Discovery Report

Great Lakes Coastal Flood Study

Lake St. Clair

Basin-wide Report

Report Number 01

February 2013

FEMA

U.S. Department of Homeland Security
Federal Emergency Management Agency Region V
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Preface

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program provides states, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By pairing accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This lake-wide Discovery Report provides users with a comprehensive and holistic understanding of the historical flood risk, existing coastal data, and current flood mitigation activities in the Lake St. Clair area. The report includes a summary of the data collected, including information that could influence flood risk decision-making, historical information, existing flood hazard data and information, and mitigation activities. County-based Discovery Reports and data can be found within the appendices of this lake-wide report.

This Discovery Report summaries FEMA's intent to proceed with a Risk MAP coastal flood study project based on the data available, data collected, and analysis performed to date.

Cover photograph: Flooding at Anchor Bay, Lake St. Clair, Michigan. Photograph taken by Carol Swinehard, Michigan Sea Grant Extension, March 28, 1986.

SUBMITTED BY:

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Project Area Community List for Lake St. Clair

This list includes all communities within the Lake St. Clair Project Area covered by this report for the Great Lakes Coastal Study under consideration for new Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) products and datasets, which may include Flood Insurance Studies (FISs) and Flood Insurance Rate Maps (FIRMs). Not all communities will receive new or updated FEMA Risk MAP products and datasets or FISs and FIRMs.

Macomb County, MI	St. Clair County, MI	Wayne County, MI
Macomb County	St. Clair County	Wayne County
Charter Township of Clinton	Algonac, City of	Detroit, City of
Chesterfield, Township of	Clay, Township of	Grosse Pointe Farms, City of
Harrison, Township of	Cottrellville, Township of	Grosse Pointe Park, City of
Mount Clemens, City of	East China, Township of	Grosse Pointe Shores, Village of
New Baltimore, City of	Ira, Township of	Grosse Pointe Woods, City of
St. Clair Shores, City of	Marine City, City of	Grosse Pointe, City of
	Marysville, City of	Harper Woods, City of
	Port Huron, City of	
	St. Clair, City of	
	St. Clair, Township of	

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Acronyms and Abbreviations

AAL	Average Annualized Loss
CAV	Community Assistance Visit
CBRS	Coastal Barrier Resources System
CID	Community Identification Number
CIS	Community Information System
CMAG	Coastal Management Assistance Grant
C-MAN	Coastal Marine Automated Network
CNMS	Coordinated Needs Management Strategy
CO-OPS	Center for Operational Oceanographic Products and Services
CRS	Community Rating System
DFO	Department of Fisheries and Oceans
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standards
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GLCF	Great Lakes Coastal Flood Study
GLCRG	Great Lakes Coastal Restoration Grant
Hazus-MH	Multi-Hazard Risk Assessment and Loss Estimation Software Program
HWM	High Water Mark
HUC8	Hydrologic Unit Code 8
LOMA	Letter of Map Amendment
LOMC	Letter of Map Change
LOMR	Letter of Map Revision
LOMR-F	Letter of Map Revision based on Fill
MLI	Midterm Levee Inventory
NDBC	National Data Buoy Center
NFIP	National Flood Insurance Program
NGDC	National Geophysical Data Center
NID	National Inventory of Dams
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
Risk MAP	Risk Mapping, Assessment, and Planning
SFHA	Special Flood Hazard Area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

Executive Summary

The Federal Emergency Management Agency's (FEMA's) Lake St. Clair Discovery Report provides users with a comprehensive and holistic understanding of historical flood risk, existing coastal data, and current flood mitigation activities within the Lake St. Clair basin. The report also provides users with a summary of FEMA's intent to proceed with a coastal flood hazard study under FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program and the Great Lakes Coastal Flood Study (GLCFS) project.

The GLCFS is a comprehensive study of coastal flood hazards for all United States shoreline along the Great Lakes Basin, including Lake St. Clair. The study is being performed by FEMA in cooperation with the U.S. Army Corps of Engineers (USACE), the Association of State Floodplain Mangers (ASFPM), and other partners. The GLCFS project will put a wide range of data in the hands of communities along the Great Lakes including Lake St. Clair to promote long-term reduction in flood risk and enhance public safety.

Like all other Risk MAP projects, the GLCFS begins with a Discovery phase. The Discovery process for Lake St. Clair involved basin-wide extensive data collection and outreach efforts with Lake St. Clair stakeholders. The Lake St. Clair stakeholder group includes representatives from FEMA, other federal agencies, state agencies, local government, and several other technical focus groups. Data collection efforts under Discovery phase include base map data, coastal data, historic flood data, risk assessment, flood mitigation information, community plans and projects along the shoreline, and other comments based on local knowledge of flood risk. Additionally, certain useful datasets are being developed for use in this study. These datasets include oblique imagery, topography and bathymetry data, shoreline feature dataset to classify shoreline characteristics, a draft transect layout and a storm surge and wave study, all of which will feed into the coastal flood hazard analysis for Lake St. Clair.

The GLCFS for Lake St. Clair will include coastal flood hazard analysis for all communities located along the shoreline and will use the response-based computation approaches outlined in FEMA's *Draft Guidelines and Specifications for Coastal Studies along the Great Lakes, Appendix D.3 Update, May 2012*. The coastal flood hazard results will be transferred to workmaps and released to communities for review. Coastal flood risk assessment products may also be generated for identified Lake St. Clair coastal communities. These products may include Flood Risk Maps, Flood Risk Reports, Changes Since Last FIRMs, Flood Depth and Analysis Grids, and Hazus 2010 1-percent exposure, as well as some additional Great Lakes products that are under consideration.

The study may result in delineation of new Special Flood Hazard Areas (SFHAs), designation of VE Zones, and identification of Limits of Moderate Wave Action (LiMWAs) on the FIRM for the first time. Communities participating in the National Flood Insurance Program (NFIP) that will have mapped VE Zones as a result of this study

will be required to adopt floodplain management regulations that meet or exceed the minimum NFIP requirements for building in VE Zone. FEMA does not impose any additional floodplain management requirements based on the LiMWA. The LiMWA is provided to help communicate the higher risk that exists in that area compared to rest of Zone AE areas.

In addition to the identification and assessment of flood risk along the Great Lakes, the GLCFS project may provide tools and information to communities that encourage identification and implementation of mitigation actions to reduce risk. Mitigation provides a critical foundation on which to reduce loss of life and property by avoiding or lessening the impact of hazard events and it is an essential part of this coastal flood study process. As part of this Discovery process, local Hazard Mitigation Plans were reviewed to better understand existing flood risk within the Lake St. Clair communities, as well as the strategies and actions that have already been developed as part of the local planning processes to mitigate that risk. By first obtaining a better understanding of existing local risk and mitigation actions during this Discovery phase, it is FEMA's intent to begin to work with communities to identify new mitigation actions and strengthen existing actions throughout the coastal flood study. In addition, FEMA will seek to identify communities that could benefit from mitigation assistance through partnership with FEMA. To support the identification and attainment of mitigation actions, as well as local mitigation planning efforts during this coastal flood study, FEMA introduced the Mitigation Action Form and Mitigation Action Tracker to Lake St. Clair stakeholders during Discovery. The form and tracker demonstrate FEMA's effort to help track and identify local potential Areas of Mitigation Interest (AoMI) and new or improved mitigation actions that seek to reduce risk.

FEMA will continue to coordinate and communicate as future developments in the Lake St. Clair coastal flood study process occur. The GLCFS website http://www.greatlakescoast.org is an excellent resource where stakeholders can obtain up-to-date information about the status of this study, data collection, upcoming meetings, new technical reports, the latest methodologies, factsheets, and much more. FEMA encourages stakeholders to remain involved and will seek to identify partnership opportunities during the study.

I. Introduction

Lake St. Clair is a fresh-water lake that lies between the Province of Ontario and the State of Michigan. The Lake has approximately 430 square miles of water and is part of the Great Lakes System. It is a shallow Lake, averaging 10 feet deep, with a maximum depth of just over 21 feet. It is the smallest lake in the Great Lakes system (U.S. Army Corps of Engineers, 2004).

Historically, Lake St. Clair flooding is generally not the result of a single storm event, but rather it is the result of a series of contributing factors, such as wind speed and lake water level. In addition, the general desire to live along the Lake St. Clair shoreline has concentrated development and consequently increased potential flooding damage.

The most damaging flooding occurred along the Lake St. Clair coast in 1973, 1985, and 1986. Storms on March 31, 1985, and April 4 and 6, 1985, with high easterly and northeasterly winds, drove the already high waters of Lake St. Clair on shore, inundating portions of all the coastal communities around the Lake. Much of the damage along Lake St. Clair shorelines has been caused by water flowing through gaps in dikes built under USACE's Operation Foresight in 1973-1974, which were subsequently lowered or removed in the late 1970's by some residents to facilitate access to Lake St. Clair. Figure 1 provides an example of flooding that occurred at Anchor Bay on March 28, 1986.

Figure 1. Flooding at Anchor Bay, Lake St. Clair, MI
Photograph taken by: Carol Swinehard, Michigan Sea Grant Extension
March 28, 1986

The intent of this report is to provide users with a comprehensive and holistic understanding of historical coastal flood risk, existing coastal data, and current activities underway to mitigate coastal flood risk within the Lake St. Clair basin. In other words, this report can help users discover the current and historic state of the Lake St. Clair basin as it relates to coastal flood risk and mitigation activities. This report includes a summary of data collected from Lake St. Clair stakeholders throughout the discovery process, as well as a compilation of Lake St. Clair long-term issues and trends as it relates coastal flooding. This report also provides users with information about the intent to move forward with a new coastal flood risk study along the Lake St. Clair shoreline as part of the Great Lakes Coastal Flood Study (GLCFS) initiative. An updated coastal flood study is needed to obtain a better estimate of coastal flood hazards on Lake St. Clair.

The subsection below outlines the Federal Emergency Management Agency (FEMA) program, Risk Mapping, Assessment, and Planning (Risk MAP), under which the new coastal flood study will be performed.

i. Risk MAP Introduction

Risk Mapping, Assessment, and Planning (Risk MAP) is a FEMA program that provides communities with flood information and tools they can use to enhance their mitigation plans and better protect their citizens against flood hazards. Through more accurate flood maps, risk assessment tools, and outreach support, Risk MAP strengthens local ability to make informed decisions about reducing flood risk.

Through collaboration with State, local, and tribal entities, Risk MAP will deliver quality data that increases public awareness and leads to action that reduces risk to life and property. FEMA intends to collaborate with Federal, State, and local stakeholders to achieve the following goals:

- Address gaps in flood hazard data to form a solid foundation for risk assessment and floodplain management.
- Ensure that a measurable increase of the public's awareness and understanding of risk results in a measurable reduction of current and future vulnerability.
- Lead and support States, local, and tribal communities to effectively engage in risk-based mitigation planning resulting in sustainable actions that reduce or eliminate risks to life and property from natural hazards.
- Provide an enhanced digital platform that improves management of Risk MAP, stores information produced by Risk MAP, and improves communication and sharing of risk data and related products to all levels of government and the public.
- Align programs and develop synergies to enhance decision-making capabilities through effective risk communication and management.

ii. Great Lakes Coastal Flood Study

Through the Risk MAP program and in cooperation with the U.S. Army Corps of Engineers (USACE), the Association of State Floodplain Managers (ASFPM), and other partners, FEMA has initiated a comprehensive study of flood hazard for all the United States shoreline along the Great Lakes Basin, including Lake St. Clair. Figure 2 provides an overview of the Great Lakes Basin. Throughout a Risk MAP project lifecycle, FEMA provides information to enhance local mitigation plans, improve community outreach, and increase local resilience to floods.

Figure 2. Great Lakes Basin Overview

The updated coastal flood study is intended to obtain a better estimate of coastal flood risk on the Great Lakes, including Lake St. Clair. Current, effective Flood Insurance Rate Maps (FIRMs) may be outdated primarily due to the age of data and the coastal methodologies used to produce them. Major changes in National Flood Insurance Program (NFIP) policies and methodologies have been implemented since the effective date of many Flood Insurance Studies (FISs) in the area, creating the need for an update that will reflect a more detailed and complete flood risk determination.

The GLCFS is a multi-year project that will accomplish the following:

- Provide storm-induced flood elevations based on surge and wave modeling and storm sampling from recorded data for water level, meteorological, and ice field conditions.
- Deliver updated flood maps and flood risk products in identified communities.
- Provide oblique photos, high-resolution bathymetry[1], geospatial inventory of coastal land features and structures, and other coastal data to advance local, State, and Federal capability in public safety, hazard mitigation, and asset management initiatives.
- Enhance local planning processes.

[1] Bathymetry is the measurement of the depth of bodies of water, including lakes or oceans

FEMA manages the NFIP, which is the cornerstone of the national strategy for preparing communities for flood-related disasters. Emulating the NFIP and the Risk MAP program, the GLCFS will include a system-wide solution that provides a comprehensive analysis of storm and high-water events within the Great Lakes Basin. FEMA, along with USACE, ASFPM, State partners, and FEMA contractors, will collaborate to update the coastal methodology and flood maps and to create new flood risk products defined by FEMA's Risk MAP program.

The GLCFS will incorporate modern analysis of historic storm and high-water events and provide for updated flood risk information serving United States communities having shoreline along the Great Lakes. The storm surge study is one of the most extensive coastal storm surge analyses to date, encompassing coastal floodplains in the eight States with coastlines on the Great Lakes. The new coastal flood hazard analyses will utilize updated 1-percent-annual-chance (100-year) flood elevations obtained from the comprehensive storm surge study being developed by the USACE

Each Risk MAP project, including the GLCFS, begins with a Discovery phase, which is the intent of this report. Section II of this report provides a Discovery overview.

II. Discovery Overview

Prior to moving forward with a Risk MAP project, FEMA conducts a process called Discovery. During the Discovery phase, FEMA:

- Gathers information about local flood risk.
- Reviews mitigation plans to understand local mitigation capabilities, hazard risk assessments, and current or future mitigation activities.
- Supports communities within the project area to develop a vision for the future.
- Collects information from communities about their flooding history, development plans, daily operations, and stormwater and floodplain management activities.
- Uses all information gathered to determine which areas require mapping, risk assessment, or mitigation planning assistance through a Risk MAP project.
- Develops a Discovery Map and Report that summarizes and displays the Discovery findings.

The Discovery process involves coordination with stakeholders at all levels, data collection and analysis, conducting community interviews, a Discovery Meeting with stakeholders or those expected to be affected by the study, and developing potential recommendations that may modify the scope of the Risk MAP project based on an analysis of data and information gathered throughout the Discovery process. Figure 3 provides an overview of the coastal Discovery Process.

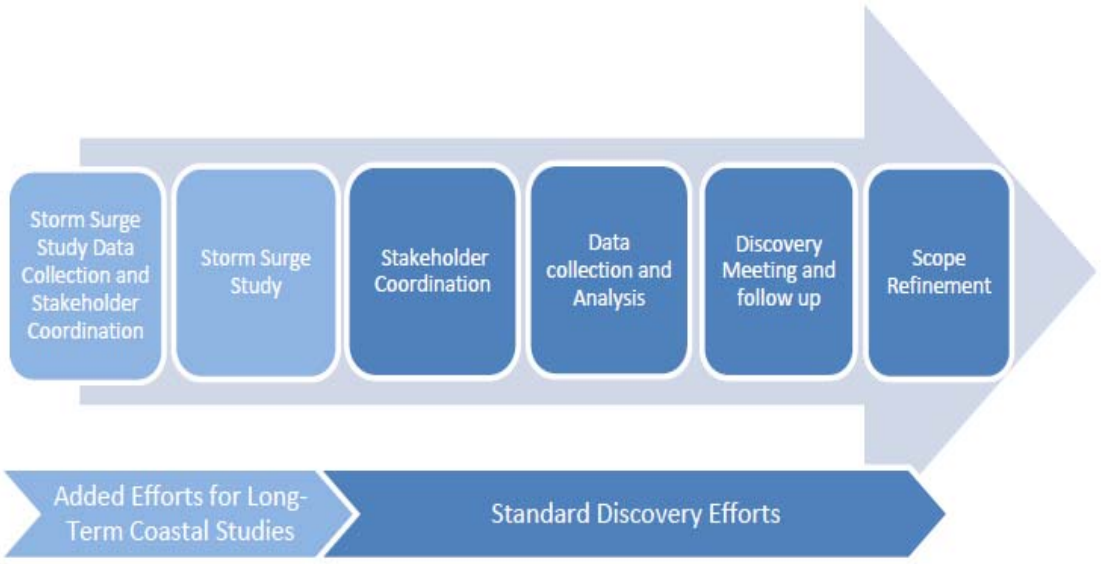


Figure 3. Discovery Process Overview

i. Purpose of Lake St. Clair Discovery

The purpose of the Lake St. Clair Discovery process and of this report is to perform basin-wide data collection and outreach efforts that lead to an informed assessment of lake-wide issues and long-term trends, which in turn will contribute towards the new coastal analysis, risk assessment, and mitigation strategy being developed for the current and potential future Lake St. Clair Risk MAP projects.

This report focuses on the Discovery efforts for Lake St. Clair coastal communities within Macomb, St. Clair, and Wayne Counties in Michigan. Figure 4 shows the counties included in the Lake St. Clair basin-wide project area, highlighted in orange.

The Lake St. Clair Discovery process will also help FEMA to better identify the types of datasets and products that will be useful at the local level, especially as it relates to identifying new mitigation strategies and actions, and for use in local planning efforts. Products that may be available to communities as a result of this Lake St. Clair flood study include updated FIRMs and FIS, coastal flood risk products, calibrated models for storm surge and wave analysis, and accurate depictions of water level and wave response of the lake occurring during hundreds of actual events. The type of product a community will receive during a Risk MAP study depends not only on the coastal flood study analysis results, but also on the type of data (local or national) that is available and the funding available in future years.

Figure 4. Lake St. Clair basin-wide project area

The Lake St. Clair Discovery process included tabular and spatial data collection, information exchange between governmental levels of stakeholders, cooperative discussion with stakeholders to better understand the Lake St. Clair area, and a collaborative approach on the project planning. This process has allowed FEMA to continue to vet the Great Lakes coastal study methodologies with a large stakeholder group, to discuss local priorities and data, to discuss mitigation strategies and coastal issues, and to move towards a project that will successfully identify the risks associated with Lake St. Clair flooding.

The results of this Discovery process and the next steps for the Lake St. Clair coastal flood study project are discussed in the remaining sections of this report.

III. Stakeholder Communication and Coordination

Communication and coordination with Federal, State, and local stakeholders are key to the success of the GLCFS. Much emphasis has been placed on identifying stakeholders early and often and working with those stakeholders continually throughout the study process, from Discovery all the way through flood map and flood risk product development. The outreach goals are to increase understanding of the new coastal study methodologies and the tools and processes that will be available for risk-based community planning, and to increase flood hazard awareness within the Great Lakes Coastal Region.

Throughout this GLCFS process, FEMA will seek to identify partnerships with stakeholders. By coordinating with stakeholders to identify local flood risk, data, and mitigation needs, FEMA can better understand types of flood risk products that may be beneficial to communities as they seek to further protect and inform their citizens against flood risk. Additional information about the coastal flood risk products that may be available to communities as a result of this study can be found in the county-based individual Discovery Reports under the "Coastal Flood Risk Products" section in Appendices C (Macomb County), D (St. Clair County), and E (Wayne County) of this report.

i. Lake St. Clair Stakeholder Coordination for Discovery

Meetings, webinars, emails, telephone calls, and letters are essential to communicate effectively throughout the life of this Lake St. Clair Coastal Flood Study project, which has begun with this Discovery process.

To kick-off this Discovery process, the Lake St. Clair Discovery Risk MAP Project Team [FEMA and Strategic Alliance for Risk Reduction (STARR)] identified a group of core stakeholders, including representatives from FEMA Region V, as well as ASFPM, USACE, National Oceanic and Atmospheric Administration (NOAA), the State NFIP Coordinator, the State Hazard Mitigation Officer (SHMO), and State Engineers. The core stakeholders reviewed the Discovery plan, objectives, and key outcomes for Lake St. Clair Discovery with FEMA, provided suggestions for outreach and communication, and raised any concerns as it related to Lake St. Clair and the coastal flood study process.

Following this kick-off process, outreach, communication, and coordination efforts with local stakeholder were initiated. A list of stakeholders within the project area covered by this Discovery Report (Lake St. Clair) has been established as part of Discovery and is included in Appendix A. This list includes the community elected officials (CEOs), floodplain administrators, planners, engineers, emergency managers, community leaders, regional planning agencies, coastal organizations, Great Lakes organizations, other federal agencies, and other key stakeholders. FEMA and STARR will continuously update this list throughout the life of this project.

Representatives from the local governments-including cities, townships, and villages- are considered fundamental stakeholders in this process because they have been elected or appointed to represent the interests of the residents of the project area.

Three Discovery Meetings were held for the Lake St. Clair project area. Discovery Meeting invitations were sent to local stakeholders within the Lake St. Clair Coastal Flood Study project area in Macomb, St. Clair, and Wayne County. In addition, an email invitation was sent to a larger list of stakeholders including, but not limited to, the core stakeholder group, other federal agencies, universities, watershed groups, Great Lakes associations, technical stakeholders, and emergency management agencies.

The Discovery Meeting letter invitations included a Coastal Data Request Form, which can be found in Appendix B following this report. The form requested communities provide information on data that they had available at the local level that may be of use during the flood study update and during the development of the coastal flood risk products. The Coastal Data Request Form listed requests for information and data, including:

- Base map data
- Coastal data
- Historic flood data
- Risk assessment
- Flood mitigation information
- Community plans and projects
- Other comments/concerns based on local knowledge

The individual Discovery Reports (one for each Discovery Meeting) are included in Appendix C (Macomb County), Appendix D (St. Clair County), and Appendix E (Wayne County) of this basin-wide report. A summary of the data and information collected via the completed Coastal Data Request Forms can be found in Section V, Summary of Data, of this report and can also be found in Attachment A of the individual Discovery Reports referenced above.

In addition to the hard copy letter invitations, and in order to improve the communication and data sharing leading up to the Discovery Meetings, FEMA offered local communities an opportunity to attend pre-Discovery Meeting conference calls, also termed “Information Exchange Sessions”. The Information Exchange conference call information was included in the Discovery invitation letters mailed to local community officials, and an email reminder was sent out as well. The sessions were held to initiate the process of learning about local data availability and critical issues for the communities, and to review the Coastal Data Request Form. Copies of the presentations from the Information Exchange Session conference calls can be found in Attachment B of the individual Discovery Reports (Appendices C, D, and E).

The Discovery Meetings are discussed in greater detail in the next section of this report.

IV. Lake St. Clair Discovery Meetings

The Discovery Meetings for Lake St. Clair coastal communities and stakeholders were held on the following dates:

- Macomb County: Monday, August 20, 2012, 2-4pm EDT in Clinton Township, Michigan
- St. Clair County: Monday, August 20, 2012, 8:30-11:30am EDT in Goodells, Michigan
- Wayne County: Tuesday, August 21, 2012, 2-4pm EDT in Grosse Pointe Park, Michigan

Communities and stakeholders potentially affected by Lake St. Clair coastal flooding were invited to the Discovery Meetings. Figure 5 shows the meeting locations.

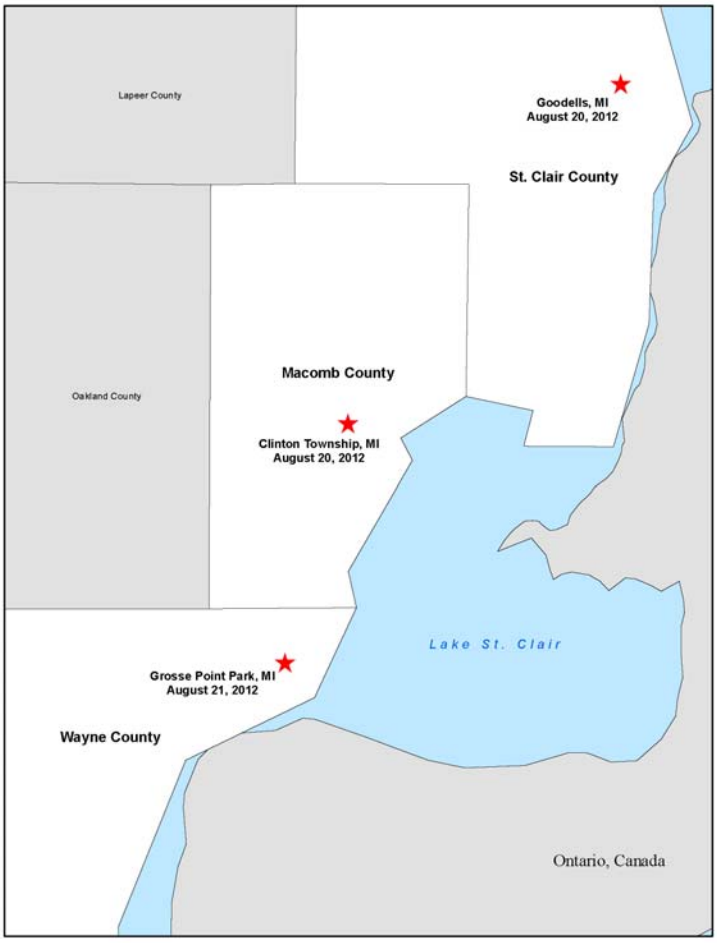


Figure 5. Lake St. Clair Discovery Meeting Locations

Below is a summary of the stakeholders in attendance, excluding FEMA, STARR, and State meeting facilitators:

- Attendees included, but were not limited to, planners, engineers, Geographic Information Systems (GIS) Specialists, natural hazard program specialists, educators, building inspectors, and conservation agents.
- Out of the 23 coastal communities included in this study area, seven (7) were represented at one (1) of the three (3) Discovery Meetings. A total of 14 community officials attended, including multiple representatives from a single community in some cases.
- There were 28 total attendees at the three Discovery meetings.
- In total, the meetings were represented by 39 percent community officials, 21 percent county officials, 11 percent local engineering firms, 8 percent State officials, 7 percent academic community, 7 percent community members and associations, and 7 percent from the Air National Guard.

Sign-in sheets for each meeting can be found within the individual Discovery Reports found in Appendices C (Macomb County), D (St. Clair County), and E (Wayne County). All stakeholders listed in Appendix A, Lake St. Clair Stakeholder List, were invited to attend these Discovery Meetings either via email or hard copy letter. Copies of the hard copy invitations, along with local community official contact lists, can be found in within the individual Discovery Reports in Appendices C, D, and E.

The objectives of the Discovery Meetings included:

- Continuation and expansion upon stakeholder engagement
- Discussion of data inputs from Federal, state, and local stakeholders
- Identification of local coastal flood hazard needs and areas of concern
- Identification of flood risk products and datasets that best advance coastal mitigation action
- NFIP regulatory updates
- Discovery schedule and deliverables

The Discovery Meeting presentations included the following information:

- An overview of the GLCFS and schedule
- Review of the Discovery process and outcomes
- Discussion of coastal mapping and flood risk topics to be aware of
- Discussion of how the study may affect the communities, including compliance requirements
- Review of hazard mitigation opportunities and grant funding
- Encouragement and facilitation discussion regarding coastal study needs, mitigation project needs, desired compliance support, and local flood risk awareness efforts

Draft Discovery Maps (found in Attachments within individual Discovery Reports in Appendices C, D, and E) were displayed and utilized during the meetings to encourage discussion regarding areas of coastal flood risk concern and Areas of Mitigation Interest (AoMI). The draft Discovery Maps shown at the meetings included geospatial and tabular data that had been collected prior to the meetings, such as:

Geospatial Data:

- Average Annualized Loss (AAL) data
- Coastal Barrier Resources System (CBRS)[2]
- Coastal structures
- Coordinated Needs Management Strategy (CNMS)[3] Data (riverine only)
- Dams
- Effective Special Flood Hazard Areas (SFHAs)
- Jurisdictional Boundaries
- Letters of Map Change (LOMCs)
- Levees
- Proposed transects locations
- Shoreline
- Streams
- USGS gages
- Watershed boundaries

Tabular Data:

- Declared disasters
- Flood insurance data
- Potential mitigation actions (from local Hazard Mitigation Plans)
- Summary of shoreline data (type and material)

Participants at each of the Discovery Meetings were asked to cooperatively identify areas of concern related to hazards and Areas of Mitigation Interest (AoMIs) within the Lake St.

[2] CBRS consists of the undeveloped coastal barriers and other areas located on the coasts of the United States that are identified and generally depicted on a series of maps. CBRS areas are ineligible for most new Federal expenditures and financial assistance.

[3] CNMS is FEMA's strategy for coordinating the management of mapping needs using modern geospatial technologies and current policies, requirements, and procedures. CNMS makes information related to mapping needs readily accessible and more usable. CNMS is only for riverine studies at this time. It is expected coastal needs will be captured in this system in the future.

Clair study area using the draft Discovery Maps (Attachment C within Appendices C, D, and E) and through general discussion during the meetings.

In addition to the draft Discovery Maps, figures showing the location of initially proposed transects around Lake St. Clair were presented during the Discovery Meetings. Transects are profiles along which coastal flooding analysis is performed. They are used to transform offshore conditions to the shoreline and to define coastal flood risks inland of the shoreline. Transects are placed to define representative profiles for a shoreline reach. Stakeholders were encouraged to review the proposed transects and provide comments related to the location and orientation of transects. The proposed transect maps that were available at the Discovery Meetings can be found in Attachment D of the individual Discovery Reports located in Appendices C, D, and E. A sample map of the proposed transect layout presented at the Discovery Meetings is in Figure 6. Users should note that transects have since been revised and should refer to the updated proposed transect locations found on the Final Discovery Maps (Appendix F).

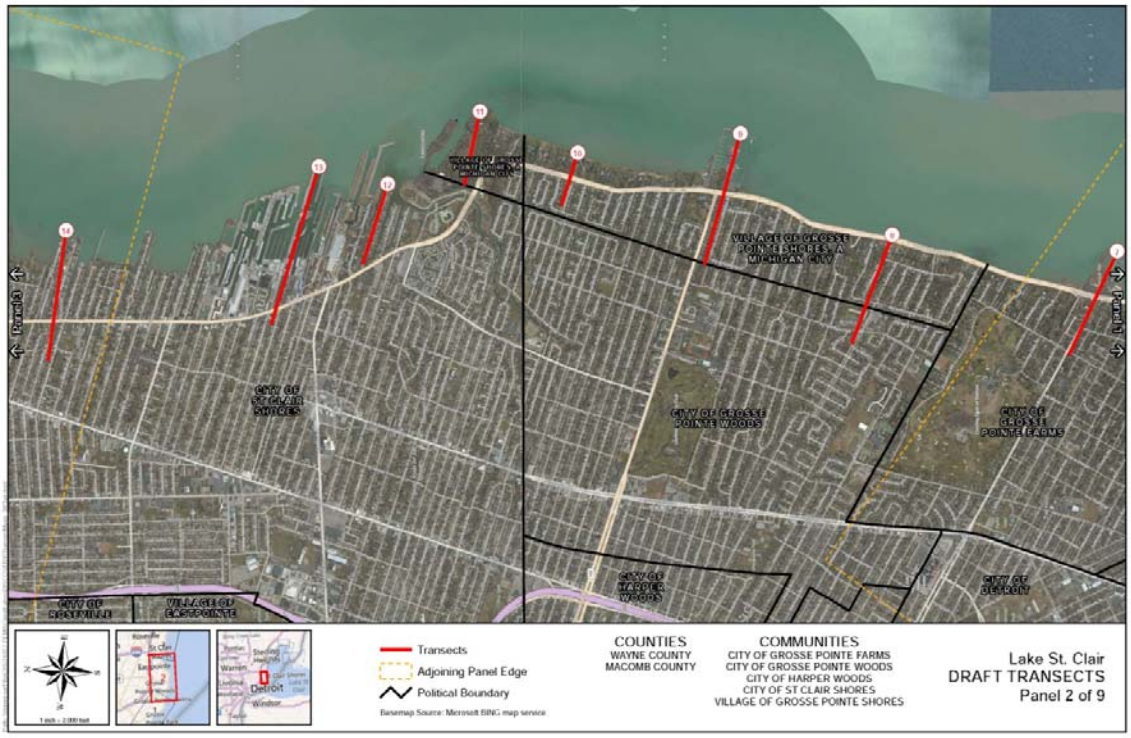


Figure 6. Sample Proposed Transect Figure (from Discovery Meeting)

All comments that were provided during the meetings on the draft Discovery Maps and transect figures have been compiled into geospatial layers and associated tables. The layers, titled "Stakeholder General Comments" and "Stakeholder Transect Comments", can be found on the Final Discovery Maps in Appendix F. A list of each comment collected for all Lake St. Clair counties is listed below, along with a map identification

number (if one exists), which correlates to its location on the Final Discovery Maps (Appendix F).

In Table 1 and on the Final Discovery Maps, the identification of a comment (ID) categorized as a "Stakeholder General Comment" is represented by using the first three letters of the county name followed by a unique number (i.e. MAC – 1, MAC – 2). The identification of a comment (ID) categorized as a "Stakeholder Transect Comment" is represented by using the first three letters of the county name, followed by "TR", followed by a unique number (i.e. MAC-TR-1, MAC-TR-2).

A summary and analysis of the comments collected during each Discovery Meeting can be found in the individual Discovery Reports for Macomb County, St. Clair County, and Wayne County, located in Appendix C, D, and E, respectively, of this report.

Table 1. Stakeholder General Comments and Transect Comments Collected During Discovery Meetings

ID (See Final Discovery Map)	County	Location of Comment	FIPS	CID	Stakeholder Comment
MAC-1	Macomb	Township of Harrison	26099	N/A	To be developed
MAC-2, MAC-TR-1, and MAC-TR-2	Macomb	Township of Harrison	26099	260123	User indicated suggested transect location; sloping rock wall; to be developed
MAC-3	Macomb	City of St. Clair Shores	26099	260127	User indicated suggested transect location; Critical lift facility - Critical Facility
WAY-4	Wayne	City of Detroit	26163	260222	Water Works Park - Critical Facility; Transect suggested at Water Works Park along Detroit River
WAY-TR-4	Wayne	Belle Isle, City of Detroit	26163	260222	Transect suggested for the eastern tip of Belle Isle
N/A	All	Macomb, St. Clair, and Wayne Counties	26099, 26147, 26163	N/A	Requested the effective transect locations be used for Lake St Clair

FIPS = Federal Information Processing Standards
CID = Community Identification Number

Discovery Meeting documents, including meeting minutes, sign in sheets, presentations, coastal data request forms, and correspondence documentation, have been included in the attachments for each individual Discovery Report found in Appendices C (Macomb County), D (St. Clair County), and E (Wayne County).

Following the Discovery Meetings and prior to the issuance of this Final Discovery Report, Great Lakes stakeholders were provided with an opportunity to review a draft Lake St. Clair Discovery Report. The 45-day review period ended on November 30, 2012. No

comments related to this Discovery Report were received during that review period. Questions received from stakeholders that related to the upcoming GLCFS projects and upcoming coastal analyses were resolved on an individual basis or could not yet be resolved due to the nature of the question and the current status of the coastal flood study projects. Those questions will be revisited as the new coastal flood study progresses.

The next section summarizes the data and information collected for Lake St. Clair during this Discovery process.

V. Summary of Data

This section summarizes the data and information collected for Lake St. Clair during this Discovery process. A massive effort of collecting tabular and spatial data was conducted for all the coastal communities from Federal, State, and local sources. In addition, information was collected through phone conversations, information exchange session conference calls, the Discovery Meetings, and the Discovery Coastal Data Request forms sent to each coastal community. Table 2 is a comprehensive list of all the types of data that were collected for this Lake St. Clair study area.

Table 2. Data Collected for Lake St. Clair Discovery

Data Types	Deliverable/Product	Source	Date of Data Collection	Level
Average Annualized Loss Data (AAL)	Discovery Map/Tabular Data	Federal Emergency Management Agency (FEMA)	June 2012	Nationwide
Bathymetry and Topography	Discovery Report	USACE	2012	Lakewide
Census Blocks	Discovery Map/Tabular Data	U.S. Census Bureau	June 2012	Countywide
Coastal Data Request Form	Discovery Report/Tabular Data	Community and County Stakeholders	July 2012	Countywide
Contacts	Discovery Report/Tabular Data	Local Community Websites, State/FEMA updates	June 2012	Countywide
Community Assistance Visits (CAVs)	Discovery Report/Tabular Data	FEMA Community Information System (CIS)	July 2012	Countywide
Community Rating System (CRS)	Discovery Report/Tabular Data	FEMA's "Community Rating System Communities and Their Classes"	July 2012	Nationwide
Comprehensive Plans	Discovery Report	Local Community Websites	July 2012	Countywide
Coastal Barrier Resources System (CBRS)	Discovery Map	U.S. Fish and Wildlife Service	July 2012	Nationwide

Table 2. Data Collected for Lake St. Clair Discovery

Data Types	Deliverable/Product	Source	Date of Data Collection	Level
Coastal Structures	Discovery Map/Tabular Data	U.S. Army Corps of Engineers (USACE)	August 2012	Nationwide
Coordinated Needs Management Strategy (CNMS) – riverine only	Discovery Map	FEMA	July 2012	Countywide
Critically Eroded Beach Areas	None Identified	None Identified	N/A	Countywide
Critical Facilities	Discovery Report/Discovery Map	Local Mitigation Plan, Discovery Meeting	July 2012	Countywide
Dams	Discovery Map/Tabular Data	USACE, National Inventory of Dams, Flood Insurance Rate Map (FIRM) Database	July 2012	Countywide
Declared Disasters	Discovery Report/Tabular Data	FEMA's "Disaster Declarations Summary"	June 2012	Nationwide
Demographics, Industry	Discovery Report/Tabular Data	U.S. Census Bureau, Local Mitigation Plans	June 2012	Countywide
Effective Floodplains	Discovery Map	FEMA Map Service Center and Mapping Information Platform	June 2012	Countywide
Flood Insurance Policies	Discovery Report/Tabular Data	FEMA CIS	July 2012	Nationwide
Hazard Mitigation Plans and Status	Discovery Report/Tabular Data	Local Mitigation Plans	July 2012	Countywide
Hazard Mitigation Assistance Program Grants Received	Discovery Report/Tabular Data	FEMA's "Hazard Mitigation Program Summary" Community Input	June 2012	Nationwide
Hazard Mitigation Projects	Discovery Report/Tabular Data	Local Mitigation Plans	July 2012	Countywide
High Water Marks	Discovery Report, Tabular Data	Effective Flood Insurance Study (FIS)	August 2012	Countywide
Historical Flooding & Storm Events	Discovery Report	Effective Flood Insurance Study (FIS), Local Mitigation Plans	July 2012	Countywide
Individual/Public Assistance	Discovery Report/Tabular Data	FEMA's "Public Assistance Sub-grantee Summary"	June 2012	Nationwide
Letters of Map Change (LOMCs)	Discovery Map/Tabular Data	FEMA's Mapping Information Platform	July 2012	Countywide

Table 2. Data Collected for Lake St. Clair Discovery

Data Types	Deliverable/Product	Source	Date of Data Collection	Level
Meteorological Gages	Discovery Map/Tabular Data	National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory	July 2012	Regionwide
Oblique Imagery	Discovery Report	USACE	2012	Lakewide
Ordinance Status	Discovery Report/Tabular Data	FEMA CIS	July 2012	Countywide
Repetitive Loss	Discovery Report/Tabular Data	FEMA CIS	July 2012	Countywide
Shoreline Classification	Discovery Map/Tabular Data	USACE	July 2012	Regionwide
Stream Gages	Discovery Map/Tabular Data	USGS	July 2012	Countywide
Water Level Gages	Discovery Map/Tabular Data	NOAA Department of Fisheries and Oceans	July 2012	Regionwide
Wave Gages	Discovery Map/Tabular Data	NOAA	July 2012	Regionwide

Information and data collected for each county along Lake St. Clair was compiled into individual Discovery Reports and can be found in Appendices C (Macomb County), D (St. Clair County), and E (Wayne County) of this report. The data in the individual reports is divided into two sections: one section contains the data that can be used for Risk MAP products and the other section contains the information that helped the study team form a better understanding of the Lake St. Clair project area prior to moving forward with the GLCFS projects.

A list of local data and information collected from local stakeholders as part of this Discovery process through the Coastal Data Request Form (Appendix B) has been summarized for Lake St. Clair in Table 3.

Table 3. Lake St. Clair Local Data Collection
Base Map Data, Coastal Data, Other Data, and Historical Flood Data

			BASE MAP DATA		COASTAL DATA							OTHER DATA					HISTORICAL FLOOD DATA
Community, County or State Organization	County	State	Topography	Property Information (Building Footprints, Parcel Data, Tax Assessor's Data)	Coastal Structure Inventory (Seawalls, Jetties, etc)	Coastal Feature Inventory (dunes, bluffs, etc)	Shoreline Change Data	Locations of beach nourishment or dune restoration projects	Areas of significant beach or dune erosion	Mean high water	Mean lake level	Hydraulic Structures (i.e. bridges, culverts, levees, dams) with inspection status, if available	Elevated roads	Critical Facilities	Other known hazards with geographical boundaries, i.e., landslide hazard areas, storm surge inundation zones, wildfire hazard areas, etc.	Other relevant data	Are you aware of any coastal flooding issues not represented on effective FIRMs:
Charter Township of Clinton	Macomb	MI															No
Macomb County Office of Emergency Management	Macomb	MI	Digital	Digital													No
Southeast Michigan Council of Governments (SEMCOG)	SEMCOG	MI	LiDAR & Contour data	Building footprints													
City of Grosse Pointe Woods	Wayne	MI															No
City of Harper Woods	Wayne	MI	Available through Wayne County	Available through Wayne County													No

Table 3. Lake St. Clair Local Data Collection
Risk Assessment and Flood Mitigation Information

			RISK ASSESSMENT		FLOOD MITIGATION INFORMATION											
Community, County or State Organization	**County**	**State**	**Does your community have HAZUS-based loss estimates from average annualized loss?**	**Does your community have other risk assessment data?**	**Does your community have a hazard mitigation plan?**	**Does the plan reflect any coastal flood hazards?**	**Does the hazard mitigation plan indicate any data deficiencies for flood hazards that could be addressed through a flood study, especially near coastal zones?**	**Does your community have on-going mitigation projects, such as acquisition, elevation, flood control, soil stabilization, natural systems restoration, floodproofing, etc.**	**Any specific coastal mitigation projects?**	**Does your community have experience with coastal flood disasters and flood disaster recovery?**	**Does your community coordinate floodplain management programs with programs for the management and planning of open space? If possible, any coastal specific?**	**Have you had any prior proactive mitigation actions and planning efforts that resulted in reduced losses? If possible, any coastal specific?**	**Has your community applied and granted Individual Assistance/Public Assistance grants for declared disasters?**	**Has your community applied for FEMA Hazard Mitigation Grants program or other mitigation funds (USACE, NRCS, USGS, state Hazard Mitigation officer, etc.) in the past?**	**How would you rank the community's ability to implement mitigation actions and to communicate flood risk to citizens?**
Charter Township of Clinton	Macomb	MI	No	No?	Yes - in review	No	No	No	No	No	Yes - Non-coastal	No	No	No	Medium
Macomb County Office of Emergency Management	Macomb	MI	No	Yes - Macomb County Hazardous Mitigation Plan, 2010-2015	Yes - it has been adopted	No	No	No	No	No	Yes - Every community has a master plan and within that plan are details for their flood plain usage and management.	Yes - 2001 Patnick Drive Mitigation Project removed 5 houses from the flood plain resulting in no further property damage since then. The reclaimed property was turned into a flood plain/non-buildable area.	No - Public Assistance was granted to Macomb County and local jurisdictions for the following presidential declared disasters: 2004/Flood; 1986/Flood; 1975/Flood; 1972/Flood; 2003/Electrical Failure; 1999/Blizzard; 1998/High Winds; 1997/Tornado; 1976/Tornado.	Yes - 2001 Patnick Drive Mitigation Project #A12346.50 [Removal of 5 structures from a known flood plain, returning that land to flood plain].	High
Southeast Michigan Council of Governments (SEMCOG)	SEMCOG	MI													
City of Grosse Pointe Woods	Wayne	MI	No	No	No	No	No	No	No	No	No				Low
City of Harper Woods	Wayne	MI	No		No	No	No	No	No	No	No	No	No	No	Low

Table 3. Lake St. Clair Local Data Collection
Community Plans and Projects and Other GIS Data

			COMMUNITY PLANS AND PROJECTS							GIS DATA
Community, County or State Organization	**County**	**State**	**Does your community have a comprehensive plan?**	**Does your community's comprehensive plan have a special consideration for coastal areas?**	**Does your community have a coastal zone management plan?**	**Does your community have planning staff or a planning/zoning commission and other measures, such as ordinances, administrative plans, or other programs contributing to effective administration of floodplain zoning, building codes, open space preservation, and coastal zone management?**	**Does your community have areas of recent or planned development/re-development and areas of high growth or other natural land changes (e.g., wildfires or landslides):**	**Are there any locations of other ongoing studies or projects and studied areas that have been modified since the effective map and require an updated study (e.g., highway improvement, seawall improvement, etc.)**	**Any other comments/concerns based on local knowledge:**	**Other GIS Data Available - be specific if possible, include type of data, date of data, data sources, etc**
Charter Township of Clinton	Macomb	MI	No	No	No	Yes - Floodplain Ordinance along with daily review of building permit applications as it relates to the floodplain.	No	No		
Macomb County Office of Emergency Management	Macomb	MI	No	No	No	Yes - EPA Phase II Watershed Management Groups; Open Space	No	No		
Southeast Michigan Council of Governments (SEMCOG)	SEMCOG	MI							SEMCOG can also provide generalized master planning data	LiDAR, Contours, and 2010 building footprints available for counties within SEMCOG
City of Grosse Pointe Woods	Wayne	MI	Yes - Our community does have a Comprehensive Plan. No - Our community's Hazard Mitigation Plan was not coordinated with the Comprehensive Plan.	No	No	Yes - Our community has planning staff and/or planning/zoning commission and other measures, such as ordinances, administrative plans, and/or other programs contributing to effective administration of floodplain zoning, building codes, open space preservation, and coastal zone management.	No	No		
City of Harper Woods	Wayne	MI	No	No	No	No	No	No		

As the Risk MAP project for Lake St. Clair advances, FEMA will continue to work with local officials to determine partnerships that may be achieved based on local community or county-based data that has been identified as already available through this Discovery process. Available datasets may be used to create certain flood risk products or may be used to help initiate mitigation projects on a community-to-community basis. It will be important for study teams to refer to this list of available local data as the study moves forward.

i. New data for Lake St. Clair

In addition to data collected from local, state, and federal sources, several new datasets were developed specifically as part of the overall GLCFS effort, and include the Lake St. Clair project area. These datasets are summarized in the sections below:

I.V.i.1 Oblique Imagery

As part of the GLCFS, USACE collected oblique imagery for the entire Great Lakes coastline in 2012. Oblique imagery is captured at an angle, as compared to an overhead view provided by orthophotos, and allows users a 3-dimensional view of landscape, buildings, and other features. This dataset may be useful to communities during emergency response, planning, and identification of shoreline types and obstructions; and management of assets, critical facilities, and public properties along the Lake St. Clair shoreline. The oblique imagery is current available via a web-based browser at http://greatlakes.usace.army.mil/.

I.V.i.2 Topography and Bathymetry

As part of the GLCFS, Light Detection and Ranging (LiDAR) was collected to develop topographic and bathymetric data along the Lake St. Clair shoreline. Topography is the configuration of natural and man-made features of a surface area and their relative position and elevations. Bathymetry is the underwater equivalent to topography.

LiDAR is an optical remote sensing technology that can measure the distance to, or other properties of, a target by illuminating the target with light, often using pulses from a laser. A narrow laser beam can be used to map physical features with very high resolution. Downward-looking LIDAR instruments fitted to aircraft and satellites are used for surveying and mapping. LiDAR can be used to create DTM (Digital Terrain Models) and DEM (Digital Elevation Models), which is a digital model or 3-dimensional representation of the terrain's surface.

The LIDAR data for this study was collected within a 1500 meter buffer (500 meters inland and 1000 meters seaward of the land/water interface). Where water clarity permitted, data was collected to cover all federal navigation projects. Flight lines were flown along the channel alignment to ensure the best possible coverage of inlets and structures.

For quality control purposes, one cross line was used every 25 miles along shore or more frequently to ensure 90 percent of all planned lines within the area were crossed by a cross line. In areas of the coast where natural or artificial barriers prevent aircraft operations, the cross line(s) were collected at the nearest possible location to the required interval, but no closer than five (5) miles to an adjacent planned cross line. Overlapping lines and datasets were compared to each other and to cross lines and the differences calculated.

At the time this report was generated, the quality control process was not yet completed on the LiDAR dataset. However, as part of that process, the vertical difference between the LiDAR and ground truth data will be calculated. Ground truth refers to a process in which a pixel on a satellite image is compared to what is there in reality. This is especially important in order to relate LiDAR data to real features and materials on the ground. The collection of ground truth data enables calibration of the LiDAR data, and aids in the interpretation and analysis of what is being sensed. Using this process, all systematic errors will be identified and eliminated and remaining errors should have a normal distribution. Differences between a DEM created from the LiDAR data representing bare ground and the ground truth data will be unbiased and within +/-15 centimeters (RMSE[4]) in flat terrain and within +/-30 centimeters (RMSE[3]) in hilly terrain. Horizontal positions will be accurate to +/- 1.5m (RMSE). Data will be processed to 2-ft contours.

During Discovery outreach efforts, Lake St. Clair stakeholders raised concerns that phragmites, wetland grass that grows along the Lake St. Clair shoreline, may reduce the accuracy of the new bathymetry. The true shoreline location and depth of water may be compromised, especially in those extremely dense phragmites areas. The processing of the bathymetric data for this study will be performed based on the strongest return of each LiDAR pulse, assuming this depth represents the bottom. Data will be processed to produce bottom reflectance data from the LiDAR data.

As of the date of this report, the LiDAR data is expected to become available in the spring of 2013 for this study area. There is a delay in the schedule to collect new bathymetric data; therefore, existing bathymetric data may be used for the transect-based coastal flood hazard analysis. Existing high-resolution bathymetric and topographic data is currently available at http://csc.noaa.gov .

I.V.i.3 Shoreline Feature Dataset

The shoreline feature dataset was generated by USACE Detroit District (U.S. Army Corps of Engineers, 2012) using 2012 oblique photographs mentioned earlier in this section. The dataset captures primary and secondary shoreline types, land uses, coverage, and vegetation types along the entire Great Lakes shoreline, including Lake St. Clair. The dataset includes identification of "artificial" shoreline, which may be indicative of local coastal flood protection structures. This dataset does not identify the level of protection of any coastal structures and it does not validate whether or not a coastal structure exists. The

[4] Root-mean-square-error is a measure of the differences between values predicted by a model or an estimator and the values actually observed.

current dataset contains data at one-mile spacing. The dataset does not include field-based reconnaissance or sediment/subsurface soil collection.

This dataset is shown on the Final Discovery Maps (Appendix F). The dataset (Great Lakes Shoreline Geodatabase) can also be downloaded from http://www.greatlakescoast.org/ under the "Technical Resources" section. Shoreline information specific to each county can be found in the individual Discovery Report in Appendices C, D, and E of this report.

I.V.i.4 Proposed Draft Transects

As discussed in earlier sections of this report, transects are cross-shore profiles along which coastal flooding analysis is performed. Transects are used to transform offshore conditions to the shoreline and are used to define coastal flood risks inland of the shoreline. They are placed to define representative profiles for a shoreline reach.

For Lake St. Clair, proposed draft transects were placed in advance of the Discovery Meetings and were provided to stakeholders for review and comment. The proposed draft transects were revised to incorporate comments captured throughout the Discovery process. The revised proposed draft transects can be seen on the Final Discovery Maps, located in Appendix F. These transects are subject to change based on the future coastal analysis and should not be considered final at this time.

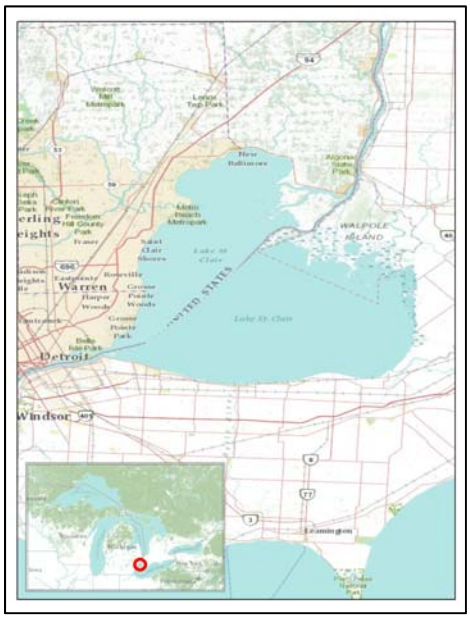
The final transect layout for a coastal hazards analysis and subsequent floodplain delineation is determined by physical factors such as changes in topography, bathymetry, shoreline orientation, and land cover data, in addition to societal factors such as variations in development and density.

I.V.i.5 Storm Surge and Wave Study

Lake level and wave climate are necessary to identify the coastal flood risks. Since there are few observations of lake levels and waves within Lake St. Clair, USACE modeled historical events (a process known as hindcasting). The hindcasted lake level and wave models are driven by wind and pressure fields on a grid defined by available bathymetric data. The resultant model outputs are available on a gridded basis within Lake St. Clair. Additional information can be found at http://www.greatlakescoast.org/ under the "Technical Resources" section.

VI. Lake-wide Issues and Long-term Trends

According to USACE's *St. Clair River and Lake St. Clair Comprehensive Management Plan*, Lake St. Clair (including St. Clair River) is a vital binational resource that provides an array of benefits to the nearly six million U.S. and Canadian residents who live in the watershed. With uses ranging from fishing, recreational boating, drinking water and commercial navigation, the lake and river are defining natural features of southeastern Michigan, as well as southwestern Ontario. They also are vital parts of the larger Great Lakes system. The lake and river are key connections between the upper and lower Great Lakes, both for commercial navigation as well as for fish and wildlife that reside or pass through the area. The St. Clair River- Lake St. Clair-Detroit River corridor is also the outlet for the three upper Great Lakes, contributing over 90 percent of the average annual water supply to Lake Erie and nearly 75 percent of the supply to Lake Ontario (U.S. Army Corps of Engineers, 2004)



The navigation channel within the Lake, which has been dredged for lake freighter passage and is maintained by the USACE, reaches a depth of approximately 27 feet. Human uses of Lake St. Clair have dramatically altered the natural processes of the system. Coastal wetlands have been drained and filled, the shoreline hardened, and a 27-foot-deep navigation channel dredged from the mouth of the St. Clair River to the head of the Detroit River. The vast majority of the watershed's original landscape has been replaced by residential, commercial, and agricultural development (U.S. Army Corps of Engineers, 2004).

Lake St. Clair is fed with fresh water flowing out of Lake Huron to its north via the St. Clair River, which has an extensive river delta. Thames River and Sydenham River flow into Lake St. Clair from Ontario, and the Clinton River flows into the Lake from Michigan. The outflow from Lake St. Clair flows from its southwestern end into the Detroit River and then into Lake Erie.

The time it takes for water to enter and leave Lake St. Clair, also known as the tarry time, averages about seven days, but this can vary from as little as two to as many as thirty days depending on the direction of the winds, the water circulation patterns, and the seasonal amount of water that is flowing out of Lake Huron. The time the water remains in the Lake is about two days if it flows through the navigation channel.

Microtopography has been formed by the dumping of excess material as a result of the dredging of the channel that extends across the lake. The Delta of the St. Clair River is the dominant feature of the Lake. This platform of deltaic deposits has been built out into the

Lake, the outer edge of which is bounded by foreset slopes extending downward from platform depths of less than one meter to greater than 3 meters depth (U.S. Army Corps of Engineers, 2004).

The subsections below detail trends and issues specific to Lake St. Clair, including water levels, historical flooding and high water marks, coastal flood protection measures, and coastal recession.

i. Water Levels

Coastal flooding along the Great Lakes is primarily the result of storm-induced surge and waves and is directly related to the long-term lake water levels. Variations in lake water levels due to decadal scale variations in precipitation and human activities affect the risk of flooding and will be taken into account during the upcoming GLCFS projects.

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) maintains several water level stations along Lake St. Clair. CO-OPS' primary motivation is the collection and dissemination of high quality and accurate measurements of lake level for scientific studies. Great Lakes water levels constitute one of the longest high quality hydrometeorological data sets in North America with reference gage records beginning about 1860 with sporadic records back to the early 1800's.

Table 4 lists the water level stations along Lake St. Clair.

Table 4. Lake St. Clair Water Level Stations

Station Number	Station	Latitude	Longitude	Hourly Records	6-minute Records
9014070	Algonac, MI	42° 37.2' N	82° 31.6' W	1/1975 – 1/2010	1/1996 – 2010
9034052	St. Clair Shores, MI	42° 28.3' N	82° 52.3' W	1/1975 – 1/2010	1/1996 – 2010
9044036	Fort Wayne, MI	42° 17.9' N	83° 50.5' W	1/1975 – 1/2010	1/1996 – 2010
9044049	Windmill Point, MI	42° 21.4' N	82° 55.8' W	1/1975 – 1/2010	1/1999 – 2010

The station information and water level data are available at NOAA CO-OPS Website: http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Great Lakes Water Level Data&state=St.+Clair+River&id1=841.

From USACE's *St. Clair River and Lake St. Clair Comprehensive Management Plan*, water levels fluctuate significantly in Lake St. Clair due to climate variability upstream on the Lake Superior-Michigan-Huron basins and downstream on the Lake Erie watershed and short-term weather events across the region. Long-term changes in water levels on Lake St. Clair are usually the result of precipitation that is above or below average. Temperature and cloud cover are also factors (U.S. Army Corps of Engineers, 2004).

During the early 1960s, low water levels in the Great Lakes were due to several years of below-normal precipitation. In the late 1960s through early 1970s and again in the mid-1980s, heavy precipitation raised water levels to new record highs (U.S. Army Corps of Engineers, 2004).

Short-term changes in water levels on Lake St. Clair usually occur within a few days when heavy rains fall on the Thames River watershed in Ontario and the Clinton River watershed in Michigan. This also occurs when ice build-up occurs in the St. Clair and/or Detroit rivers (U.S. Army Corps of Engineers, 2004)

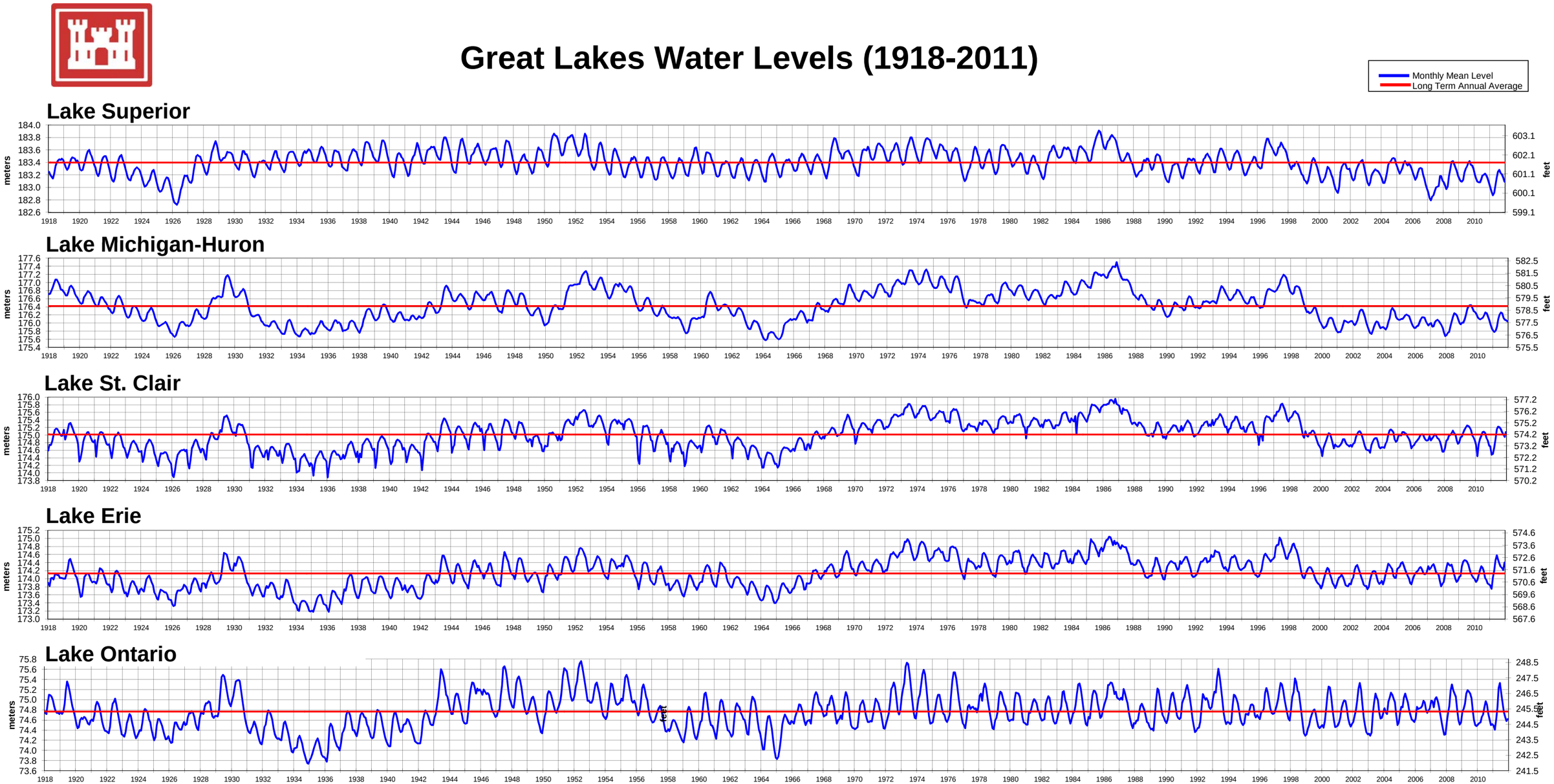
Lake levels on Lake St. Clair are also influenced by control of the Lake Superior outflows into St. Marys River at Sault Ste. Marie, Michigan and Ontario. The controls are managed by the International Joint Commission (IJC), in accordance with established criteria to minimize the extremes of levels that can occur on either Lake Superior or the combined Lake Michigan-Huron. This control does affect the magnitude and timing of flows into Lake St. Clair, though is secondary to the local climate causes (U.S. Army Corps of Engineers, 2004).

Geologic studies indicate that the upper Great Lakes have regular intervals of high and low levels. Short-term fluctuations usually occur every 30-35 years with long-term fluctuations occurring about every 150-160 years. Water levels have generally declined over the last several years. On average, the Lake's water level varies about 1.6 ft. (0.5 m) depending on the season, with low levels typically occurring in February and high levels occurring in July of each year (U.S. Army Corps of Engineers, 2004) .

The longest recorded time series for Lake St. Clair is at Windmill Point gage, and suggests a stationary lake level for the last 100 years. .

The monthly high and low water level data from the year 1918 to 2011 at Lake St. Clair are available at the USACE website: http://www.lre.usace.army.mil/greatlakes/hh/greatlakeswaterlevels/. Figure 7 is USACE's graphic that shows Historic Great Lakes Water Levels from 1918 to 2011 (U.S. Army Corps of Engineers, 2012). Monthly mean level and long term annual water level elevations are shown in both feet and meters and are referenced to the International Great Lakes Datum (IGLD 1985).

Great Lakes Water Levels (1918-2011)



The monthly average levels are based on a network of water level gages located around the lakes.

Elevations are referenced to the International Great Lakes Datum (1985).

Recent developments in mathematical and computer modeling of storm winds, waves, and storm surge, combined with more extensive measurements, provide an opportunity to significantly improve the accuracy of flood risk maps along the Great Lakes (U.S. Army Corps of Engineers, October 2012). In USACE's October 2012 technical report, *Wave Height and Water Level Variability on Lake Michigan and Lake St. Clair*, the evaluation and assessment of lake levels were used as the basis for a proposed strategy for revising the flood risk maps for the Great Lakes. By evaluating long term lake levels, seasonal trends, and storm-induced changes in lake levels on Lake St. Clair, the statistical characteristics of the data was able to be analyzed in the context of computing flood risk.

To view USACE's analysis of the historical storm climatology and resulting measured waves and water levels, detailed history of water levels and wave time series, and flood map methodology proposed to seek improved accuracy to base flood elevation prediction along the Great Lakes, the October 2012 final technical report *Wave Height and Water Variability on Lakes Michigan and St. Clair* can be accessed from http://www.greatlakescoast.org/ under the "Technical Resources" section.

ii. Historical Flooding & High Water Marks

Floods are the result of a multitude of both naturally occurring and human induced factors, but can simply be defined as the accumulation of too much water in too little time in a specific area.

In the analysis of a flood event, often the high water mark is identified to determine the maximum elevation of floodwaters. If a high water mark on a tree, building, or other fixed object can be identified and measured following a flood event, the floodwater elevation and therefore the extent of flooding can be determined. Such high water mark information combined with storm data, lake level, and river stage data can be useful when modeling the extent of flooding associated with the 1-percent-annual-chance event during the upcoming coastal flood hazard studies.

Information on historical flooding and high water marks was collected during the Discovery data mining effort. Communities were also asked to provide this data through the Coastal Data Request Form and at the Discovery Meetings.

Table 5 lists the high water mark data that was identified from the effective Macomb County Flood Insurance Study (FIS) (Federal Emergency Managment Agency, 2012). Instantaneous high stillwater levels recorded at the St. Clair Shores gage for the 1973, 1985, and 1986 periods are shown. Stillwater levels reflect lake setup, but not wave run-up during a storm. No additional information on high water mark data was identified or provided during Discovery.

Table 5. High Water Marks

Flooding Source	Date	Elevation (ft. NAVD88)
St. Clair Shores, Macomb County Shoreline - Still water levels	March, 1973	577.7
St. Clair Shores, Macomb County Shoreline	March, 1985	577.6
St. Clair Shores, Macomb County Shoreline	October, 1986	577.9

NAVD88 = North American Vertical Datum of 1988
Source: (Federal Emergency Managment Agency, 2012)

The historical flooding information provided below was compiled from effective FISs for Macomb (Federal Emergency Managment Agency, 2012), St. Clair (Federal Emergency Managment Agency, 2010), and Wayne (Federal Emergency Management Agency, 2012) counties.

Lake flooding is not generally the result of a single storm event, but rather it is the result of a series of causative factors. One such factor occurs when the wind, blowing over large water surface areas, transfers large amounts of energy to the water surface by shear stress. As a result of these stresses acting over a period of time, the water surface is tilted. This tilt will last until the wind velocity is significantly reduced or the wind changes direction. This phenomenon is called wind tides and the magnitude of the tilt between two locations is known as the wind set up. The magnitude of the wind tide depends primarily on the wind speed, the fetch length over which the wind acts, and the depth of the Lake. Lake St. Clair, because of its shallowness and surface area, can react quickly to strong wind forces. Storm waves are another factor that affects the western shore of the Lake. These wind generated waves can reach a height of 4 feet and cause floodwaters to rise higher than recorded flood levels indicate (Federal Emergency Managment Agency, 2012).

Continuous winds, blowing strongly from a southerly direction across Lake St. Clair, can create a wind setup or rise in lake level above the normal undisturbed water level along the north shore. Additionally, waves generated by these winds may induce wave run-up or a further increase in water-surface elevations above the setup level. These phenomena are of comparatively short duration and quickly subsides when the wind velocity lessens or the wind direction changes. An increase in the water-surface elevation of Lake St. Clair will be manifested by an attendant rise in the St. Clair River's stage (Federal Emergency Managment Agency, 2010).

For Lake St. Clair in Macomb County, the combination of high lake levels and easterly winds produces conditions favorable for flooding. The general desire to live along the shoreline has concentrated development and consequently increased potential flooding damage. The area fronting the lake and immediate canal areas are particularly susceptible to erosion and damage from wave action. Another factor in lower areas being favorable for flooding is sewer backup associated with high wind tides (Federal Emergency Managment Agency, 2012).

Flooding along Lake St. Clair in St. Clair County is experienced from rainstorms in the spring or early summer. The more severe flooding occurs in late winter or early spring from rainfall and/or snowmelt in conjunction with ice jams. Water-surface elevations on the Great Lakes vary from season to season and from year to year. Seasonal variations generally reach peak values during the period from May to July, then recede to a low value in the month of February (Federal Emergency Managment Agency, 2010).

Historically, the most damaging flooding has occurred along the Lake St. Clair coast in 1973 and again in 1985 and 1986 (U.S. Army Corps of Engineers, 1989). Storms on March 31, 1985, and April 4 and 6, 1985, with high easterly and northeasterly winds, drove the already high waters of Lake St. Clair on shore, inundating portions of all the coastal communities around the Lake. Some of the worst damage was caused by water flowing through gaps in dikes built by the USACE under Operation Foresight in 1973-1974, which were subsequently lowered or removed in the late 1970's by some residents to facilitate access to Lake St. Clair and Lake Erie. The three 1985 storms collectively caused about $4.7 million in damages in Macomb County, with 985 homes and 31 businesses reporting flood damages (Federal Emergency Managment Agency, 2012).

In Wayne County, the storms on March 31, 1985, and April 4 and 6, 1985, collectively caused about $2 million in damages, with approximately 1,300 homes reporting flood damages (U.S. Army Corps of Engineers, 1989). This included portions of the Charter Township of Brownstown; the Cities of Ecorse, Gibraltar, Grosse Pointe, and Grosse Pointe Park; the Township of Grosse Ile; and the extreme northeastern portion of the City of Detroit (Federal Emergency Management Agency, 2012).

For the portion of Wayne County that borders the Detroit River, Lake Erie, and Lake St. Clair, a combination of high lake and river levels along with easterly winds produces conditions favorable for flooding. Historically, the most damaging floods have occurred as a result of this combination. Severe flooding occurred along this shoreline in 1954, 1973, 1985, and 1986 (U.S. Army Corps of Engineers, 1989; U.S. Army Corps of Engineers, 1974). Flooding of record in the Township of Clay occurred during the period from March 15 to 19, 1973. Undisturbed water levels in Lake St. Clair were approximately 4.0 feet above low water datum at the time. Southwest winds created an additional wind setup along the northern shore of Lake St. Clair and raised both river and lake stages above overflow levels. Ponding of water was reported in houses, garages and yards in several of the residential areas. This flood had an estimated frequency of 200 years. Low lying areas along in the Township of Clay and the Township of Ira have been subject to periodic flooding caused by overflows of the St. Clair River or rises in the water levels of Lake St. Clair and the dredged waterways that are directly connected to Lake St. Clair (Federal Emergency Managment Agency, 2010).

Local stakeholders who may have historical flooding photographs and high water mark information are encouraged to submit them to the FEMA Region V Mitigation Division.

iii. Coastal Flood Protection Measures

Coastal structures and shoreline material along Lake St. Clair will be reviewed in more detail during the engineering analysis portion of the Lake St. Clair study and were not analyzed as part of this Discovery process. A summary of information collected regarding existing coastal structures, shoreline material, and flood protection measures is described below.

Much of the shoreline along Lake St. Clair has steel, concrete, and wood seawalls and breakwaters to protect from flooding and erosion. However, most of these protective works have been inadequate and easily topped by flood waters. It's important to note that these shore protection measures are multi-purpose in nature and do not necessarily offer protection from the 1-percent annual chance of occurrence flood elevations; however, they may protect from most ice damage and from floods of lesser magnitude.

During 1972 and 1973, the USACE took emergency measures with Operation Foresight. This program was a cooperative effort between Federal, State, and local governments. With the help of the USACE, most of the shore and canal properties were protected by dikes of sandbags and cribbing under cooperation of residents and volunteers. At that time, at a lakefront elevation of 582.1 feet (NAVD88) in Macomb County, the crib top was approximately 4.6 feet above the highest recorded instantaneous static elevation level and appeared to be adequate protection from wave damage. In St. Clair County, under Operation Foresight, elevations of 580.8 feet (NAVD88) were established for lakefront dikes and 578.5 feet (NAVD88) for canal dikes. In Wayne County, these protection measures consisted of earthen dikes and sand or rock filled cribs in Charter Township of Brownstown and the Cities of Detroit, Ecorse, Gibraltar, Grosse Ile, Grosse Point, and Grosse Point Park (U.S. Army Corps of Engineers, 1974)

The design for Operation Foresight was for a temporary measure and the dikes and other structures have since been partially removed by home owners. The protection measures were constructed to meet immediate flood threats and were never considered to be permanent. Earth-filled dikes may provide protection from wave action and spray, however, when they are breached or overtopped, they tend to entrap water behind the wall and do not permit drainage back into the Lake (U.S. Army Corps of Engineers, 1974)

In 1985, as part of the USACE Advance Measures initiative, additional clay dikes and sand filled cribs where constructed in the Charter Township of Brownstown (Wayne County). In response to flooding in 1985 and 1986, the City of Detroit (Wayne County) made substantial modifications to sheet piling in the vicinity of Fox Creek in the late 1980s. Numerous residential, commercial, and industrial areas along the shore have employed flood protection measures such as the filling of lower areas or the installation of sheet piling for bank stabilization and shore protection (U.S. Army Corps of Engineers, 1974).

Many local property owners use seawalls, revetments, riprap, and/or groins to prevent storm damage and beach erosion along Lake St. Clair. Concrete and steel sheet piling at the bank level protect against erosion. (Federal Emergency Managment Agency, 2010).

A levee exists in Wayne County along the Grosse Pointe Park Lake St. Clair shoreline. The current effective FIRMs for Wayne County, dated February 2, 2012, depict this levee as providing protection from the 1-percent-annual-chance flood event per a Provisionally Accredited Levee (PAL) agreement with FEMA. As of the date of this report, the PAL agreement has expired and thus the area designated as PAL behind the levee system, and mapped as a Zone X (shaded), is currently under review regarding the extent to which the levee provides protection from the 1-percent-annual-chance flood. Additional information on PALs can be found by visiting http://www.fema.gov/library/viewRecord.do?id=1987 . The regulatory requirements of the NFIP that apply to the evaluation and mapping of levee systems and levee-impacted areas are cited at Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations. Interested parties may access Section 65.10 of the NFIP regulations through the FEMA website at http://www.fema.gov/library/viewRecord.do?id=2741 .

The USACE also maintains a large infrastructure of over 900 coastal structures in the United States. These coastal structures protect harbors and shore-based infrastructure, provide beach and shoreline stability control, provide flood protection to varying degrees, and protect coastal communities, roadways and bridges, etc. These maintained coastal structures include seawalls, bulkheads, revetments, dikes and levees, breakwaters, groins, sills/perched beaches, and jetties and piers.

The USACE coastal structure data for Lake St. Clair was extracted from the Enterprise Coastal Inventory Database (ECID) from the Engineer Research and Development Center (ERDC) through USACE. Additional information on this database can be found by visiting the website http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=Projects;246.

Table 6 lists the coastal structures found within the Lake St. Clair basin that are maintained by the USACE.

Table 6. USACE Coastal Inventory Database

USACE Office	Coastal Structure Name	State	Completion Date	Type	Length (m)	Length (ft.)
Detroit	Clinton River Breakwater	MI	1966	Laid Stone	4263.7	1400
Detroit	Clinton River Earth-Fill	MI	1966	Rock Rubble	1127.8	3700

As previously stated, it is important to note that these coastal structures do not necessarily protect areas from the 1-percent-annual-chance flood event. Many of these USACE coastal structures were built between 1860 and 1940 and low lake water levels since the

1990's have accelerated deterioration. The USACE recently launched condition assessments to obtain average overall condition of each structure. The Clinton River structures have been given a "B" rating, which indicates low risk of failure. Please note that identified structures will be assessed in greater detail during the engineering portion of this coastal flood study and have not been assessed as part of this report.

Figure 8 shows the 2012 USACE Shoreline Feature Dataset, including identification of artificial shoreline material (which may include steel, concrete, or wood seawalls as described above), as well as the USACE Coastal Inventory within the Lake St. Clair basin.

iv. Coastal Recession

Coastal erosion is the recession of land and the removal of beach or dune sediments. It affects all of the beaches and coasts in the world, including those of Lake St. Clair. Important factors in coastal erosion are the types of rock or soil being eroded, the presence or absence of beaches or human-made structures, and how the shore is oriented with respect to prevailing winds and waves, water levels, climatology, and groundwater and surface drainage.

In Michigan, areas prone to erosion along the shoreline, including Lake St. Clair, are subject to special setback requirements established by the Michigan Department of Environmental Quality (MDEQ). From the MDEQ's website (http://www.michigan.gov/deq/), high risk erosion areas are those shorelands of the Great Lakes and connecting waters where recession of the zone of active erosion has been occurring at a long-term average rate of one foot or more per year. The erosion can be caused from one or several factors, including high water levels, storms, wind, ground water seepage, surface water runoff, and frost. The high risk erosion area regulations require setback distances to protect new structures from erosion for a period of 30 to 60 years, depending on the size, number of living units and type of construction. Approximately 300 miles of shoreline are classified as high risk erosion area. Updates of the recession rate studies, which form the basis of the setbacks, are periodically conducted to reflect changing water levels and shore protection efforts.

For the Lake St. Clair study area, high risk erosion area maps were provided by MDEQ for the Township of Fort Gratiot (part of Lake Huron study) and the City of Port Huron (St. Clair County) and can be found in Appendix G of this report. The maps depict the high risk erosion areas and show the number, in feet, of the 30-year projected recession distance and 50-year projected recession distance.

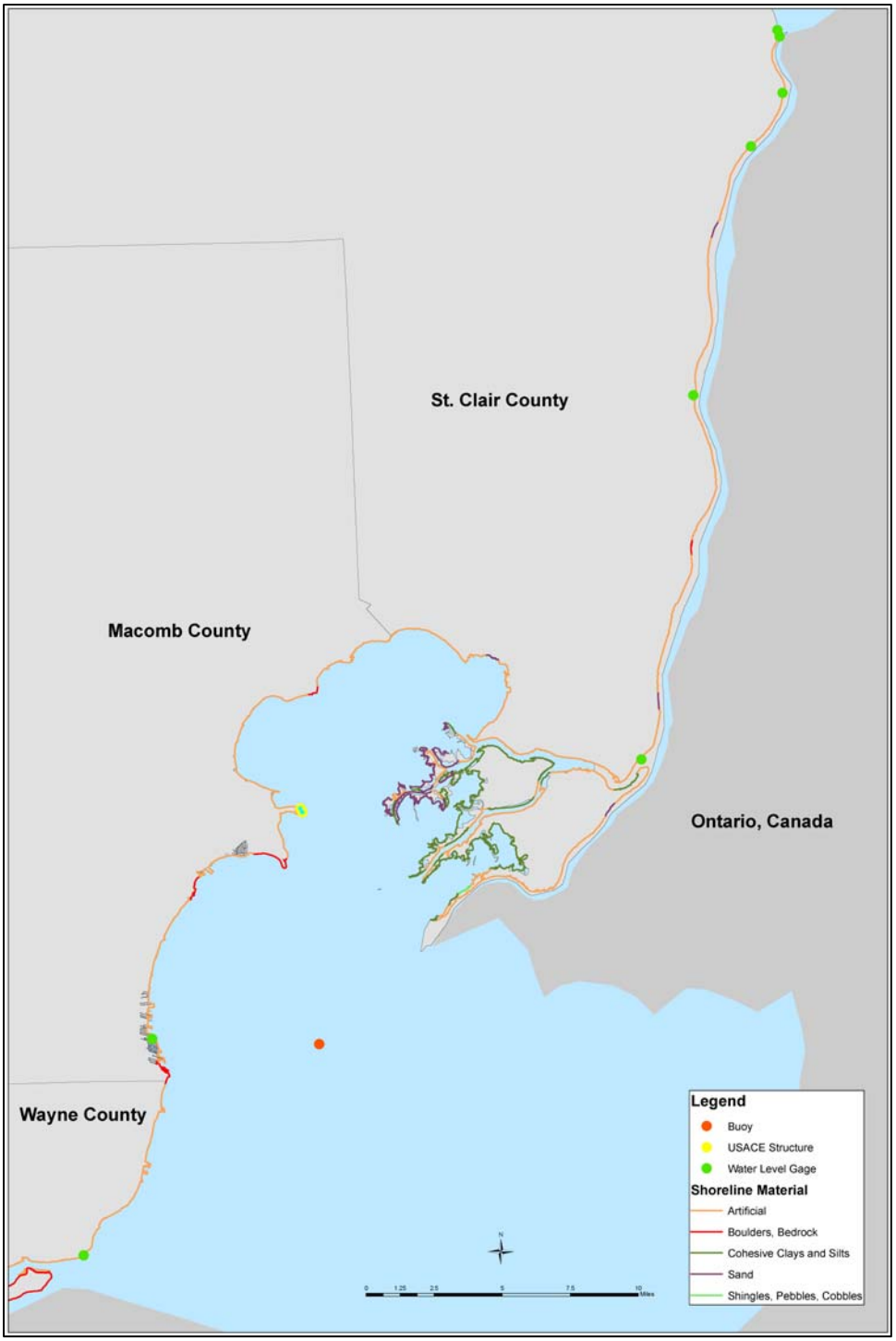


Figure 8. Lake St. Clair Shoreline Material and Coastal Structures

Additional information can be found at the MDEQs High Risk Erosion Areas website at http://www.michigan.gov/deq/0,1607,7-135-3313_3677_3700-10860--,00.html .

The next section discusses Hazard Mitigation resources that are available to stakeholders, the importance of hazard mitigation planning, and existing and potential strategies and actions around Lake St. Clair that seek to reduce flood risk.

VII. Hazard Mitigation Resources, Strategies, and Actions

Hazard mitigation resources, strategies, and actions were reviewed as part of this Discovery process and were discussed with Lake St. Clair stakeholders during the Information Exchange Sessions and the Discovery Meetings. This section provides general information about hazard mitigation, as well as mitigation topics specific to Lake St. Clair.

i. Hazard Mitigation Overview

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. This creates safer communities and facilitates resilience by enabling communities to return to normal function as quickly as possible after a hazard event. Once local officials understand risk from flooding and other hazards, the community is in a better position to identify potential mitigation actions that can reduce that risk to its people and property. Mitigation activities may be implemented prior to, during, or after an incident. However, it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. Hazard mitigation planning helps communities develop strategies to reduce their risk to natural hazard events.

Hazard mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters.

Hazard mitigation plans are required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000, as well as the National Flood Insurance Act of 1968, as amended by the Flood Insurance Reform Act of 2004 (Public Law 108-264). Under the Disaster Mitigation Act of 2000, governments have certain responsibilities including reviewing and updating effective mitigation plans every five (5) years.

The status of hazard mitigation plans in Macomb, St. Clair, and Wayne Counties is listed in Table 7.

Table 7. Hazard Mitigation Plan Status

Jurisdiction	Approval Date	Expiration Date
Macomb County (Multi-Jurisdictional)	November 9, 2010	November 9, 2015
St. Clair County (Multi-Jurisdictional)	May 9, 2006	May 9, 2011
Wayne County (City of Detroit)	March 22, 2007	March 22, 2012
Wayne County (Multi-Jurisdictional)	June 22, 2007	June 22, 2012

Source: FEMA Region V

From the previous table, St. Clair County, Wayne County, and the City of Detroit all have expired hazard mitigation plans. Currently, both St. Clair County and the City of Detroit have obtained planning grants and efforts are underway to update their respective hazard mitigation plans.

Figure 9 displays the status of local hazard mitigation plans, along with hazard mitigation projects that have been funded historically. In Lake St. Clair, several projects that involved the elevation of structures, labeled "Elevation Increase" in the figure below, occurred along the Macomb County shoreline.

As part of this Discovery process, existing hazard mitigation plans in the study area were reviewed to better understand flood risks within the Lake St. Clair communities and the strategies and actions that have already been developed as part of their planning process. By obtaining a better understanding of efforts made at the local level to reduce risk, FEMA can identify areas of need or areas where partnerships may be formed throughout this GLCFS process. As a part of this review process, potential mitigation actions and strategies were compiled from each plan and have been provided as tables within the individual Discovery Reports found in Appendices C (Macomb County), D (St. Clair County), and E (Wayne County). Table 8 contains a summary of common hazard mitigation actions related to flooding in Lake St. Clair coastal communities. Note that mitigation actions compiled in Table 8 may apply to all types of flooding, not just coastal.

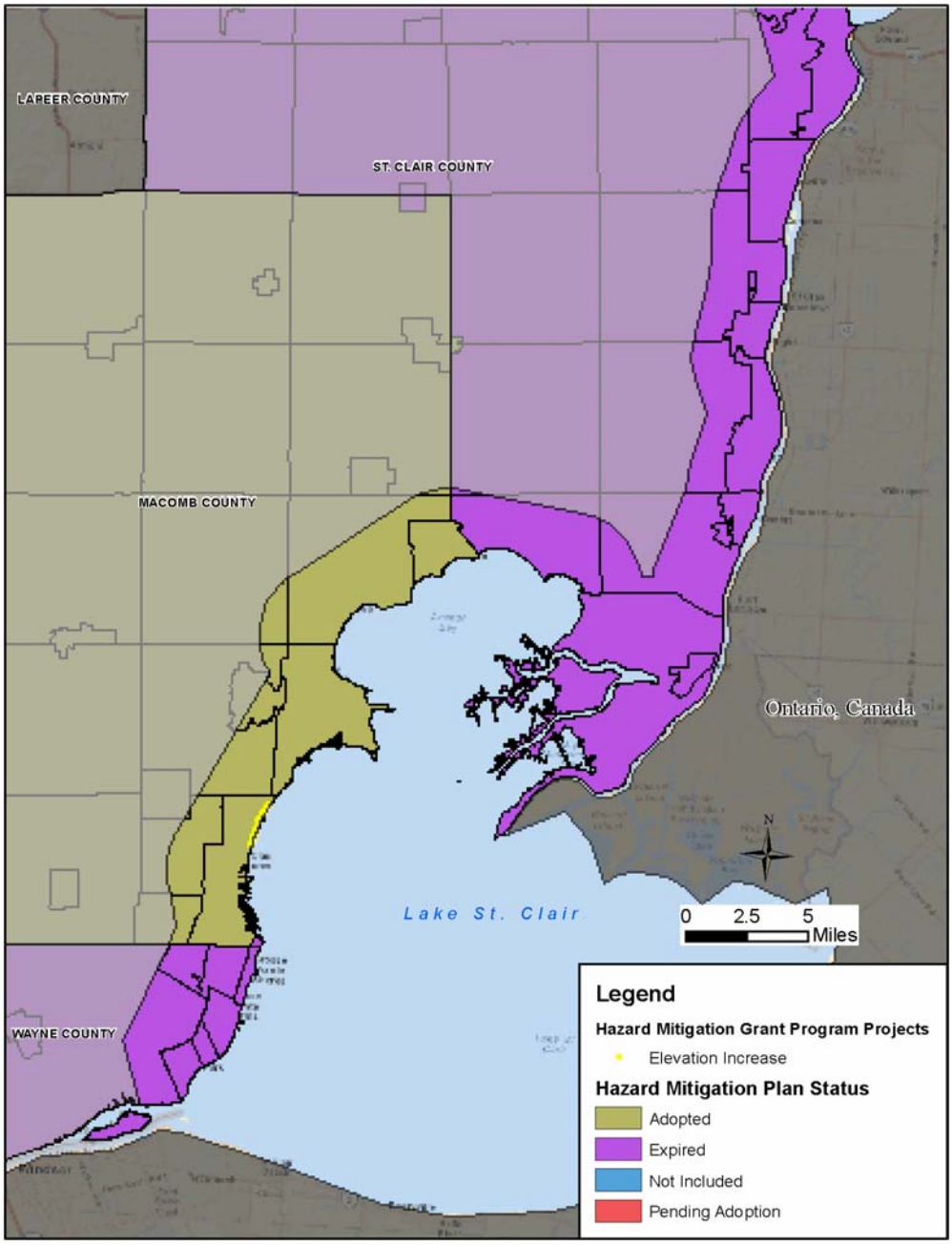


Figure 9. Hazard Mitigation

Table 8. Summary of Mitigation Actions and Strategies from Local Hazard Mitigation Plans

Action Number	Hazard Mitigation Action or Strategy
1	Floodproof homes
2	Mitigate flooding of roads
3	Mitigate flooding of residences along shoreline
4	Develop disaster mitigation/emergency response GIS. Continue to enhance the capabilities of GIS systems to function as a planning tool to aid in regulatory efforts to mitigate hazard events.
5	Install flood monitoring equipment
6	Riverbank stabilization and restoration to the parts of the riverbanks to prevent future floodwater erosion of the streambank.
7	Proposed dredging, riverbank stabilization, debris removal, retention basin construction
8	Maintain updated floodplain mapping
9	Implement land use planning regulations in floodplain and coastal zone areas
10	Alleviate repetitive loss properties by: wet floodproofing of structures; dry floodproofing structures; acquisition of repetitive loss properties; purchase or transfer of development rights; conservation easements
11	Implement effective stormwater management
12	Use land development techniques, such as cluster housing, to preserve natural resources and features
13	Improve floodplain management by planning acceptable uses for these areas, involving drain commissioners, hydrologic studies, etc. in analyses and decisions

Source: Local Hazard Mitigation Plans for Macomb, St. Clair, and Wayne Counties

The next subsection discusses new Risk MAP tools introduced to communities during this Discovery process to support the identification and attainment of mitigation actions.

ii. The Mitigation Action Form and Action Tracker

As part of this Discovery process, FEMA introduced the Mitigation Action Form and Mitigation Action Tracker to Lake St. Clair stakeholders. The Mitigation Action Form and Action Tracker are new Risk MAP tools designed to supplement existing mitigation planning processes by tracking and identifying local potential Areas of Mitigation Interest (AoMI) and new or improved mitigation actions that seek to reduce risk. The Mitigation Action Form, which aligns with questions on the Action Tracker website, can be completed by anyone that has identified a potential AoMI.


Mitigation Action Form

Purpose and Help

This form is meant to assist the collection of Mitigation Actions.

Online Mitigation Action Collection:

State Hazard Mitigation Officers Directory:

Your Information

Please enter the primary contact associated with this Mitigation Action.

1. Full Name *Required*

2. Email Address *Required*

3. Your Title and Organization *Required*

Once in the Action Tracker, an AoMI can be tracked by a variety of entities, such as the community, county, state, and FEMA, for different uses such as:

- To identify all AoMIs in a community, State, or Region
- To document AoMIs in between mitigation plan updates
- To track progress on mitigation activities
- To assess the ability of the Risk MAP program to encourage communities to take action to reduce risk

FEMA uses the Action Form and Action Tracker website to document and track local mitigation needs and actions.

It is important to note that entering a potential Mitigation Action does not obligate a jurisdiction to fund or complete an identified action. When updating local hazard mitigation plans, local planning teams may find it useful to review the actions stored in the Mitigation Action Tracker, assess them, and consider adding them as new or modified actions during the planning process.

Through collaboration between Risk MAP project teams and communities, new actions can be identified and existing actions may be improved upon. In addition, funding and collaboration opportunities to implement mitigation actions may be identified.

Stakeholders who attended the Discovery Meetings were provided with the Mitigation Action Form (Appendix H) and were encouraged to complete and return the form to FEMA Region V. Although no forms for the Lake St. Clair project area had been returned to FEMA at the time this report was created, there was discussion throughout the discovery process between the local stakeholders and FEMA regarding the intent to update the expired hazard mitigation plans in St. Clair County and Wayne County in the near future. The updating of hazard mitigation plans is considered to be an identified action.

The Mitigation Action Tracker can be accessed at: http://fema.starr-team.com. Stakeholders are encouraged to visit the site and add in new potential actions or revise and update existing actions. The Mitigation Action Form template can be downloaded and printed at http://fema.starr-team.com/MAF-Form.pdf.

FEMA is undertaking an effort in 2013, with support from state partners and a core stakeholder group, to identify a strategy that defines hazard mitigation actions to reduce loss of life and property and build resilience throughout the coastal communities of the Great Lakes regions.

FEMA's Mitigation Planning Technical Assistance (MPTA) may also be available to help communities plan for and reduce risks by providing communities with specialized assistance. MPTA is a part of the Risk MAP program and includes risk assessment, mitigation planning, and traditional hazard identification (flood mapping) activities. Additional information on MPTA and how it applies to the Lake St. Clair Coastal Flood Study is included in Section VIII of this report under "Potential for Mitigation Assistance".

The next subsection provides a description of various types of mitigation actions.

I.VII.ii.1 Types of Mitigation Actions

Hazard mitigation actions include adoption of local plans and regulations, creation of community identified programs that may help to reduce flood risk or other risks within a community, and structure and infrastructure projects. The FEMA Mitigation Action Form requests the identification of potential mitigation actions in one of these three categories. The outline presented below lists the types of potential actions that fall within each category.

Local Plans and Regulations:

- *Building codes.* The use and enforcement of building codes and development standards can ensure structures are safe from flooding.
- *Planning and land use regulations.* These regulations can mitigate flooding by influencing development. Consider updating and aligning Comprehensive and Master Plans, as well as other local plans to ensure that risk is considered at all levels of community planning.
- *Stormwater management plan.* Rainwater and snowmelt can cause flooding and erosion in developed areas and the plan can seek to mitigate that risk.
- *Floodplain management*. Through enforcement and adoption of NFIP floodplain management requirements, communities can reduce risk for new developed areas, and property owners in participating communities may purchase insurance protection against flood losses.

Community Identified Programs:

- *Funding mechanisms.* Mechanisms can be developed for local risk reduction.
- *Incentives for local risk reduction.* Studies have shown that many people are willing to take actions to reduce their risk if they believe they are actually at risk.
- *Mitigation Program.* Regular maintenance will help drainage systems and flood control structures to continue functioning properly.

Structure and Infrastructure Projects:

- *Structure Protection.* There are many ways to protect residential and non-residential structures from flood damage, such as flood proofing and elevation.
- *Infrastructure and Critical Facility Protection.* Techniques can be used to protect infrastructure and critical facilities from flood events.
- *Flood Control Structures.* These structures can be built to prevent flood damage.

- *Natural Systems.* Natural systems can provide floodplain protection, riparian buffers, and other ecosystem services that mitigate flooding.
- *Soil Stabilization or Erosion Control.* These processes can stabilize slopes that may be susceptible to erosion.

To learn more about mitigation planning, mitigation actions, and mitigation best practices, we recommend you visit http://www.fema.gov/hazard-mitigation-planning-resources .

The next section discusses funding opportunities that may be available to assist local officials in implementing hazard mitigation planning and projects.

iii. Hazard Mitigation Programs and Assistance

Not all mitigation activities require funding, and those that do are not limited to outside funding sources. For those mitigation actions that require assistance through funding or technical expertise, several state and federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances such as after a presidential disaster declaration.

Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at http://www.fema.gov/hazard-mitigation-assistance

FEMA, as well as other federal agencies, award many mitigation grants each year to states and communities to undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding.

The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 9. State and local mitigation plans are a requirement for most FEMA HMA project grant funding.

Table 9. FEMA Hazard Mitigation Assistance Program

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	To reduce or eliminate claims against the NFIP

Table 9. FEMA Hazard Mitigation Assistance Program

Mitigation Grant Program	Authorization	Purpose
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	A national competitive program focused on mitigation project and planning activities that address multiple natural hazards
Repetitive Flood Claims (RFC)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Seeks to reduce flood claims against the NFIP through flood mitigation; properties must be currently NFIP insured and have had at least one NFIP claim
Severe Repetitive Loss (SRL)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Seeks to reduce or eliminate the long-term risk of flood damage to SRL residential structures currently insured under the NFIP

The HMGP and PDM programs, described in the table above, offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA, RFC, and SRL programs focus funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible states, tribes, and territories (applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and State Hazard Mitigation Officers (SHMO) is available on the FEMA website at www.fema.gov.

Some examples of other Federal programs that include funding available for hazard mitigation are displayed in Table 10. Several of these agencies, such as USACE, USGS, Natural Resource Conservation, and NOAA, have specialists on staff and can offer further information on flood hazard mitigation programs. The State NFIP Coordinator and SHMO are State-level sources of information and assistance.

Table 10. Other Agency Mitigation Program and Assistance

Mitigation Program or Assistance	Agency	Purpose
Coastal Services Center Cooperative Agreements	National Oceanic & Atmospheric Administration (NOAA)	Funds for coastal wetlands management and protection, natural hazards management, public access improvement, reduction of marine debris, special area management planning, and ocean resource planning. http://www.csc.noaa.gov/funding /
Coastal Services Center Grant Opportunities	National Oceanic & Atmospheric Administration (NOAA)	Formula and program enhancement grants for implementing and enhancing Coastal Zone Management programs that have been approved by the Secretary of Commerce. http://www.csc.noaa.gov/funding//
Coastal Zone Management Program	National Oceanic & Atmospheric Administration (NOAA)	The Office of Ocean and Coastal Resource Management (OCRM) provides federal funding and technical assistance to better manage our coastal resources. http://coastalmanagement.noaa.gov/funding/welcome.htmll
Marine and Coastal Habitat Restoration	National Oceanic & Atmospheric Administration (NOAA)	Funding for habitat restoration, including wetland restoration and dam removal. http://www.nmfs.noaa.gov/habitat/recovery//
Planning Assistance to States (PAS)	U.S. Army Corps of Engineers (USACE)	Fund plans for the development and conservation of water resources, dam safety, flood damage reduction and floodplain management. http://www.lre.usace.army.mil/planning/assist.htmll
Emergency Streambank and Shoreline Protection	U.S. Army Corps of Engineers (USACE)	To prevent erosion damages to public facilities by the emergency construction or repair of streambank and shoreline protection works. www.usace.army.mill
Environmental Laboratory	U.S. Army Corps of Engineers (USACE)	Guidance for implementing environmental programs such as ecosystem restoration and reuse of dredged materials. http://el.erdc.usace.army.mil/index.cfmm
Small Flood Control Projects	U.S. Army Corps of Engineers (USACE)	To reduce flood damages through small flood control projects not specifically authorized by congress. www.usace.army.mill
Coastal Wetlands Conservation Grant Program	U.S. Fish & Wildlife Service	Matching grants to states for acquisition, restoration, management or enhancement of coastal wetlands. http://ecos.fws.gov/coastal_grants/viewContent.do?viewPage=homee
Disaster Recovery Assistance	U.S. Department of Housing and Urban Development (HUD)	Disaster relief and recovery assistance in the form of special mortgage financing for rehabilitation of impacted homes. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

Table 10. Other Agency Mitigation Program and Assistance

Mitigation Program or Assistance	Agency	Purpose
Neighborhood Stabilization Program	U.S. Department of Housing and Urban Development (HUD)	Funding for the purchase and rehabilitation of foreclosed and vacant property in order to renew neighborhoods devastated by the economic crisis. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/neighborhoodspg
USDA Smith-Lever Special Needs Funding	U.S. Department of Agriculture (USDA)	Grants to State Extension Services at 1862 Land-Grant Institutions to support education-based approaches to addressing emergency preparedness and disasters. http://www.csrees.usda.gov/funding/rfas/smith_lever.html
Community Facilities Direct Loans	U.S. Department of Agriculture (USDA)	Loans for essential community facilities. http://www.rurdev.usda.gov/HCF_CF.html
Community Facilities Direct Grants	U.S. Department of Agriculture (USDA)	Grants to develop essential community facilities. http://www.rurdev.usda.gov/HCF_CF.html
Farm Service Agency Disaster Assistance Programs	U.S. Department of Agriculture (USDA)	Emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland and livestock damaged by natural disasters. http://www.fsa.usda.gov//
Small Business Administration Loan Program	U.S. Small Business Administration (SBA)	Low-interest, fixed rate loans to small businesses for the purpose of implementing mitigation measures to protect business property from damage that may be caused by future disasters. Also available for disaster damaged property. http://www.sba.gov/about-sba-services/208

The programs described above may require a local match or have requirements that must be met in order for one to be eligible. To learn more about these programs and assistance, please contact your SHMO as they are the state-level source of information and assistance. A listing of SHMOs can be found by visiting http://www.fema.gov/state-hazard-mitigation-officers .

VIII. Risk MAP Projects and Needs

This section provides information about the planned next steps for the Lake St. Clair coastal flood study, including information about the upcoming coastal study, potential for mitigation technical assistance within the project area, possible changes in compliance as a result of the coastal flood study, future communications, and how unmet needs will be addressed.

i. Future Coastal Study

Information and data collected as part of the Lake St. Clair Discovery effort and provided in this report will be utilized in the upcoming GLCFS for Lake St. Clair.

A summary of the GLCFS project, as well as project updates, can be found at http://www.greatlakescoast.org/ under the "Great Lakes Coastal Analysis & Mapping" section.

The following work is expected to be performed for Lake St. Clair as part of the GLCFS, pending congressional funding. The scope of work described in this section is therefore subject to change and may not be performed within all Lake St. Clair communities.

All engineering and mapping analysis performed as part of this study will follow guidance provided within FEMA's Draft *Guidelines and Specifications for Coastal Studies Along the Great Lakes*, issued on May 8, 2012 (Federal Emergency Management Agency, 2012). The upcoming study is expected to include the following tasks: creation of bathymetric and topographic data, base map acquisition, coastal flood hazard analysis, and risk assessment product development.

I.VIII.i.1 Engineering and Mapping

Coastal flood hazard analyses and mapping for all communities of the United States located along the Lake St. Clair shoreline will be performed. Below is a summary of data that will be collected and analysis that will be performed:

1) Creation of Bathymetric and Topographic Map Data Inventory.
   New bathymetric LiDAR, RGB Imagery, and Hyperspectral Imagery will be used for the coastal study areas. Topographic data for the coastal areas to be studied will be used for coastal analysis, floodplain boundary delineation and/or testing of floodplain boundary standard compliance. The topographic data used will be based on the data collected as part of this Discovery process, and will depend on the ability to gather currency and accuracy information for existing topographic data. Only topographic data that is of better quality than that of the original study or effective studies will be used. New topographic and bathymetric LiDAR, RGB Imagery, and Hyperspectral Imagery will be used for the coastal study areas and will replace the existing datasets.

2) Base Map Acquisition.
   Base map data for all counties, including data collected during this Discovery process as an initial inventory, will be collected and organized. The necessary permission from the map sources will be obtained to allow FEMA to use and distribute hardcopy and digital map products using the digital base map. Base map data must comply with FEMA G&S (Federal Emergency Managment Agency, 2003).

3) Coastal Flood Hazard Analysis.
Response-based computational approaches outlined in FEMA G&S Appendix D.3 draft dated May 2012 will be used to perform coastal flood hazard analysis for the Lake St. Clair shoreline and areas subject to coastal flooding. The coastal flood hazard analyses include the following components:

- Wave setup
- Erosion
- Wave runup
- Wave overtopping
- Overland wave propagation
- Primary frontal dune identification (where applicable).

A transect-based approach for assessing coastal flood risks along Lake St. Clair will be used. The Lake St. Clair study will include the St. Clair River included within the model domain defined by USACE ERDC for Lake St. Clair.

The 1.5 foot breaking wave height will be selected from the Wave Height Analysis for Flood Insurance Studies (WHAFIS) results and used to define the Limit of Moderate Wave Action (LiMWA) as described in FEMA Procedural Memorandum No. 50 updated in 2012.

The coastal flood hazard results will be transferred to topographic work maps. Topographic data provided by the USACE in 2012 and early 2013 will be utilized. Coastal flood hazards will be mapped as outlined in FEMA's G&S Appendix D.3 draft dated May 2012 (Federal Emergency Management Agency, 2012). Flood hazard mapping will extend to the landward limit of coastal flooding as a result of waves and storm surge.

Draft coastal flood maps (or workmaps) will be produced for the study area. The workmaps will include the 1-percent- and 0.2-percent-annual chance Special Flood Hazard Area (SFHA), Coastal High Hazard (VE Zone) and Coastal A Zone (AE Zone), Base Flood Elevations (BFEs), and LiMWA. Communities will be provided with an opportunity to review the workmaps after the coastal analysis is complete and prior to FIRM production.

I.VIII.i.2 National Flood Insurance Program Data Integration

Regulatory FIRM files may be updated through FEMA's Physical Map Revision (PMR) process using the floodplain delineations created from the work performed in the Engineering and Mapping tasks. For areas adjacent to updated coastal analysis, tie-ins will be resolved between coastal and riverine floodplains using the topographic data acquired.

Data collected as part of the coastal analysis will be put into FIRM database format and reviewed per FEMA's G&S Procedural Memorandum No. 42 for Quality Control Requirements in the FIRM Production Process.

The final production and distribution of updated FIRMs will be dependent on the results of the coastal analysis and discussions with the communities, as well as congressional funding. Therefore, it cannot yet be identified at this time the exact communities that will received updated FIRMs for adoption. The risk assessment products and their distribution, discussed below, are also dependant on the results of the coastal analysis and further community discussions and are subject to change.

I.VIII.i.3 Risk Assessment Product Development

Depending on available data, results of coastal analysis, local needs identified, local partnerships, and fiscal year funding, coastal flood risk products, such as Flood Risk Map, Flood Risk Report, Changes Since Last FIRM (CSLF), Flood Depth and Analysis Grids, and Hazus-MH analyses, may be generated for identified coastal communities in Macomb, St. Clair, and Wayne Counties. Optional Flood Risk Assessment products such as coastal wave height grids, erosion risk determination, and wave hazard severity area datasets have not yet been funded. Table 11 summarizes the products projected for coastal communities by county.

Table 11. Potential Flood Risk Products for Lake St. Clair Communities

County	State	Flood Risk Map and Flood Risk Report	Changes Since Last FIRM	Flood Depth and Analysis Grids	Hazus-MH	Optional Flood Risk Assessment Products
Macomb	MI	✓	✓	✓	✓	Not yet funded
St. Clair	MI	✓	✓	✓	✓	Not yet funded
Wayne	MI	✓	✓	✓	✓	Not yet funded

Below is a brief description of each flood risk product and its uses:

Changes Since Last FIRM (CSLF)

The CSLFs serve the following purposes:

- Identifies areas and types of flood zone change:
  - Compares current effective (previous) with proposed (new) flood hazard mapping
  - Categorizes and quantifies flood zone changes
- Provide study/reach level rationale for changes including:
  - Methodology and assumptions
  - Changes of model inputs or parameters (also known as Contributing Engineering Factors)

Flood Depth and Analysis Grids

- Flood Depth and Analysis Grids (DAGs) will be created for the 1-percent-annual-chance event of the coastal engineering studies performed and as appropriate for the data. Wave runup areas may not be applicable.

HAZUS 2010: 1-Percent Exposure

- The 2010 HAZUS national dataset for 1-percent exposure data will be used to tabulate the results by identified communities.

For additional information regarding coastal flood risk products, users may review the individual Discovery Reports found in Appendices C, D, and E of this report or visit http://www.fema.gov .

ii. Potential for Mitigation Assistance

As part of a Risk MAP project, Mitigation Planning Technical Assistance (MPTA) may available to help communities plan for and reduce risks by providing communities with specialized assistance. MPTA includes risk assessment, mitigation planning, and traditional hazard identification (flood mapping) activities. Technical assistance through MTPA can be performed at any time during the hazard mitigation planning process.

Determining which communities receive MPTA is dependent on identification of a need, the willingness of a community to partner with FEMA, local resources and data availability, and federal funding availability. Unfortunately, not every community will be able to receive MPTA as part of a Risk MAP project. Forming a partnership between FEMA and a local community is an essential part of initiating a MPTA project. Assistance will be prioritized after all data and information is collected and assessed by FEMA in coordination with the local communities to determine where MPTA resources would be beneficial. Communities should alert FEMA of any resources that are available at the local level and of actions they are interested in implementing in partnership with FEMA. Technical assistance activities should be based on the needs of the community and assist with already established capabilities.

Some technical assistance activities could include (but are not limited to):

- Advising in the creation of initial hazard mitigation plans
- Advising in the update of existing hazard mitigation plans
- Training to improve a community's capabilities for reducing risk
- Assistance in incorporating flood risk datasets and products into potential and effective community legislation, guidance, regulations, procedures, etc.
- Assistance with the creation, acquisition, and incorporation of GIS data into potential and effective maps, planning mechanisms, emergency management procedures, etc.
- Facilitating the identification of data gaps and interpret technical data to identify risk reduction definiencies that should be corrected.

During the Discovery process, FEMA (and STARR) met with the communities and discussed their recent and current mitigation actions and projects. I t was identified that St. Clair County and City of Detroit (Wayne County) have received planning grants and are in

the process of updating their hazard mitigation plans. Wayne County's plan has expired and plans to update were unknown at the time this report was developed. It is recommended additional discussion occur between FEMA and these stakeholders as this coastal flood study moves forward to see if MPTA would be an appropriate and beneficial option.

Continued discussion regarding FEMA partnership with local communities to assist in developing new mitigation actions and moving those actions forward will be essential as this coastal project moves forwards.

iii. Compliance

FEMA uses a number of tools to determine a community's compliance with the minimum regulations of the NFIP. Among them are Community Assisted Contacts (CACs), Community Assistance Visits (CAVs), the Letter of Map Change (LOMC) process, and Submit-for-Rates. These tools help assess a community's implementation of their flood damage reduction regulations and identify any floodplain management deficiencies and violations.

The CAC is a telephone call or brief visit by a FEMA staff member (or staff of a State agency on behalf of FEMA) verifying the community's floodplain management contact. The CAC can be used as a way to screen for potential floodplain management issues in communities that would require a CAV.

The CAV is a visit to a community by a FEMA staff member or staff of a state agency on behalf of FEMA that serves the dual purpose of providing technical assistance to the community and assuring that the community is adequately enforcing its floodplain management regulations. Potential violations may be identified during the CAV visit as a result of touring the floodplain, inspecting community permit files, and meeting with local appointed and elected officials.

Violations can also be discovered when Letter of Map Revision based on Fill (LOMR-F) applications depict a non-compliant structure based on elevation data; or can be found through Submit-for-Rate requests, which occur when a structure applies for flood insurance but has been identified as being two or more feet below BFE. Elevation comparisons identified through LOMR-F applications and Submit-for-Rates imply structures were not built compliantly.

If administrative problems or potential violations are identified, the community will be notified and given the opportunity to correct those administrative procedures and remedy the violations to the maximum extent possible within established deadlines. FEMA or the state will work with the community to help them bring their program into compliance with NFIP requirements. In extreme cases where the community does not take action to bring itself into compliance, FEMA may initiate an enforcement action against the community.

After coastal analysis is completed for this study, communities may be faced with adopting new regulations related to coastal high hazard areas. An understanding of regulations associated with coastal areas will be important so that communities remain compliant. During this Discovery process, stakeholders were provided with information regarding NFIP requirements that are associated with coastal hazard zones, as well as information about new FEMA guidance related to moderate wave action. These topics, including coastal SFHAs, building requirements in VE Zones, and LiMWA, are compiled below and discussed in greater detail.

I.VIII.iii.1 Coastal Special Flood Hazard Areas (SFHAs)

The Lake St. Clair Coastal Flood Hazard study analysis may result in new SFHAs, which are defined as areas that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. SFHAs labeled as Zone AE have been studied by detailed methods and show BFEs. SFHAs labeled as Zone VE are along coasts and are subject to additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic analyses are shown within these zones.

The NFIP shows coastal flood hazards in two different zones on its FIRMs:

- Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet; and
- Zone AE, where the delineated flood hazard includes wave heights less than three feet.

During the Discovery Meetings these zones were discussed in greater detail as the updated coastal analysis results may show that these flood risks exist along the Lake St. Clair shoreline.

Additional information on coastal SFHAs can be found at http://www.greatlakescoast.org under the "Great Lakes Flood Zones Overview" section.

I.VIII.iii.2 Building Requirements in VE Zones

The zone designation and the BFE are critical factors in determining what requirements apply to a building and, as a result, how it is built. The NFIP minimum requirements for buildings built in Zone VE (coastal high hazard areas) are:

1) The building must be elevated on pile, post, pier, or column foundations,
2) The building must be adequately anchored to the foundation,
3) The building must have the bottom of the lowest horizontal structural member at or above the BFE,
4) The building design and method of construction must be certified by a design professional,
5) The area below the BFE must be free of obstructions,

6) If enclosed, the enclosure must be made of lightweight wood lattice, insect screening, or breakaway walls.

Communities participating in the NFIP that have mapped VE Zones must adopt floodplain management regulations that meet or exceed these minimum NFIP requirements, as described above.

I.VIII.iii.3 Limit of Moderate Wave Action

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour, which can cause damage to Zone AE-type construction in these coastal areas.

To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued Procedure Memorandum No. 50 in December of 2008, which provides guidance on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action, or LiMWA. The LiMWA alerts property owners that although their property is in a Zone AE area, it may also be affected by waves 1.5 feet or higher. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE. Figure 10 helps to explain the LiMWA zone location.

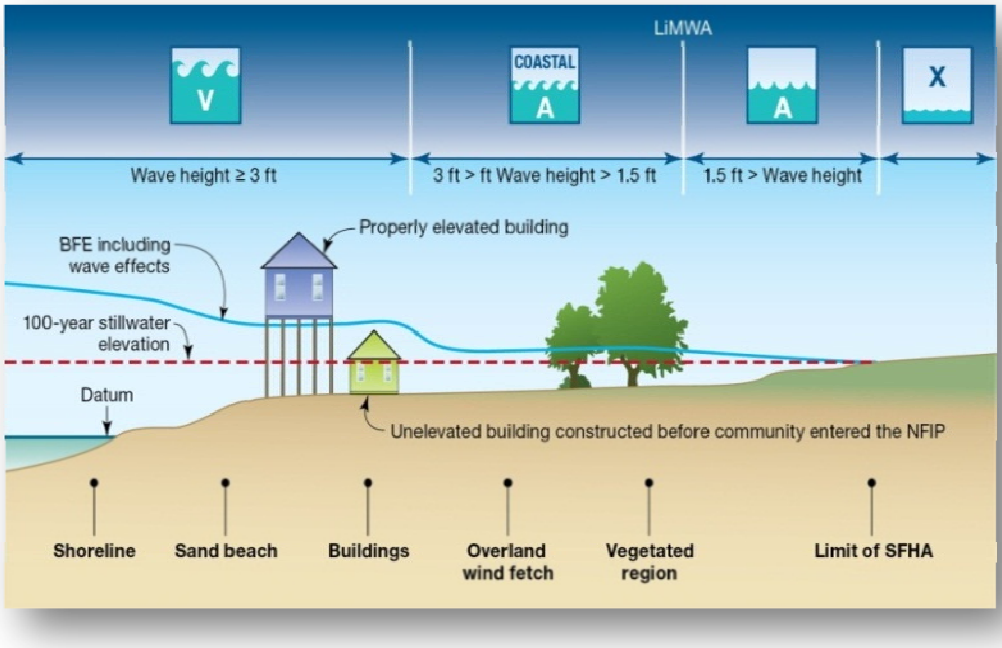


Figure 10. Limit of Moderate Wave Action

If areas that are subject to waves between 3-ft and 1.5-ft are identified, then FEMA will delineate the inland extent of the 1.5-ft wave as the LiMWA when producing new FIRMs. A new line layer will be added to the FIRM Database to accommodate the LiMWA features and will be depicted on updated FIRMs as two black dots and three white dash lines in a sequential pattern. The LiMWA will be identified in the FIRM legend as "Limit of Moderate Wave Action" and a note will be included in the "Notes to Users" section on the map panel to explain the LiMWA boundary.

Although not labeled as such on FIRMs, the areas between the LiMWA and the Zone V boundary (or shoreline) are also referred to as "Coastal A Zones". Current effective FIRMs may not show a LiMWA, however future maps may include the LiMWA boundary if the data supports it.

Figure 11 is an example FIRM showing the delineated LiMWA. The area in Map A shows the delineation of the LiMWA in an area where the predominant coastal flood hazard is overland wave propagation. Map B shows delineation of the LiMWA in a region where the major coastal flood hazard is wave breaking and run-up.

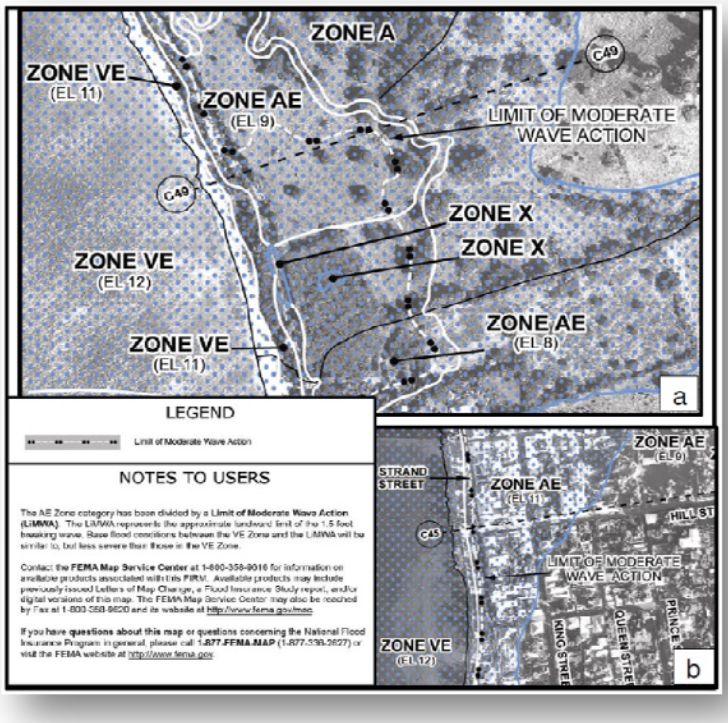


Figure 11. Example FIRM showing LiMWA

While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Because the 1.5-foot breaking wave in the LiMWA zone can potentially cause

foundation failure, communities are encouraged to adopt building construction standards similar to Zone VE in those areas. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. CRS credits can lower insurance premiums for residents and business owners. For additional information on CRS, please visit http://www.fema.gov/national-flood-insurance-program/community-rating-system .

Starting in 2009, flood-resistant provision and floodplain management requirements began to be incorporated into model building codes, such as the International Building Code (IBC), the International Residential Code (IRC), and the National Fire Protection Association (NFPA). If a local community has adopted a recent version of these codes, specifically the IBC, without amending the code to remove the flood provision then the community must enforce flood-resistant design and construction requirements based on the IBC, as well as the floodplain management ordinance that must be adopted to meet minimum requirements per the NFIP. It is important for local communities to note that some Coastal A Zone practices, specifically practices that go above the minimum NFIP requirements, may be required by the IBC through its reference to American Society of Civil Engineers (ASCE) Flood Resistant Design and Construction (24-98). In ASCE 24-98 (issued in 2000), there are basic building requirements related to high risk flood areas and flood hazard areas subject to high velocity wave action. In addition, ASCE has issued an update in 2006, Flood Resistant Design and Construction (24-05), which includes basic requirements for flood hazard areas including high-risk flood hazard areas, coastal high-risk hazard areas, and Coastal A Zones.

Mapping the LiMWA, or Coastal A Zone, will provide community officials and other stakeholders with additional important flood risk details to consider when buying/developing, mitigating, or enforcing floodplain management regulations in the coastal flood hazard areas.

Residents and business owners living or working in the LiMWA, or Coastal Zone A, should be aware of the potential wave action along with floating debris, erosion, and scour that could cause significant damage on their property. They are encouraged to build safer and higher than minimum local requirements to reduce the risk to life and property. Additional guidance for design and construction in Coastal A Zones can be found in FEMA 499, Home Builder's Guide to Coastal Construction (http://www.fema.gov/fima/mat/fema499.shtm).

While the risk of damage is higher between the LiMWA line and the Zone VE line than other parts of the coastal AE zone, the NFIP flood insurance rates currently do not differ from other AE zone rates. The Federal mandatory purchase requirement does apply in these zones and property owners are encouraged to carry coverage equivalent to the replacement cost of their building and to include contents coverage.

For additional background information on LiMWA, please refer to FEMA Procedure Memorandum No. 50 at www.fema.gov/library/viewRecord.do?id=3481.

iv. Communication

Throughout this Discovery process, community representatives and local stakeholders indicated the need to be kept informed about the results of Discovery, the upcoming coastal flood study, and opportunities for public input throughout the study process. As a result of communication to date, several new stakeholders have been identified and added to the master contact database for this study.

Throughout this study process, Federal, State, and local stakeholders will be kept informed via email, phone calls, letters, newsletters, and meetings as appropriate. A dedicated email account was created (GreatLakesFloodStudy@STARR-Team.com) to distribute project information, meeting reminders, and summaries.

Stakeholder involvement will continue to be important through the remainder of the project. The GLCFS website http://www.greatlakescoast.org is an excellent resource where stakeholders can obtain the most update-to-date information about the status of the Great Lakes flood study projects, data collection, upcoming meetings, new technical reports, the latest methodologies, factsheets, and additional information.

Social media sites such as Twitter (http://www.twitter.com/GreatLakesCoast) and Facebook (http://www.facebook.com/pages/Great-Lakes-Coastal-Flood-Mapping-Program/225293657496579) will also be important communication tools to keep stakeholders informed and engaged throughout this process.

FEMA encourages stakeholders to remain involved throughout the study process and will seek to identify partnership opportunities during the study process.

v. Unmet Needs

During this Discovery process, stakeholders provided FEMA with a wide variety of information. Some of the information, while valuable, may not be able to be utilized in the upcoming coastal study. In addition, some questions may be unresolved as of the end of this Discovery process. This section seeks to summarize those unmet needs and to provide the steps that may be taken to address them in the future.

During the Discovery Meetings and throughout the Discovery process, Lake St. Clair stakeholders were concerned about what to expect in terms of extent of new SFHA boundaries, the possible introduction of VE Zones, the number of property owners who would be affected, and the additional NFIP requirements and flood insurance costs that may go along with a flood map revision. FEMA acknowledged this concern, adding that upcoming engineering and mapping tasks include the distribution of workmaps and other

flood risk products designed to give local stakeholders an opportunity to review and comment on flood risk data before the data is carried into NFIP FIRM maps.

Concerns were also expressed relative to density of near-shore vegetation, particularly phragmites, which may compromise accuracy of new LiDAR bathymetry being collected as part of the Lake St. Clair study. St. Clair County stakeholders suggested it would be helpful to photograph potential problem areas and build site-specific datasets to enhance ground-truthing techniques. There was an offer to consider local resources in obtaining survey points and photographs of the shoreline for ground verification and independent validations.

Comments and questions related to the proposed draft transects were discussed during the Discovery Meeting by State, county, and community representatives. It was suggested by stakeholders that the effective transects along Lake St. Clair be used where possible. This request was incorporated into the revised proposed draft transects where possible, however, it should be noted that the transects proposed in this report remain subject to change pending further coastal analysis.

IX. Close

Federal, State, and local stakeholders that were involved in this Discovery process contributed valuable information about Lake St. Clair, including information and data that may be utilized in the upcoming Lake St. Clair coastal flood study. The data and opportunities presented in this report will be considered as the study process moves forward and will assist the project team as the Lake St. Clair coastal flood study proceeds. FEMA encourages continued participation and engagement from stakeholders throughout this coastal flood study.

The ultimate goal of this Discovery process and the future coastal flood study is to provide updated flood risk information to local stakeholders and to increase awareness of those flood risks, which in turn leads to actions that reduce risk.

X. References

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XI. Appendices

Discovery data and information, as well as this report and appendices, have been stored digitally on FEMA's Mapping Information Platform (MIP) Discovery Data Repository at J:\FEMA\DISCOVERY_DATA_REPOSITORY\R05_DATA\MICHIGAN_MI_26 and can be accessed by FEMA authorized users. The MIP can be accessed from https://hazards.fema.gov/. A username and password is required to access certain data within the MIP.

The final Discovery Report and appendices are also available for download from http://www.greatlakescoast.org/.

Appendices for this report include:

Appendix A: Lake St. Clair Stakeholder List
Appendix B: Coastal Data Request Form
Appendix C: Macomb County Discovery Report (with attachments)
Appendix D: St. Clair County Discovery Report (with attachments)
Appendix E: Wayne County Discovery Report (with attachments)
Appendix F: Final Discovery Maps
Appendix G: High-Risk Erosion Figures (MDEQ)
Appendix H: Mitigation Action Form