7 General overall HRV summary of Dam Failure.

A dam failure at one of the larger dams could potentially destroy infrastructure and could quickly exceed state and local resources. It is anticipated that a significant amount of external resources will be required for a disaster response for such an event. Damaged primary and secondary roads may not be functional for many weeks or months. Damage to transportation, communication, and other infrastructure systems will isolate communities, creating virtual islands within the dam failure inundation areas. Significant aid from state/federal governments may not be immediately available, for at least 72 hours following a dam failure. Affected local governments and individuals should be prepared to meet their own emergency needs during the first three days following the dam failure.

Dam failure inundation of the planning area poses a significant hazard to the citizens of Richmond County. The identification of goals, objectives, and actions to mitigate dam failure events is a priority of the HMPC.

3.5.1 Default Databases

Default inventory databases provided with HAZUS are of two types. The first type is a national listing of individual facilities, such as dams, bridges, or locations where toxic materials are stored. These databases are modified versions of publicly available databases. The modifications that have been made to eliminate data elements that are not needed for the loss estimation methodology. The second type of default database consists of data aggregated on a census tract or census block scale. Examples are building stock square footage for each census tract and census data. These default databases are also derived from publicly available data, eliminating fields of data that are not needed for the methodology.

The databases are stored on the HAZUS DVDs. When user aggregates a region, HAZUS extracts only those portions of the databases that are relevant to the region. The user can then access these region specific default databases and update them with improved information that was obtained. The following default inventory data are currently supplied with HAZUS:

- Demographic Data
- Population Distribution
- Age, Ethnic, and Income Distribution
- General Building Stock
- Square Footage of Occupancy Classes for Each Census Tract
- Essential Facilities
- Medical Care Facilities
- Emergency Response Facilities (fire stations, police stations, EOCs)
- Schools
- High Potential Loss Facilities
- Dams
- Nuclear Power Plants
- Military Installations
- Facilities Containing Hazardous Materials
- Transportation Lifelines
- Highway Segments, Bridges and Tunnels
- Railroad Tracks, Bridges, Tunnels and Facilities
- Light Rail Tracks, Bridges, Tunnels and Facilities
- Bus Facilities
- Port Facilities
- Ferry Facilities
- Airports Facilities and Runways
- Utility Lifelines
- Potable Water Facilities, Pipelines and Distribution Lines

- Waste Water Facilities, Pipelines and Distribution Lines
- Oil Facilities and Pipelines
- Natural Gas Facilities, Pipelines and Distribution Lines
- Electric Power Facilities and Distribution Lines
- Communication Facilities and Distribution Lines

Note that only the Demographics, General Building Stock, and Essential Facilities are used in the loss models developed for the present version of the Hurricane Model. The remaining default inventory databases can only be viewed in tables or as map layers.

Chapter 4: Natural Hazards Mitigation Goals and Objectives; Overall Community Mitigation Goals, Policies and Values

Chapter 4 of the HMP describes Natural Hazard Mitigation Goals, Objectives, Policies and Values evaluated by Augusta-Richmond County and participating municipalities, both on their individual (local), as well on the overall, county-wide level. This chapter provides a plan of action for Augusta-Richmond County and its communities to increase resilience to natural hazards and is a culmination of a process that started with HRV assessment in Chapter 2. This Chapter consists of the following sections:

- Introduction;
- Goals And Objectives Update Summary;
- Tornado Windstorm Hail Mitigation Strategy;
- Flood Mitigation Strategy;
- Drought / Extreme Heat Mitigation Strategy;
- Severe Winter Storm Mitigation Strategy;
- Wildfire Mitigation Strategy; and
- Earthquake Mitigation Strategy

The table below summarizes updates on 2006 HMP mitigation natural hazards ranking and subsequent addition of seismic hazard:

Chapter 4 Section	Updates to 2006 HMP
I. Natural Hazard A Tornado Wind Storm Hail	• Renamed from Wind Hazards • Updated Mitigation Goals, Objectives, and Actions
II. Natural Hazard B Flooding	• Updated Mitigation Goals, Objectives, and Actions
III. Natural Hazard C Drought / Extreme Heat	• Renamed from Drought • Updated Mitigation Goals, Objectives, and Actions
IV. Natural Hazard D Severe Winter Storm	• Updated Mitigation Goals, Objectives, and Actions
V. Natural Hazard E Wildfire	• Renamed from Urban Wildland Interface Fire • Updated Mitigation Goals, Objectives, and Actions
VI. Natural Hazard F Earthquake	• New section

Table 4.1: Overview of updates to Chapter 4: Local Natural Hazard Mitigation Goals and Objectives Overall Community Mitigation Goals, Policies and Values

INTRODUCTION

The intent of the Mitigation Strategy is to provide Augusta-Richmond County and participating municipalities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature. The development of the strategy included a thorough review of natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to assist Augusta-Richmond County and its communities achieve compatible long-term economic, environmental and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation and assigned target completion deadlines. Funding sources are identified that can be used to assist in project implementation.

Mitigation goals define strategic development and resilience-strengthening directions that Augusta-Richmond County intents to follow. Most often, mitigation goals are expressed through broad policy statements representing desired long-term results.

Mitigation objectives describe more refined action steps directed towards accomplishing mitigation goals. It is not uncommon to have complex mitigation goals accomplished through separate mitigation objectives in different mitigation categories.

Mitigation actions are individual, concrete measures that are quantifiable, both in time and resources. The period of performance for mitigation actions can be defined within five-year plan renewal cycle.

Augusta HMPC has identified a total of four different classes of mitigation actions applicable in this planning process:

Programmatic actions that prevent exposing new development to identified hazards and that protect natural resources (land use, open space, regulations and codes, stormwater management, drainage maintenance, wetlands protection, erosion and sediment control).

Property protection actions address site-specific existing problems (acquisition, elevation, retrofit, backflow prevention)

Structural solutions entail structural strengthening of the critical facilities or building of the new flood control structures (dams/ponds, levees/floodwalls, channel modification).

Public outreach, information gathering and emergency actions entail a variety of measures intended to: educate and alert citizens, elected officials and

property owners (through outreach projects, web page content, library materials, flood and tornado warning systems); gather additional information by performing various types of studies (drainage, economic, floodmapping studies). Emergency actions are usually not considered mitigation actions but, when applied, they do reduce hazard impact on lives and property. Emergency actions are usually defined in conjunction with Emergency Operations Plan (EOP).

GOALS AND OBJECTIVES UPDATE SUMMARY

In Chapter 2 of this Plan Update, members of the Augusta-Richmond County HMPC conducted quantitative and qualitative evaluation of the community's exposure to natural hazards through HRV process. As a direct result of the prevalent natural hazard evaluation, HMPC established the following 2011 mitigation goals and objectives:

Goal 1: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to tornadoes, wind, storms, and hail.

Objective 1.1: Increase resilience of critical facilities (including shelters) to the effects of tornado winds, violent storms, and hail.

Objective 1.2: Increase public awareness and increase level of protection to local population from the effects of tornado winds, violent storms, and hail in Augusta-Richmond County.

Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to the riverine and localized flooding.

Objective 2.1: Increase resilience of building stock, critical infrastructure, and essential facilities to the effects of flooding.

Objective 2.2: Increase public awareness and increase level of protection to local population from the effects of flooding.

Goal 3: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to drought and effects of extreme heat.

Objective 3.1: Increase public awareness and increase level of protection to local population and economy from the effects of drought and extreme heat in Augusta-Richmond County.

Goal 4: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of winter storms.

Objective 4.1: Increase public awareness and increase level of

protection to critical infrastructure and local population from the effects of winter storms.

Goal 5: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of wildfire.

Objective 5.1: Increase public awareness and increase level of protection to critical infrastructure and local population from the effects of wildfire in Augusta-Richmond County.

Goal 6: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of earthquakes.

Objective 6.1: Increase public awareness and increase level of protection to critical infrastructure and local population from the effects of seismic activity.

SECTION 1. TORNADO WINDSTORM HAIL MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 1: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to tornadoes, wind, storms, and hail.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

Mitigation options to address potential damage due to winds include structural (e.g., strengthening critical facilities), programmatic (e.g., requirements related to design and construction of buildings, public safety and information), and non-structural (e.g., efficiently handling debris). Despite the relative ranking of "high" (due to frequency of wind events rather than degree of past damage), the members of HMPC determined that building-specific retrofits were inappropriate and unnecessary.

EXISTING POLICIES, REGULATIONS, ORDINANCES, AND LAND USE

Current building code requirements administered by Augusta, Blythe and Hephzibah that are related to resisting certain wind conditions apply to new construction, installation of manufactured homes, and some work on existing buildings such as re-roofing and additions. There is no evidence to suggest that the code requirements are inadequate. Application of the building code continues to be the best mitigation against damage to new buildings and structures (for damage other than direct impacts from tornadoes).

NEW AND EXISTING BUILDINGS AND INFRASTRUCTURE

Public projects and construction projects that are undertaken by Augusta, Blythe and Hephzibah must comply with current building codes, including:

- New buildings and critical facilities (such as the new Fire Station #15 on Flowing Wells Road);
- Work on existing buildings and critical facilities (such as recent renovation of a Fire Station); and
- Rehabilitation and reconstruction housing projects managed by Housing & Economic Development.

The entire planning area is exposed to the same potential wind conditions; there are no land use or zoning elements that are directly related to tornadoes and wind hazards.

Mitigation Goal 1: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to tornadoes, wind, storms, and hail.

Objective 1.1: Increase resilience of critical facilities (including shelters) to the effects of tornado winds, violent storms, and hail.

GOAL 1- Objective 1.1 – Mitigation Action 1.1.1 (MULTI JURISDICTIONAL)	
Review capacity of the existing tornado shelters and construct new ones if needed	
Responsible Department	Augusta-Richmond County EMA with support of cities of Hephzibah and Blythe
Anticipated cost	TBD
Existing and potential funding sources	FEMA HMA programs
Jurisdiction	Augusta-Richmond County, cities of Hephzibah and Blythe
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	NEW

GOAL 1- Objective 1.1 – Mitigation Action 1.1.2 (MULTI JURISDICTIONAL)	
Debris Management Plan - Work with the cities, Georgia Forestry Commission, power companies, and other entities to develop a Debris Management Plan. Note: FEMA has a guidebook for developing debris management strategies and examples from other jurisdictions are available.	
Responsible Department	Augusta-Richmond County EMA with support of cities of Hephzibah and Blythe
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County, cities of Hephzibah and Blythe
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 1- Objective 1.1 – Mitigation Action 1.1.3	
Augusta Public Tree Maintenance - Continue tree maintenance on city streets and city-owned property (reduce debris, impacts of falling).	
Responsible Department	Augusta-Richmond County Public Services with support of Recreation and Parks
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 1- Objective 1.1 – Mitigation Action 1.1.4	
Promote Enhanced Anchoring of Manufactured Homes – making them less susceptible to tornado damages and detachment from the pad.	
Responsible Department	Augusta-Richmond County EMA with support of cities of Hephzibah and Blythe
Anticipated cost	TBD
Existing and potential funding sources	Potential FEMA funding through PA
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	NEW

Objective 1.2: Increase public awareness and increase level of protection to local population from the effects of tornado winds, violent storms, and hail in Augusta-Richmond County.

GOAL 1- Objective 1.2 – Mitigation Action 1.2.1 (MULTI JURISDICTIONAL)	
Severe Storm Awareness - Continue public outreach on severe storm and tornado risks; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of representatives from Augusta, Blythe, Hephzibah, and members of the public, including nonprofit and neighborhood organizations and others, to look at outreach efforts and materials provided by the National Weather Service, FEMA, the American Red Cross, and others and determine whether changes are appropriate. Expand use of Augusta's website to make information readily available to the public.	
Responsible Department	Augusta-Richmond County Public Services with support of Recreation and Parks
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 2. FLOOD MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to the riverine and localized flooding.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

Four categories of options are generally considered when addressing flood hazards:

- Programmatic actions that prevent exposing new development to flood risks and that protect natural resources (land use, open space, regulations and codes, stormwater management, drainage maintenance, wetlands protection, erosion and sediment control);
- Property protection actions that address site-specific existing problems (acquisition, elevation, retrofit, backflow prevention);
- Structural solutions (dams/ponds, levees/floodwalls, channel modification);
- Public information and emergency actions (outreach projects, web page content, library materials, flood map determinations, flood warning)

Augusta addresses flood hazards through a number of existing mechanisms, including some actions from each of the above-listed categories. For some of the existing mitigation initiatives, site-specific problems were examined to identify feasible and cost-effective solutions, including drainage improvements and property acquisition.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

Chapter 6 contains a detailed overview of Augusta's capability to address hazards, including how the City plans and grows and how different departments have been affected by and how they handle hazards. Similarly, the Chapter briefly describes the cities of Blythe and Hephzibah and how hazards are addressed in normal city functions.

EXISTING FLOOD MITIGATION INITIATIVES

Floodplain Acquisitions Prompted by significant flooding in 1998, which resulted in Presidential Declaration DR 1209, the City began to consider seeking federal grant funds to acquire a number of flood-damaged homes. There were many more damaged homes than available funding; for the most part the selection was driven by federal and state emphasis and the limited amount of available funds.

The City's first federal grant for acquisition of flood-prone homes provided $618,928 from the Hazard Mitigation Grant Program to cover 75% of eligible costs. The grant was awarded through the Georgia Emergency Management Agency for the acquisition and removal of 12 substantially damaged and repetitive loss properties (8 were in FEMA's "repetitive loss target group"). Although homes were located in several places (green circles on Figure 2-3) many were concentrated in the Hollywood Subdivision. For this first grant, the State provided 15% and the City provided 10% towards the 25% non-federal match (Table 4-2).

Another flood in 2002, although not qualifying as a major disaster declaration, caused extensive damage to homes in Augusta. As a result, the City applied for and received a grant to pursue more floodplain acquisitions (Phase 2). Phase 3 was funded by a grant that was approved in late August 2003, and Phase 4 was funded by a Pre-Disaster Mitigation Grant approved in 2004. The latest grant came from 2010 HMGP program, and was approved in April of 2011. A total of 11 homes are in process of being acquired.

Table 4-2. Floodplain Acquisition Grants (as of May 2011)

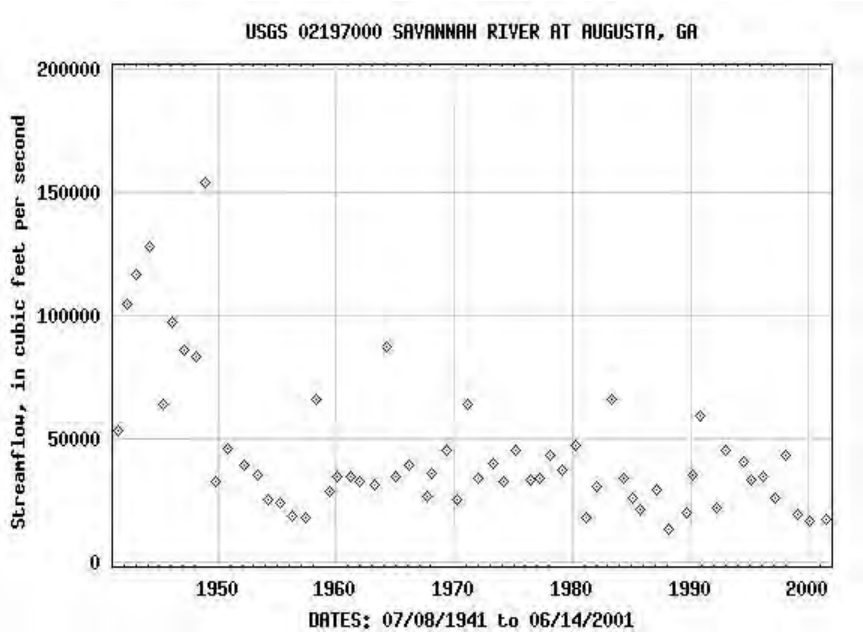
	Approved	Federal Share	Local & State Share	Total Project Cost
Phase 1 - 2000 HMGP (12 homes)	3/2001	$1,106,899	$368,966	$1,475,865
Phase 2 – 2001 HMGP (4 homes)	2/2003			
Phase 3 – 2002 HMGP (6 homes)	8/2003			
Phase 4 - 2003 PDMC (13 homes / 5 acq.)	4/2004	$49,100	$16,366	$65,466
2010 HMGP (11 homes / 0 acq.)	4/2011	$338,663	$112,887	$451,550
TOTAL 45 homes		**$1,494,662**	**$498,219**	**$1,992,881**

As a condition of the mitigation grants, the acquired lands must be retained as open space. As shown on Figure 2-3, these lots are in several locations, complicating re-use for recreational purposes or other compatible open space purposes. The Hollywood area, where some homes have been acquired and several others have been abandoned due to repetitive flood damage, may be a suitable site for wetlands restoration. If buildings can be removed from a large, contiguous area, the land would likely revert to wetlands, given the frequency of flooding.

Augusta/Savannah River Levee The Augusta/Savannah River Levee is about 11.5 miles long, running from the high ground on the south side of Rae's Creek to the high ground at New Savannah Bluff, just south of Butler Creek. There are five gate structures; two railroad crossings, one road crossing, two combined road/rail

crossings, and several road ramps, and one section of sheet pile wall.

Figure 4-1. USGS Savannah River Gage at Augusta



Started in 1908 and completed between 1914 and 1916, the Flood of 1929 damaged certain sections that were rebuilt to "stand up against greater floods." In 1936, the U.S. Congress authorized improvements by the U.S. Army Corps of Engineers, which completed work in 1941. Initially, the Levee was designed to have two-feet of freeboard under a design discharge of 550,000 cubic feet per second (measured at the 5th Street Bridge water level gage, which is not operational).

The Clarks Hill Dam and Lake project began impounding water in December 1951 and continues to control the Savannah River. Analyses in the early 1980s suggested the Levee would overtop during flows greater than 55,000 cfs, which had a stage of 30-feet on the Butler Creek gage and 51.8-feet at the 5th Street gage. At the time, this was characterized as the 0.2% annual chance flood (500-year). However, as shown in Figure 4-1, USGS measurements at Gage 02197000 (Savannah River at Augusta), discharges on this well-regulated river have exceeded 50,000 cfs only five times since 1950.

The City of Augusta is the local sponsor and owns, operates, and maintains the Levee. The Operations and Maintenance Manual, prepared in 1984 by the Corps of Engineers, acknowledges that the effectiveness of the levee depends on people in three key ways, each is addressed in detail: routine maintenance; inspection and periodic reporting; and operations and flood fight. In conjunction with the Corps, the Augusta Emergency Management Agency prepared the *Emergency Levee*

Closure Plan (1999), which is exercised every two years (last exercise was in 2004). The exercise includes mobilization all City departments involved, deployment of a crane, and the actual closure of at least one gate structure.

With respect to permanent development on the Levee, the Corps did not have the authority (under then-current legislation) to approve permanent modifications. General criteria for encroachments are set forth and a procedure is outlined, including a requirement that the City Engineer certify that the design of any encroachment "does not affect the levee integrity or impair his ability to operate or maintain the levee and perform flood fights."

Oates Creek Project In 1986, the U.S. Army Corps of Engineers prepared the Oates Creek Flood Control Project design. The project, constructed in the late 1980s, was expected to provide an average annual flood damage reduction benefit of $1.78 million (1979 dollars). The project was designed to carry discharges for the 10-year to 25-year floods and is expected to reduce or eliminate flooding of 218 homes by the 1%-annual chance flood (100-year). The channel improvement project modified the Oates Creek mainstream and Tributary No. 1 and consisted of several components:

- Realignment of the waterway from its confluence with Beaver Dam Ditch upstream to the New Savannah Road Bridge;
- Just over a mile of rectangular cross-section, concrete-lined channel, ranging from 30- to 40-feed wide;
- Over 6,600 feet of grass-lined channel with sloped sides and bottom widths of 10- to 60 feet;
- A low earth levee on the south bank downstream of Central of Georgia Railroad crossing, extending 1,800 feet long and ranging from 4- to 9-feet high; and
- Modifications to a bridge and utilities.

Richmond County was the original non-federal sponsor and project owner. As part of the consolidation of governments, the City of Augusta became the project owner. The City, in conjunction with the Corps of Engineers, inspects the project twice a year. Reportedly, "high flood control efficiency" is achieved, but modifications are planned to reduce excessive annual maintenance requirements and costs. To concentrate low flows and to minimize sediment deposition, the bottom of the upper portion of earthen channel will be re-graded and concrete pilot channel will be constructed in the lower portion of earthen channel. Rip-rap will be placed on channel slopes and at other locations to reduce erosion. Construction was expected to be completed by the end of 2004.

Rae's Creek Improvements Prompted by repeated flooding in the early 1990s, the City undertook a $1.4 million stream improvement project on Rae's Creek. From Lake Olmstead upstream to about Wrightsboro Road, the stream was cleaned and widened. To reduce streambank erosion, riprap was placed on the banks.
Georgia DOT and Crane Creek Project. Georgia Department of Transportation is designing two projects in the Crane Creek watershed that are anticipated to provide

some flood relief, although the degree of relief has not yet been determined due to on-going design factors:

The I-20/Crane Creek project to prevent flooding of Interstate 20 at Crane Creek; and; The I-20/I-520 Interchange project with stormwater detention ponds.

Two other DOT projects in Crane Creek are in the design phase; both will include stormwater management measures to manage runoff increases associated with the project only:

The Davis Road Widening project; and The Interstate 20 Widening project from Bel-Air Road to the Augusta Canal.

A significant flooding event occurred on June 20, 2000, when Crane Creek overtopped Interstate 20. Interstate 20 is a major hurricane evacuation route for this area of Georgia and South Carolina. Many homes in the area were also flooded.

These homes have had repetitive flood losses and several were abandoned as a result of the June 20, 2000 flooding. In late spring of 2003, the concept for the final alternative and the environmental document were approved by the Georgia Department of Transportation and FHWA.

The Georgia DOT project for the I-20/I-520 Interchange Reconstruction includes grade separation of one nearby intersection (I-520 at Scott Nixon Memorial Drive), new loop ramps that will be reconfigured to flyover ramps, and realignment of the other two loop ramps. The new loop ramps and flyovers allow for construction of twelve stormwater detention ponds to provide additional flood relief by staggering the peak release rates of stormwater flows along Crane Creek. These ponds were designed beyond the Georgia Department of Transportation guidelines for detention ponds to provide "over-detention" of the stormwater flows draining to the ponds, although the degree to which the "over-detention" may reduce downstream flood elevations will not be finalized until the final design phase is completed.

Corps of Engineers: Flood Reduction Study The U.S. Army Corps of Engineers, Savannah District, initially looked at six watersheds in the City of Augusta. Four were selected for further consideration and basic studies were completed in 2004: Rae's Creek; Augusta Canal; Phinizy Ditch; and Rocky Creek (not selected were Beaver Dam Ditch and Butler Creek). As of early 2005, progress is slowed due to funding constraints; examination of flood reduction alternatives will be undertaken only for the Rae's Creek and Rocky Creek areas.

As of late 2004, the Corps had requested additional funding in order to complete the feasibility work to identify specific projects and those elements that do and do not qualify for funding. Any project that is eligible for Corps funding will require a non-federal cost share. Effective projects that do not qualify under the Corps' programs may be considered by the City. Alternatives that will be considered include nonstructural measures (such as acquisition, elevation-in-place, and

floodproofing). A Corps expert consulted with the Corps Team in the Spring of 2003, resulting in an emphasis on nonstructural measures.

The hydrology and hydraulic analyses for both existing conditions and future conditions (extrapolated from the 1995 Land Use Plan and the 1992 Comprehensive Plan) have been completed. FEMA is represented on the team. The Corps' modeling meets FEMA specifications and is expected to support FEMA's planned map revisions (scheduled to be effective and ready for adoption in 2007). Detailed elevation data (ground, lowest floor) have been collected by survey. Initial impacts indicate:

Rocky Creek: average annual damages of $1,450,000 (not including industrial). Flood-prone structures include approximately 1,000 homes (average value $30,000) and 200 commercial/industrial facilities.

Rae's Creek: average annual damages of $1,480,000 (for only about half the number of structures in Rocky Creek, reflecting higher home values). The confluence with Crane Creek is a primary damage area. The upper reach was not analyzed in detail, in part because of assumed flood reduction benefits associated with a Georgia DOT project.

Rae's Creek Hydrology Study (2001) In 2000, the City contracted for a study to examine four known or potential problem areas along Rae's Creek between Jackson Road and Walton Way. As of mid-2003, no specific actions have been implemented pending the outcome of the Corps of Engineers' study.
The report recommended:

Repair existing spillway and construct additional emergency spillway capacity at Walton Way/Lake Aumond.

To meet target flood elevations at West Lake Forest Drive and Heirs Pond, construction additional outlet culvert at Heirs Pond and stabilize downstream banks to correct existing slope erosion.

Discontinue routine operation of gates on Heirs Pond and Lake Aumond because they do not provide any peak flow reduction benefits for Forest Hills Racquet Club and downstream areas; without measurable benefits, City personnel are placed at risk unnecessarily while operating the gates.

Widen Rae's Creek from the upstream end of Heirs Pond upstream to Jackson Road; throughout this reach, remove block walls that obstruct and divert flows; replace Courtside Drive with box beam bridge.

Mitigation Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to the riverine and localized flooding.

Objective 2.1: Increase resilience of building stock, critical infrastructure, and essential facilities to the effects of flooding.

GOAL 2- Objective 2.1 – Mitigation Action 2.1.1	
Drainage and Stormwater Management. Implement central database for staff to record drainage and flooding problems (build on existing software). Train staff of all departments that receive citizen calls to use the database to register appropriate information to ensure quality data. Develop method to consider the database contents in setting priorities for drainage projects and to support identification of flood mitigation opportunities. Formalize detention basin maintenance procedures and system to prioritize maintenance.	
Responsible Department	Engineering Services with Support of Planning and Zoning
Anticipated cost	TBD
Existing and potential funding sources	City of Augusta
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.2	
Sewer Line Infiltration and Inflow. Continue to undertake projects to identify and resolve infiltration and inflow. During wet weather and flooding conditions, water infiltrates into sewer lines and flows into the system through submerged manhole covers, based on qualitative assessment of cost/effort and long-term benefits.	
Responsible Department	Augusta Utilities
Anticipated cost	TBD
Existing and potential funding sources	City of Augusta CIP
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.3	
Soil Erosion and Sediment Control Sedimentation in waterways may be contributing to drainage problems and flooding Due to the significant size and duration of four projects proposed by Georgia DOT for the upper part of the Crane Creek basin, and the high visibility of downstream flooding, request GDOT's continued attention to exemplary sediment and erosion control practices. Communicate with City crews and contractors that City projects are to be undertaken with exemplary sediment and erosion control practices. Examine the feasibility of offering training for local contractors to reinforce proper installation and maintenance of sediment control measures; seek cooperative partners, including the District Soil Conservation Office, Georgia DOT, and GA Department of Natural Resources. Increase frequency of inspections of sediment control measures and work with project owner/contractor to maintain effective measures throughout construction. Continue cooperative efforts with Columbia County regarding installation and maintenance of sediment and erosion control measures on active construction sites in the upper portions of waterways that drain into Augusta, with particular attention to Crane Creek, Rae's Creek, and Butler Creek.	
Responsible Department	Augusta Engineering Services, License and Inspections, supported by Soil Conservation and Planning and Zoning
Anticipated cost	TBD
Existing and potential funding sources	Additional staff and funding needed
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.4	
Flood Hazard Map Revisions and Updates Pursue City-wide revision of the Flood Insurance Rate Maps, building on the City's new digital topography and work underway by the U.S. Army Corps of Engineers to prepare flood studies as part of the *Flood Reduction Study* (including Rocky Creek, Rae's Creek, Crane Creek, Augusta Canal and Phinizy Swamp), and including other studies and identified watersheds. Communicate to the Georgia Department of Natural Resources and FEMA Region IV the importance of receiving revised maps in the Digital Flood Insurance Rate Map format. When available for local use, annotate digital map with the "lower floodway fringe" delineation to facilitate awareness of and application of the Flood Damage Prevention Ordinance and to more clearly identify areas targeted for greenspace purposes. Incorporate new flood maps into the City's GIS. Develop a database of property owners for use in public awareness activities.	
Responsible Department	Planning and Zoning, support Engineering, IT
Anticipated cost	Low cost

Existing and potential funding sources	Within budget
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.5	
Economic Analysis related to Flood Hazard and critical facilities Perform economic analysis related to identifying the most effective flood mitigation projects. Utilize newly developed FEMA DFIRMs and new topography to ascertain economic impact of flooding at various frequencies. Develop several scenarios and identify the most cost-beneficial mitigation measures or the most exposed industrial facility in downtown Augusta.	
Responsible Department	Planning and Zoning, support Engineering, IT
Anticipated cost	TBD
Existing and potential funding sources	Seek various grants
Jurisdiction	Augusta-Richmond County
Timeframe	2 years
STAPLEE Priority	TBD
Status (deferred or new)	NEW

GOAL 2- Objective 2.1 – Mitigation Action 2.1.6
Policies & Procedures for Flood Mitigation Projects. Develop Flood Mitigation Project Policies and Procedures Manual. Establish systematic method for using and prioritizing funds, including a mechanism to account for changes in priorities as a function of several variables (such as the funding agency's priorities, recent flooding, degree of damage, damage history, predicted depth of flooding, existing drainage problems, sewer infiltration, proximity to other public open space/ greenspace, etc.). Gather data on buildings in FEMA-mapped floodways and repetitive loss areas to have available in the post-flood period; use to target efforts for recovery, permitting, and grant application development. Obtain FEMA's Residential Substantial Damage Estimator software and maintain ability to use it to facilitate damage estimates and substantial damage determinations. Develop policy on abandoned homes in SFHA (donations, condemn, demolish, HUD funds). Examine the Corps' database of buildings in the SFHA and pre-identify those most likely to sustain significant damage if floods equivalent to the SFHA or greater occur, i.e., those predicted to have more than 2-feet of water above the lowest floor. Use the identified list to target post-flood inspections. Maintain awareness of different sources of mitigation funding (pre-disaster, post-disaster, CDBG/HOME, NFIP flood insurance claims payments, etc.). Continue to seek mitigation grant funds to implement mitigation in high priority actions. Explore with GDOT if, as part

of its environmental enhancement and wetlands mitigation requirements, funding could support additional buyouts areas where the frequency of flooding indicates the hydrology would support allowing areas to return to wetland functions. Include consideration of flood mitigation opportunities in the City's identification of projects for which ISTEA applications will be prepared, which may include projects to preserve floodway greenspace or floodplain buyouts in areas where detention is required or wetlands are desirable.	
Responsible Department	Planning and Zoning, other departments Committee
Anticipated cost	TBD
Existing and potential funding sources	Additional funds and staff required
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.7	
The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: 1) Reduce flood losses; 2)Facilitate accurate insurance rating; and 3)Promote the awareness of flood insurance.	
Responsible Department	Planning and Zoning, support Engineering, IT
Anticipated cost	TBD
Existing and potential funding sources	Additional staff needed
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.1 – Mitigation Action 2.1.8	
Dam Safety. For State-designated Category I dams that are located in the City or on waterways that drain through the City, estimate potential impacts and determine if the downstream risks are sufficient to contact owners to encourage their development of limited emergency action plan procedures, and periodic inspections, that are coordinated with the City.	
Responsible Department	Emergency Management with support of Public Services
Anticipated cost	TBD
Existing and potential funding sources	Additional staff needed
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

Mitigation Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to the riverine and localized flooding.

Objective 2.2: Increase public awareness and increase level of protection to local population from the effects of flooding.

GOAL 2- Objective 2.2 – Mitigation Action 2.2.1	
Public Awareness Initiative. Mitigation is a partnership and citizens are both obligated and responsible for certain actions to help reduce exposure to flooding and to improve the City's ability to recover from flooding. To increase public awareness and responsibility, convene a work group (e.g., City departments, neighborhood associations, NRCS/SCS, Corps of Engineers, others) to prepare and implement a multi-year plan for public awareness. The Plan may contain the following actions: Encourage property owner purchase of flood insurance to provide financial protection that helps personal recovery; Encourage property owner purchase of flood insurance to increase options for post-flood mitigation (because of Increased Cost of Compliance insurance coverage). Prepare articles for publication emphasizing what property owners can do to plan and prepare for floods and to reduce losses (flooded road safety, low cost mitigation measures, insurance, the automated 911 Message flood warning alerts). Coordinate with campaigns undertaken by the State (flood awareness, winter storm awareness, etc.). Develop web-based materials; link to other sites (GEMA, FEMA, Red Cross, Extension Service). Co-op with stormwater management initiative to distribute periodic mailing to property owners along waterways to inform them of their responsibility to keep drainageways clear (don't dump debris, yard clippings, tree limbs, etc.). Develop materials for the Planning Commission and License and Inspections to handout with permits or mailings (tailored for homeowners, business owners, and owners of vacant lands). Topics to include flood insurance, mitigation options, flood safety, permit requirements, etc. Improve consistency of communication to the public regarding flooding, prepare briefing of basic information for City staff who field calls or meet with citizens groups. Establish a hotline for citizen reports of flooding and drainage problems. Request and sponsor periodic NFIP workshops provided by others (GADNR, FEMA) for lenders, insurance agents, real estate professionals and others. To facilitate preparation of Elevation Certificates and other uses, post database of elevation benchmarks and reference marks on the City's webpage and notify local surveyors and engineers of its availability. Research options to improve disclosure of flood hazards as part of the property transfer process.	
Responsible Department	Emergency Management with support of Public Services
Anticipated cost	TBD

Existing and potential funding sources	Additional staff needed
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED
GOAL 2- Objective 2.2 – Mitigation Action 2.2.2	
Flood Mitigation Staffing. Seek new staff position to coordinate the City's floodplain management and mitigation efforts. Functions would include: leadership for implementation and tracking of priority action items identified in the Plan; provide staff review of permit applications for floodplain development; function as the City's Community Rating System Coordinator; develop flood mitigation policies and procedures; apply for and administer mitigation grants; coordinate the City's interaction with the U.S. Army Corps of Engineers; coordinate multi-year effort to revise FIRMs; coordinate the Flood Damage Assessment Team (with L&I) for substantial damage determinations; serve as liaison with press and the public on matters related to flooding.	
Responsible Department	Augusta Emergency Services, Planning and Zoning
Anticipated cost	TBD
Existing and potential funding sources	Not within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.2 – Mitigation Action 2.2.3
Savannah River Flood Protection and Awareness. Although there is a very low probability that flood levels on the Savannah River would prompt closure of the eight breaches in the Levee, the consequences of such flooding would be catastrophic. Residential and nonresidential uses exist on the riverside of the levee (some on City-owned land) and may be subject to damage at different floodwater levels. To enhance protection and awareness: Convene a City work group to review and revise the Emergency Levee Closure Plan. For City-owned property on the riverside of the Levee that is leased to private entities, examine lease conditions with respect to adequate advisory language to protect the City. Consider whether lessees should be notified of the risk of flooding; that the City periodically conducts a levee closing exercise; and that certain conditions of flooding predicted by the U.S. Army Corps of Engineers may prompt the City to require evacuation. Other topics for consideration: the availability of flood insurance to cover losses (for both structure and contents); the requirement to obtain permits for building improvements, additions, and repair of damage; termination of leases under certain circumstances (e.g., if buildings are substantially damaged by any cause (e.g., flood or fire); etc. Notify owners of private property on the river side of the Levee about the risk of flooding, levee closing procedures, requirement to evacuate, availability of flood insurance, and the requirement to obtain permits. Continue to exercise the Emergency Levee Closure Plan every two years.

Responsible Department	Emergency Management with support of Public Services
Anticipated cost	TBD
Existing and potential funding sources	Implementation within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 2- Objective 2.2 – Mitigation Action 2.2.4	
Flood Warning - Augusta's watersheds are relatively small and tend to respond rapidly to heavy rainfall, making it difficult to use the traditional door-to-door notification to adequately warn residents to evacuate. For the same reason, placing barricades or stationing City personnel at flood-prone roads is problematic, especially in the upper reaches of watersheds. To enhance flood safety: Use GIS and flood maps to identify buildings within flood hazard areas and develop phone groups for automated, generalized flood warning announcements through 911 Message; exercise the announcement system periodically. Explore if the automated rain gages that may be installed by Augusta Utilities as part of watershed assessments can be used to augment the City's preparations during times when flooding is likely. Improve the list of flood-prone roads; evaluate whether the most frequently flooded areas warrant signs to alert the traveling public.	
Responsible Department	Emergency Management with support of Engineering, IT, and Utilities
Anticipated cost	TBD
Existing and potential funding sources	Exploring grant funds to support gages; implementation within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 3. DROUGHT AND EXTREME HEAT MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 3: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to drought and effects of extreme heat.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

Other than the effects of drought on crops, landscaping, street trees, and forested areas, drought rarely causes physical property damage. Since the early 1990s about 20 older homes have sustained foundation damage due to settling associated with falling water table and soil consolidation; current foundation requirements appear to adequately guard against this problem.

Public education and water conservation, along with imposed water use restrictions, can address the most significant impacts of drought.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

The City prepared the *Augusta Water Conservation Plan* pursuant to State and federal rules for outdoor water use. The purpose of the Plan is to conserve the available water supply and to protect the integrity of water supply facilities. The Plan places emphasis on domestic water use, sanitation, and fire protection, and protection of public health, welfare, and safety. To minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the Plan calls for restrictions on water use as a function of drought conditions and available supplies. Certain non-essential uses are regulated and may be curtailed during times of water shortage or other emergency water supply conditions. Violators may be assessed penalties. Augusta Utilities sends notices to its 66,000 customers about water restrictions.

The Georgia Forestry Commission and the Augusta Fire Department restrict outside burning with particular attention during prolonged periods of rainfall deficit.

The availability of water is a significant factor that influences development. Land use and development patterns show that most growth occurs in areas served by City water.

Objective 3.1: Increase public awareness and increase level of protection to local population and economy from the effects of drought and extreme heat in Augusta-Richmond County.

GOAL 3- Objective 3.1 – Mitigation Action 3.1.1 (MULTI JURISDICTIONAL)	
Water Conservation Awareness. Augusta Utilities to continue implementation of the Water Conservation Plan; continue to comment on proposed development site and landscaping plans; continue to report on and encourage conservation in The H2O Newsletter and to highlight water conservation tips on its web page. The City of Hephzibah will continue to follow and implement the State's water conservation guidelines.	
Responsible Department	Augusta Utilities, Hephzibah, County Extension Service, Georgia DNR
Anticipated cost	TBD
Existing and potential funding sources	Implementation within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 4. SEVERE WINTER STORM MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 4: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of winter storms.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

Other than ice on roads and bridges, which limits traffic and may contribute to accidents, the most significant damage due to winter storms is tree damage, downed power lines, and an increase in structure fires when occupants employ unsafe methods to stay warm.

The power companies respond to downed lines. As part of Augusta's response activities, emergency transportation assistance may be coordinated by the Emergency Management Agency.

Public education about preparing for cold weather and power outages can address the most significant impacts of winter storms. Messages should explain safe use of heaters and the importance of turning off automatic outdoor watering systems to prevent road icing.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

Within budget constraints, Augusta maintains and trims City trees to improve tree health and to minimize damage during storms.

All new buildings must be designed and constructed to meet current building code requirements, including snow loads. New and renovated public buildings must meet current building code requirements for snow loads.

The effects of winter storms are not influenced by land use and development trends. The Augusta Emergency Management Agency posts storm awareness materials on its web page and distributes materials to citizens.

Objective 4.1: Increase public awareness and increase level of protection to critical infrastructure and local population from the effects of ice and winter storms.

GOAL 4- Objective 4.1 – Mitigation Action 4.1.1 (MULTI JURISDICTIONAL)

Severe Winter Storm Awareness - Continue public outreach on severe winter storm and ice; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of representatives from Augusta, Blythe, Hephzibah, and members of the public, including nonprofit and neighborhood organizations and others, to look at outreach efforts and materials provided by the National Weather Service, FEMA, the American Red Cross, and others and determine whether changes are appropriate. Expand use of Augusta's website to make information readily available to the public.	
Responsible Department	Augusta-Richmond County Public Services with support of Recreation and Parks
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 4- Objective 4.1 – Mitigation Action 4.1.2	
Augusta Public Tree Maintenance - Continue tree maintenance on city streets and city-owned property (reduce debris, impacts of falling).	
Responsible Department	Augusta-Richmond County Public Services with support of Recreation and Parks
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 4- Objective 4.3 – Mitigation Action 4.1.3 (MULTI JURISDICTIONAL)	
Debris Management Plan - Work with the cities, Georgia Forestry Commission, power companies, and other entities to develop a Debris Management Plan. Note: FEMA has a guidebook for developing debris management strategies and examples from other jurisdictions are available.	
Responsible Department	Augusta-Richmond County EMA with support of cities of Hephzibah and Blythe
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County, cities of Hephzibah and Blythe
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 5: WILDFIRE MITIGATION STRATEGY

Goal 5: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of wildfire.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

Many communities in the Western U.S. adopt regulations that require property owners to maintain separation between buildings and forest interfaces and some building codes in those communities specify fire-resistant roofing materials. Given the low occurrence of wildland interface fires, such measures are not appropriate for the Augusta area.

Public education about outdoor fire risks – especially during periods of drought – can address the most significant impacts of urban wildland interface fires (most of which are started by carelessness). The Georgia Forestry Commission undertakes a variety of activities to educate the public about outdoor burning and risks of forest and wildland interface fires.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

The Augusta Fire Department's capability to suppress wildland fires is an important factor that prevents small fires from growing into large fires. In 2004, the department purchased wildland firefighting protective clothing.

When regional conditions warrant it, the State may impose bans on outdoor burning. In addition, Augusta, Blythe and Hephzibah all have the authority to impose burn bans independent of whether the State restricts such activities. Augusta does not have specific provisions in land use regulations and ordinances related to minimizing the effects of urban wildland interface fires. However, as growth extends south into forested areas, it will be important that fire suppression capability be increased to maintain adequate response time.

Objective 5.1: Increase public awareness and increase level of protection to critical infrastructure and local population from the effects of wildfire in Augusta-Richmond County.

GOAL 5- Objective 5.1 – Mitigation Action 5.1.1	
Pre-Suppression Planning for City-Owned Lands. Request assistance from the Georgia Forestry Commission to evaluate fire risks on City-owned parks and greenspace to develop prevention plans to improve forest health.	
Responsible Department	Administrator's Office, Trees and Landscape, Recreation and Parks
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 5- Objective 5.1 – Mitigation Action 5.1.2	
Subdivisions & Driveway Access for Fire Vehicles. Request that the Quarterly Subdivision Regulations Review Committee consider new standards for widths of subdivision roads and shoulders, and for common driveways for multiple flagpole lots to provide safer access by larger fire trucks.	
Responsible Department	Planning Division with Fire Department
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 6: EARTHQUAKE MITIGATION STRATEGY

Goal 6: To minimize losses of life and property, and other economic losses in Augusta-Richmond County due to effects of earthquakes.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

In Augusta, seismic hazard has not been previously recognized as a source of credible risk. However, Augusta's relative proximity to three major eastern seaboard faults at New Madrid, Appalachian Mountains and, in particular, Charleston, SC, indicate that we cannot ignore it any longer. The principal mitigation measures for this hazard would be inspection of the structurally compromised buildings and public outreach

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

It is not clear if Augusta has any regulations that pertain specifically to existing seismic exposure.

Objective 6.1: Increase public awareness and increase level of protection to critical infrastructure and local population from the effects of seismic activity.

GOAL 6- Objective 6.1 – Mitigation Action 6.1.2	
Outreach and seismic inspection Request that the building inspectors conduct field verification of the building's overall health and field operators Seismic inspection of the residential structure**.**	
Responsible Department	EMA with Engineering Department
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	NEW

CHAPTER 5: LOCAL TECHNOLOGICAL HAZARDS MITIGATION GOALS AND OBJECTIVES; OVERALL COMMUNITY MITIGATION GOALS, POLICIES AND VALUES

Chapter 5 of the HMP describes Technological Hazard Mitigation Goals, Objectives, Policies and Values evaluated by Augusta-Richmond County and participating municipalities, both on their individual (local), as well on the overall, county-wide level. This chapter provides a plan of action for Augusta-Richmond County and its communities to increase resilience to technological hazards and is a culmination of a process that started with HRV assessment in Chapter 3. This Chapter consists of the following sections:

- Introduction;
- Goals And Objectives Update Summary;
- Chemical Leak / Release Mitigation Strategy
- Terrorism Mitigation Strategy
- Nuclear Plant Incident Mitigation Strategy
- Dam/Levee Failure Mitigation Strategy

The table below summarizes updates on 2006 HMP mitigation technological hazards ranking and subsequent addition of three more hazards:

Chapter 5 Section	Updates to 2006 HMP
I. Technological Hazard A Chemical Leak / Release	• Renamed from Hazardous Materials • Updated Mitigation Goals, Objectives, and Actions
II. Technological Hazard B Terrorism	• New Section
III. Technological Hazard C Nuclear Plant Incident	• New Section
IV. Technological Hazard D Dam / Levee Failure	• New Section

Table 5.1: Overview of updates to Chapter 5: Local Technological Hazard Mitigation Goals and Objectives
Overall Community Mitigation Goals, Policies and Values

INTRODUCTION

The purpose of this Chapter is to highlight prevalent technological hazards, as previously identified by the members of Augusta-Richmond County HMPC. As mandated by the State regulations, all technological hazards and actions related to their prevention and mitigation are the responsibility of the local Emergency Management Agency. The primary guiding document is the Augusta Local Emergency Operations Plan (LEOP) (updated October, 2009), that identifies 15 Emergency Support Functions (ESFs), naming principal and supporting agencies for each one of them. For the purpose of this Plan Update, the hazards and the strategies are reviewed primarily from the mitigation standpoint. As in Chapter 4, each hazard is addressed through mitigation goals, objectives and actions.

GOALS AND OBJECTIVES UPDATE SUMMARY

In Chapter 3 of this Plan Update, members of the Augusta-Richmond County HMPC conducted quantitative and qualitative evaluation of the community's exposure to technological hazards through HRV process. As a direct result of the prevalent technological hazard evaluation, HMPC established the following 2011 mitigation goals and objectives:

Goal 1: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to chemical spills / airborne release.

Objective 1.1: Increase environmental safety with respect to flood hazards and downtown Augusta railroad infrastructure.

Objective 1.2: Increase public awareness and increase level of protection to local population from the effects of chemical spills / airborne release.

Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to terrorism.

Objective 2.1: Increase public awareness and increase level of protection to local population from the effects of terrorism.

Goal 3: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to nuclear plant incident.

Objective 3.1: Increase public awareness and increase level of protection to local population and economy from the effects of nuclear plant incident.

Goal 4: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to dam / levee break.

Objective 4.1 (in conjunction with Objective 1.1):
Maintain public awareness and increase level of protection to critical infrastructure and local population from the effects of dam / levee break.

SECTION 1. CHEMICAL SPILLS / AIRBORNE RELEASE MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 1: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to chemical spills / airborne release.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

As stated before, mitigation does not replace the importance and need for a response plan tailored to the presence of hazardous materials in a community. The Augusta Emergency Management Agency is responsible for planning, coordinating and responding to hazardous materials incidents. For the purposes of this Plan Update, the focus of this mitigation is on two subjects:

Chemical spill hazard at the facilities damaged by flooding (either rain-induced flooding (Natural Hazard 2) or catastrophic dam/levee failure-induced flooding (Technological Hazard 2); Chemical leak / airborne release caused by the incident involving trains carrying chemical load through downtown Augusta and elsewhere in the County.

EXISTING POLICIES, REGULATIONS, ORDINANCES, AND LAND USE

The responsibilities of the Augusta Fire Department include environmental compliance by handlers of hazards materials. State licensed facilities are inspected annually; other locations with hazardous materials also are scheduled for annual inspections. The Augusta Commission established the Augusta-Richmond County Local Emergency Planning Committee (LEPC). The LEPC consists of members of the community who represent industry, chemical transporters, local government, emergency response departments, schools, environmental groups, citizens, utility companies, and the news media. The primary purpose of the LEPC is to address many of the public concerns of industry and the community regarding the use, storage, manufacturing, and transporting of hazardous materials. In cooperation with local industries, the LEPC sponsors numerous annual events such as community meetings, open houses, bus tours of industries, training exercises, shelter-in-place training, and special seminars about risk management plans.

The Augusta-Richmond County EOP identifies several Emergency Service Functions (ESFs), directly concerning this Objective: ESF-5 (Emergency Management Services), ESF-8 (Public Health and Medical Services), ESF-10 (Hazardous Materials) and ESF-14 (Long Term Recovery and Mitigation)

Objective 1.1: Increase environmental safety with respect to flood hazards and downtown Augusta railroad infrastructure.

GOAL 1- Objective 1.1 – Mitigation Action 1.1.1	
Environmental Safety and Flood Hazards. Improve geo-location data for the actual physical locations of hazardous materials and use the GIS-based mapped flood hazard areas to identify sites that are in or near mapped floodplains. Flood hazards should be identified both from FEMA DFIRMs and USACE inundation maps. For sites determined to have some degree of flood risk, request that the LEPC use the information to inform owners/operators and encourage including flood threat recognition and protective measures into risk management plans.	
Responsible Department	Augusta-Richmond County EMA with support of LEPC members and IT
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	5 years
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

GOAL 1- Objective 1.1 – Mitigation Action 1.1.2	
Downtown Railroad Safety. Continue to pursue activities (engineering, land acquisition, etc.) related to relocating railroads from downtown Augusta; in particular, NS Railroad mainline off of 6th Street right-of-way. This action is contained in the Augusta-Richmond County Comprehensive Plan.	
Responsible Department	Augusta-Richmond County EMA and Planning & Development Commission with support of LEPC, Georgia DOT, Railroad companies
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County, cities of Hephzibah and Blythe
Timeframe	Ongoing
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

Objective 1.2: Increase public awareness and increase level of protection to local population from the effects of chemical spills / airborne release.

GOAL 1- Objective 1.2 – Mitigation Action 1.2.1
Chemical Spill Awareness - Continue public outreach on chemical spills and airborne release; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of representatives from Augusta, LEPC, and members of the public, including nonprofit and neighborhood organizations and others, to look at outreach efforts and materials provided by the National Weather

Service, FEMA, the American Red Cross, and others and determine whether changes are appropriate. Expand use of Augusta's website to make information readily available to the public.	
Responsible Department	Augusta-Richmond County EMA with LEPC members
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	DEFERRED

SECTION 2. TERRORISM MITIGATION STRATEGY

COMMUNITY MITIGATION GOALS

Goal 2: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to terrorism.

Objective 2.1: Increase public awareness and increase level of protection to local population from the effects of terrorism.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

The counterterrorism measures in Augusta-Richmond County are within jurisdiction of law enforcement and the judicial system as mandated by State and Federal laws. Deployment of resources and incident management actions during an actual or potential terrorist incident are conducted in coordination with the Federal Bureau of Investigation, (FBI). The role of the local Emergency Management Agency is to coordinate, plan and respond to incidents caused by terrorism. This role is regulated in detail in the local EOP.

The mitigation options applicable to this hazard are directed primarily to education of the public and owners/operators of the critical facilities.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

The counterterrorism measures are regulated by the State and Federal Laws and Law enforcement regulations.

Objective 2.1: Increase public awareness and increase level of protection to local population from the effects of terrorism.

GOAL 2- Objective 2.1 – Mitigation Action 2.1.1 (MULTI JURISDICTIONAL)	
Terrorism Awareness - Continue public outreach on terrorism; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of emergency management and law enforcement representatives from Augusta, Blythe, Hephzibah, LEPC and members of the public, including nonprofit and neighborhood organizations and others, to look at outreach efforts and materials provided by the Department of Homeland Security, Georgia Bureau of Investigation (GBI), and GEMA. Ensure that all essential facilities have threat of terrorism evaluated and provided for in their contingency plans. Provide training and emergency drills for operators of all essential facilities. Expand use of Augusta's website to make information readily available to the public.	
Responsible Department	Augusta-Richmond County EMA, Law enforcement in Augusta, Hephzibah, and Blythe
Anticipated cost	TBD
Existing and potential funding sources	Various federal sources
Jurisdiction	Augusta-Richmond County, cities of Hephzibah and Blythe
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	NEW

SECTION 3: NUCLEAR PLANT INCIDENT MITIGATION STRATEGY

Goal 3: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to nuclear plant incident.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

In light of the recent tragic events at the Fukushima Nuclear Plant in Japan, public awareness and the level of concern in Augusta has risen in recent months. Augusta is within miles of two nuclear facilities: the Savannah River Site and the Vogtle Electric Generating Plant.

The Savannah River Site (SRS), operated by Savannah River Nuclear Solutions (SRNS), is a 310 acre site and sits on the northern side of the Savannah River in Aiken County, Barnwell County and Allendale County in SC. The major focus of the site is the cleanup of waste related to the nation's buildup of nuclear products from the Cold War.

Plant Vogtle sits on the southern, Georgia side of the Savannah River in Burke County, Georgia and is situated 40 miles south of Augusta and is east of Waynesboro, Georgia. Plant Vogtle is one of two nuclear facilities owned by Georgia Power and one of three owned by the Southern Company. There are currently two units producing nuclear energy at the site. Southern Company has a "Safety

Calendar" a web publication with extensive information on evacuation procedures. SRS has a very similar link, "Community Emergency Preparedness Information", on their web site.

Mitigation options in the Augusta-Richmond County area are relatively limited, except for the efforts related to public education, outreach, information and alert, most of which are already ongoing. Augusta EMA, the principal agency coordinating nuclear incident emergencies, can count on significant State and Federal resources in case of the General Event (the most severe incident level) at any of the two facilities.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

The operation of both nuclear facilities is regulated by Federal laws and is under jurisdiction of the Federal Department of Energy.

Objective 3.1: Increase public awareness and increase level of protection to local population and economy from the effects of nuclear plant incident.

GOAL 3- Objective 3.1 – Mitigation Action 3.1.1 (MULTI JURISDICTIONAL)	
Nuclear Plant Incident Awareness - Continue public outreach on nuclear hazard; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of emergency management and representatives from Augusta, Blythe, Hephzibah, LEPC, SRNS, Southern Company and members of the public, including nonprofit and neighborhood organizations and others, to evaluate existing outreach efforts and materials and propose improvements, if necessary. Provide training and emergency drills for operators of all essential facilities. Expand use of Augusta's website to make information readily available to the public.	
Responsible Department	EMA
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County, Hephzibah and Blythe
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	NEW

SECTION 4: DAM / LEVEE BREAK MITIGATION STRATEGY

Goal 4: To minimize losses of life and property, and other economic losses in Augusta-Richmond County and participating communities due to dam / levee break.

IDENTIFICATION AND ANALYSIS OF RANGE OF MITIGATION OPTIONS

FEMA and the USACE maintain the National Inventory of Dams (1998), a database

of high and significant hazard dams. For the most part, data is provided by state agencies responsible for regulation and inspection of dams or by the Corps of Engineers. The records show that seven high hazard dams (and 3 significant hazard dams) are located in Augusta and one high hazard dam is located outside the City in the upper portion of Spirit Creek.

High hazard dams are those of specific height or volume of impounded water that, if failure occurred, there would be a high likelihood of loss of life and substantial property damage. There is no requirement for owners to develop emergency action or maintenance plans, although high hazard dams are required to be brought up to state specifications to protect public safety and property.

EXISTING POLICIES, REGULATIONS, ORDINANCES AND LAND USE

The Augusta EMA reports that the three Savannah River dams are the only high hazard dams for which a response plan and inundation maps are on-file (updated July 1994; DP 1130-2-16). The USACE dams are the Hartwell, Richard B. Russell, and J. Strom Thurmond. The Corps document considered several dam failure scenarios and predicts the arrival times ranging from 4.5 to 13 hours, and peak flood elevations at various locations.

The Corps' Savannah District operates the dams, monitors flood conditions, and notifies emergency management officials in downstream jurisdictions if flooding is predicted. The Augusta EMA has prepared an Emergency Evacuation Plan based on the Corps' report and maintains a response plan for closing the levee openings. Map

Objective 4.1 (in conjunction with Objective 1.1): Maintain public awareness and increase level of protection to critical infrastructure and local population from the effects of dam / levee break.

GOAL 4- Objective 4.1 – Mitigation Action 4.1.1
Dam / levee Break Flood Hazard Considerations. . Improve geo-location data for the actual physical locations of hazardous materials and use the GIS-based mapped flood hazard areas to identify sites that are in or near mapped floodplains. For sites determined to have some degree of flood risk, request that the LEPC use the information to inform owners/operators and encourage including flood threat recognition and protective measures into risk management plans. Continue public outreach and maintain awareness of the dam/levee break hazard; encourage families to prepare Disaster Supply Kits; encourage people with special medical needs to notify Augusta Emergency Management Agency. Convene a working group of emergency management and representatives from USACE, smaller dam owners and members of the public, including nonprofit and neighborhood organizations and others, to evaluate existing outreach efforts and

materials and propose improvements, if necessary. Provide training and emergency drills for operators of all essential facilities. Expand use of Augusta's website to make information readily available to the public. Evaluate dam/levee break warning systems.	
Responsible Department	EMA, Engineering Department, Public Services
Anticipated cost	TBD
Existing and potential funding sources	Within existing budget
Jurisdiction	Augusta-Richmond County
Timeframe	Continuous
STAPLEE Priority	TBD
Status (deferred or new)	NEW

CHAPTER 6 EXECUTING THE PLAN

Chapter 6 of this Plan update discusses how the Mitigation Strategies will be implemented by Augusta-Richmond County, Blythe and Hephzibah and how the overall updated Hazard Mitigation Plan will be evaluated and enhanced over time. This chapter also describes how the public and participating stakeholders will continue to be involved in the hazard mitigation planning process.

SECTION 1. IMPLEMENTATION ACTION PLAN

ADMINISTRATIVE ACTIONS AND DISTRIBUTION. Upon adoption by the HMPC, and subsequently, by Augusta-Richmond County, Blythe, and Hephzibah the updated Hazard Mitigation Plan will be posted on the Planning Commission's web site and notices of its availability will be distributed to the following:

- The Federal and State agencies that were notified and invited to participate in HMP update development;
- Adjacent counties and cities;
- Citizens who attended public meetings (if contact information provided); and
- The organizations, agencies, and elected officials who received notices of public meetings.

AUTHORITY AND RESPONSIBILITY. Each proposed mitigation action in Chapters 4 and 5 is assigned a lead agency (and supporting agency or authority in most cases). The lead agency for each mitigation action is responsible for incorporating that action into its work plan and schedule over the indicated period of performance. In collaboration with Augusta Planning Commission and Augusta Emergency Management Agency, lead agencies will report on progress and issues in conducting these actions.

PRIORITIZATION

Methodology for Prioritization (for grant funding). This updated HMP does not pre-identify projects that entail mitigation of hazards on private property because many factors must be considered when defining such projects. Some of the factors include: history of damages, interest of owners to participate in the program, and the availability of the non-federal cost share which cannot be projected due to the local budget process.

Natural Hazards Mitigation Action 2.1.6 (Policies and Procedures for Flood Mitigation Projects), calls for establishment of a systematic method for using and prioritizing use of funds. For projects that may qualify for grant funds administered by State and Federal agencies, the following factors will be considered when developing site-specific projects and prioritizing them for submission:

- Exposure to hazard and frequency;
- Documented history of past damages;
- Probability and magnitude of future damage;
- Eligibility as defined by potential funding source;
- Interest of affected citizens and property owners in participation;
- Estimate of project costs and benefits using FEMA's flood insurance claims histories and Benefit/Cost Modules where applicable; and
- Availability of local share of the mitigation project cost.

Use of cost-benefit. In a preliminary project selection, it is important that the local community ascertain benefits of each proposed mitigation project (or action) applying STAPLEE criteria: Social, Technical, Administrative, Political, Legal, Economic, and Environmental. By using this methodology, the community has an opportunity to objectively rank projects and to successfully document and defend decisions based on such ranking. While the STAPLEE approach may utilize a standard stand-alone benefit cost analysis (in its economic section), the methodology as a whole is far more comprehensive and applicable to many more non-technical activities.

Alternative prioritizing methodologies. Many of the mitigation actions identified in this Plan update are administrative or programmatic in nature, including addressing how hazards are incorporated into local processes, public awareness and warning, flood map revisions, sediment control on construction sites, staffing, water conservation, debris management, and refining what is known about flood risks at locations where hazardous materials are handled. The designated rankings are recommended by the HMPC and are largely based on whether actions are ongoing or can be incorporated into current workloads, budgets and staffing. In effect, this assessment is similar to balancing the benefits of an action with its costs of implementation (although a formal analysis of that comparison was not performed). Each lead agency is responsible for determining priorities within the framework of their overall responsibilities.

Incorporating Mitigation in Other Plans. Augusta-Richmond County, Hephzibah and Blythe each address hazards in their respective Comprehensive Plans through current planning mechanisms and processes, including land development, Greenspace, infrastructure design, and public outreach.

Certain types of site-specific projects (such as flood mitigation projects that have been undertaken by Augusta) must be identified in the Special Purpose Local Option Sales Tax (SPLOST) plan. When projects and potential funding sources are identified, amendments to SPLOST will be recommended.

The Short Term Work Plan (2008-2012) included in the Augusta-Richmond County Comprehensive Plan (2008) identifies a number of capital projects that have bearing on natural hazards, including drainage projects. During the next revision of the Comprehensive Plan, the Planning Commission will review the updated 2011 Hazard Mitigation Plan to determine if any mitigation action is appropriately included in the Short Term Work Plan.

SECTION 2. EVALUATION, MONITORING, UPDATING

The Augusta Planning Commission and the Augusta Emergency Management Agency are charged with monitoring this Plan and mitigation activities and preparing quarterly progress reports. A meeting may be held, or the mayors of Blythe and Hephzibah and the agencies that are assigned lead functions may be contacted and asked to report on the status of implementation, including obstacles to progress and recommended solutions. The reports will be compiled into a single document and submitted to the Georgia Emergency Management Agency.

In addition to the annual report, a meeting will be convened after damage-causing natural hazard events to review the effects of such events. Based on evaluation of those effects, adjustments to the mitigation actions and priorities may be made or additional event-specific actions may be identified (especially if funds to support projects become available).

Critical Facilities Update. The City Clerk or designee of the cities of Blythe and Hephzibah will work with Augusta – Richmond County to update the GMIS online database and all local plans and documents with Critical Facility Information throughout the five year life-cycle of the HMP update.

Multi-Jurisdictional Considerations. Blythe and Hephzibah will be included in all communications related to executing the updated Plan. They will be responsible for reporting on any damage due to the occurrence of a hazard event and for reporting any actions taken to reduce future damage and risk.

SECTION 3. PLAN UPDATE AND MAINTENANCE

Revisions that warrant changing the text or incorporating new information may be prompted by a number of other circumstances, including identification of specific new mitigation projects, completion of several mitigation actions, or to satisfy requirements to qualify for specific funding. Minor revisions may be handled by addenda.

Major comprehensive review of and revisions to this Plan will be considered on a five-year cycle. Because the Plan is adopted in 2011, it will enter the next evaluation and review cycle sometime in 2015, with adoption of revisions anticipated in August of 2016. The Multi-Jurisdictional HMPC will reconvene to conduct the comprehensive evaluation and revision. At that time, natural hazard events that have occurred will be incorporated and the risk assessment will be updated if such events indicate new or altered exposures. Particular attention will be given to progress made on the mitigation actions. Actions that have not been completed and additional actions will be re-prioritized and examined in terms of feasibility given authorities, staff resources, goals, and budget limitations that will need to be taken into account at the time.

The public will be involved during the major comprehensive review to the Plan in the same ways used during the original Plan development in 2005 and the subsequent Plan update in 2011. The public will be notified when the revision process is started and provided the opportunity to review and comment on changes to the Plan and the priority action items. It is expected that a combination of informational public meetings, surveys and questionnaires, draft documents posted on the web site, and/or public meetings may be undertaken.

CHAPTER 7 CONCLUSIONS

7.1 – Summary

The jurisdictions of Richmond County gained a wealth of knowledge about the County's disaster history and potential for future disasters as a result of the multi-jurisdictional hazard mitigation planning process. Research on the hazard history of during the past fifty years and a comprehensive assessment of vulnerability provided invaluable information to inform the planning process. The critical facilities database containing detailed information on facility structures, equipment, and population hazard exposure for each jurisdiction gave insight to vulnerability and mitigation strategies. The HMPC and community stakeholders shared experience, ideas, and actions to minimize exposure and protect the citizens and assets of the planning area.

Community involvement was extensive and proactive, and the HMPC was responsive and supportive of input, suggestions, and concerns. The planning process included stakeholders representative of the community at large, public and private agencies, and entities. Multiple public planning sessions and hearings were conducted to provide every Richmond County citizen with opportunities to participate in the HMP update.

As the planning process evolved, the community as a whole embraced the project and contributed energy, time, resources, and insight to guide the Plan update. An additional benefit of the planning process is evidenced in increased communication between local government, citizens, and businesses. The exhaustive efforts of each produced a Plan update that provides sound, doable measures to mitigate exposure to Natural and Technological Hazards. The Augusta – Richmond County Multi-Jurisdictional Hazard Mitigation Plan (HMP) is truly a collaborative effort between local government and those it serves to implement measures for a safer, sustainable future for its citizens.

7.2 References

7.2.2 Publications

Paulson, R.W., Chase, E.B., Roberts, R.S., and Moody, D.W. 1991. National water summary, 1988-89-Hydrologic events and floods and droughts: U.S. Geological Survey Water-Supply Paper 2375, 591 p.

2000 Emergency Response Guidebook. (A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Material

Incident), developed jointly by the U.S. Department of Transportation, Transport Canada, and the Secretariat of Transport and Communications of Mexico, 2000.

7.2.3 Websites

Environmental Protection Agency. (2005, August 17). *NTB.ORG.* Retrieved July 22, 2001, from Norfolk Southern Derailment, Graniteville, SC: http://www.nrt.org/production/NRT/RRTHome.nsf/resources/RRT4AugMeetings2/$File/Graniteville_Case_Study_short.pdf.

FEMA. (2011, July 15). *U.S. Department of Homeland Security*. Retrieved July 15, 2011, from Federal Emergency Management Agency. Declared Disasters by Year or State.: http://www.fema.gov/news/disaster_totals_annual.fema.

GEMA. (2011, July 14). *Georgia Emergency Management-Homeland Security.* Retrieved July 14, 2011, from Hazard Mitigation: http://www.gema.ga.gov/content/atts/mitigation/Hazard%20Mitigation/Planning/2011%20Georgia%20Hazard%20Mitigation%20Strategy.pdf.

Georgia Mitigation Information System. (2011, July 18). *GMIS.* Retrieved July 18, 2011, from GMIS: https://www.itos.uga.edu/gema/Login.do.

Hazards & Vulnerability Research Institute. (2011, May 18). *Hazards & Vulnerability Research Institute*. Retrieved June 10, 2011, from Social Vulnerability Index : http://webra.cas.sc.edu/hvri/products/sovi.aspx.

Hazards and Vulnerability Research Institute. (2011, May 18). *SHELDUS™ Maps and Charts.* Retrieved June 10, 2011, from HVRI, SHELDUS™: http://webra.cas.sc.edu/hvri/products/sheldusmaps.aspx#lossmaps.

NOAA. (2011, June 18). *National Oceanic and Atmospheric Administration*. Retrieved June 18, 2011, from National Climatic Data Center: http://www.ncdc.noaa.gov/oa/ncdc.html.

NOAA. (2011, July 12). *NOAA Economics*. Retrieved July 13, 2011, from NOAA Extreme Events: http://www.economics.noaa.gov/?goal=weather&file=events/tornado&view=costs.

USGS. (2011, July 19). *Earthquake Hazards Program*. Retrieved July 19, 2011, from Earthquake Facts and Statistics: http://earthquake.usgs.gov/earthquakes/eqarchives/year/eqstats.php.

7.2.4 Other References

FEMA. (2011). *HAZUS - MH Report of Damages for Richmond County.* Atlanta: FEMA.

Georgia Emergency Management Agency (GEMA). (2003). *GEMA Hazard Frequency Table.* Atlanta: GEMA.