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Leading Community Risk Reduction

# Examining Flood Preparedness in Cincinnati, Ohio

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

Signed: _____

Abstract

The research problem was the City of Cincinnati lacks a coordinated flood preparedness plan. The purpose of the research was to identify the resources and flood preparedness methods available to Cincinnati. The descriptive research method was used to answer the following research questions:

1. What areas of Cincinnati are susceptible to flood damage?
2. What prevention, evacuation, and shelter plans are currently in place?
3. What are the available resources for water rescue?
4. What resources and flood preparedness plans are in place in other flood prone cities?
5. What is the process for Cincinnati to request local, state and federal assistance?

The procedure for this project included a literature review, local and national fire department surveys, and personal interviews.

The results of the research revealed the flood preparedness plan information is disjointed and unavailable to responders. The research also revealed water rescue resources available are inadequate.

It was recommended the City of Cincinnati produce a coordinated flood response plan, increase water training and safety equipment for firefighters and the importance of evacuation of prioritized areas of the city.

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## Introduction

Rivers, creeks and other natural water resources have brought wealth and prosperity as well as death and destruction to millions of people throughout history. The City of Cincinnati was settled along the Ohio River in order to take full advantage of the wealth and prosperity of the river and its tributaries. In addition to the opportunities for interstate commerce and travel comes the danger of flooding when the river and its tributaries overflow their banks. Flooding is the cause of the worst natural disasters in United States history and lead all natural disasters in the number of people affected and resultant economic loss worldwide (Ray, 2000) (United Nations Department of Economic and Social Affairs [UNDESA], n.d.). Communities need to have a coordinated plan to respond to the emergency needs of citizens in the event of a flood.

The City of Cincinnati is located along twenty-six miles of the Ohio River and the city has several creeks and smaller rivers as tributaries to the Ohio River. The research problem is the City of Cincinnati lacks a coordinated flood preparedness plan which places citizens and rescuers in danger and may cause avoidable injuries or deaths. The purpose of this research is to identify the current resources and flood preparedness methods available to the City of Cincinnati.

The descriptive research method will be used to answer the following research questions:

1. What areas of the city are susceptible to flood damage – the population and industry 33affected?
2. What prevention, evacuation, and shelter plans are currently in place?
3. What are the available resources for water rescue at the local, state and federal level?
4. What resources and flood preparedness plans are in place in other flood prone cities?
5. What is the process for the city to follow to request local, state and federal assistance?

## Background and Significance

Ohio's primary threat to life and property from a natural disaster is from flooding (Ohio Emergency Management Agency [OEMA], 1998). The City of Cincinnati is located along twenty-six miles of the Ohio River which forms the southern boundary of the State of Ohio. In the seventy year span from 1930 to 2000, the Ohio River has reached flood stage (fifty-two feet or higher) thirty-eight times – greater than once every two years on average. Two of the more significant floods occurred in 1937 and 1997. In 1937, the Ohio River crested at eighty feet. The 1937 flood left 100,000 people homeless and damage reached $20 million in 1937 dollars ("Infamous Floods", n.d.). The Sunday before the river crested in 1937 was termed "Black Sunday", when more than ten gas tanks exploded and sent oil and gasoline burning in the Ohio River and in the Mill Creek (Findsen and McWhirter, n.d.). During the more recent flood of 1997, the Ohio River crested at 64.7 feet. The 1997 flood caused the evacuation of nearly 20,000 people. Damage estimates reached $180 million (Jackson and Vivian, 1997).

Cincinnati also has several creeks and rivers within its boundaries. The Mill Creek traverses eleven miles from the northernmost boundary of the city all the way to the Ohio River in the center or core area of the city. The Mill Creek is designed to remove the water from within the city to the Ohio River. The Little Miami River is located on the easternmost boundary of Cincinnati and is a tributary of the Ohio River. The Duck Creek is a 19.3 mile watershed also located within the north-eastern boundaries of the City of Cincinnati and has experienced several flash floods in recent years claiming at least three lives.

The Cincinnati Fire Department (CFD) is the primary rescue responder for emergency incidents along the Ohio River, Mill Creek, Little Miami River, and the Duck Creek within the borders of the City of Cincinnati. The Cincinnati Fire Department will also be the lead agency in

the event of a flood involving any of these waterways. These incidents could range from a short term flash flood to a long-term flood emergency and recovery similar to the flood of 1997.

The City of Cincinnati lies inside the geographic boundaries of Hamilton County. The City of Cincinnati Emergency Operations Plan only addresses general emergency operations. The plan does not have flood specific annexes to delineate roles and responsibilities specific to a flood emergency. Likewise, the Cincinnati Fire Department does not address flood emergencies within its Operations Manual or the Procedures Manual. As a result there are no guidelines or procedures for the members of the Cincinnati Fire Department to follow in the event of a flood emergency and are relegated to using their best judgment at the time of the emergency. The Hamilton County emergency operations plan does contain a flood specific annex however the Hamilton County plan is not incorporated or distributed within the City of Cincinnati.

The Cincinnati Fire Department not only lacks procedures and guidelines to effectively mitigate a flood emergency it also does not have the equipment or training to safely operate under normal water conditions. Operating under flood conditions is often more dangerous and requires proper safety equipment and competent, well-trained rescuers to safely operate in the flood zone.

The Cincinnati Fire Department is comprised of 26 engine companies, 12 ladder companies, 2 heavy rescues, 4 advanced life support units, and 6 basic life support units. The CFD also has two boat units – 1 fire boat and 1 pontoon boat – neither of which are conducive to flood or backwater rescue. The boats are housed in a firehouse in the downtown business district within one mile of the Ohio River. The boats must be placed in the water for every emergency response greatly delaying the response time to the victim. The only personal flotation devices (PFD's) available are located on the boats or on the heavy rescue squad located in the downtown

business district. As a result of the lack of PFD's fire companies responding to water emergencies are often operating within ten feet of the water without a PFD. To make matters worse the firefighters are often wearing structural fire fighting clothes further adding to the danger should they fall into the water. The fire companies do not have rescue throw bags or ring buoys to perform a shore based rescue. Without the proper safety devices the Cincinnati Fire Department is placing its members in danger when responding to water emergencies.

The fire companies responsible for boat operations, Engine 3 and Truck 3, have received minimal to no formal training regarding boat operations and water rescue. Any training the members may have has been delivered "on the job" from other members of the company and has been limited to boat operations on the Ohio River. Several members of the heavy rescue squad have limited water rescue training, however do not have the capability to deploy without a vessel. The water training status of the department has recently forced the Operations Chief to suspend all water rescue responses by the department.

The lack of procedures, training, and equipment has negatively affected the Cincinnati Fire Department's ability to safely respond to flood and other water emergencies to perform rescue operations. The lack of preparedness within the City of Cincinnati may lead to fire fighter and/or civilian deaths or injuries in the event of another flood or water emergency. The lack of flood preparedness directly affects the mission of the United States Fire Administration (USFA) "to reduce life and economic losses due to fire and related emergencies" ("About the U.S. Fire Administration,"n.d.).

This research project directly relates to the Leading Community Risk Reduction (LCRR) curriculum of the "Five-E's of Potential Risk Reduction Strategies". The "Five E's" include Engineering, Education, Enforcement, Economic Incentives and Emergency Response as

outlined on pages 4-41 to 4-43 of the LCRR student manual. The Engineering factor encompasses building plan review to determine the building location in relation to the flood plain. The Emergency Response Factor will include all response to protect life and property throughout the duration of the incident.

My research will identify the current water rescue resources available to Cincinnati as well as to investigate flood preparedness methods utilized in other municipalities. This information may reveal methods not currently employed by the City of Cincinnati and lead to the reformation of the Emergency Operation Plan. This investigation will use the descriptive research method.

## Literature Review

The World's number one weather related killer is flooding. Flooding causes more property damage than all other weather related events combined totaling greater than $40 billion annually (Segerstrom, 2001). In light of this fact, the United States has no national flood response system as state and federal programs concentrate on protecting property with mitigation and relief programs. The Federal Emergency Management Agency's (FEMA) Project Impact only deals with property losses and ignores the loss of life potential associated with flooding. Annually, 200-300 Americans and three rescuers die in floods (Ray, 2000). The most significant losses of life and property occur in urban areas due to the higher concentration of people and also the higher property loss due to the socio-economic investment (UNDESA, 2004).

Throughout history there have been several responses and theories to flooding. Pre-1917 was considered the Frontier Era when development anywhere was encouraged and the goal was to "conquer the wild landscape and to promote productive use of the land". Flood hazards during

the Frontier Era were largely the problem of the homeowner or dealt with at the local level. The Structural Era spanned 1917 to 1959 and was marked with an attempt to control floodwaters and to get the floodwaters off the land as quickly as possible. The federal government assumed the cost for the construction of levees, dams and reservoirs however the flood damage was not being reduced. The Stewardship Era spans 1960 to the present and recognizes the benefits and natural function of the floodplain area. The responsibility has shifted back to the local level for flood plain management. The federal government does provide federal assistance to recover from flood related disasters (Ohio Emergency Management Agency [OEMA], 2004).

The federal government does provide limited flooding emergency assistance through the United States Army Corps of Engineers (USACE). The Assistance provided through the USACE consists of: technical advice and assistance, emergency repairs to levees and other flood control projects, and will furnish materials such as sandbags, polyethylene sheeting, lumber, and pumps (United States Army Corps of Engineers [USACE], n.d.) The federal government also has taken steps to reverse rising flood damage by instituting a variety of programs. These programs can be grouped into several categories: Keeping flood waters away from people and buildings, keeping people and buildings away from flood waters, and reducing the cost of flooding to individuals with programs such as the Flood Insurance Program and flood disaster relief (“Ohio Department of Natural Resources [ODNR], n.d.).

According to the United Nation’s *Guidelines for Reducing Flood Losses,* emergency planning and preparedness is relegated to a local responsibility. The guidelines also acknowledge the need for local government to coordinate and collaborate with other entities both from the private sector as well as state and federal agencies (United Nations Department of Economic and Social Affairs [UNDESA], 2004). Community based disaster management and preparedness is

essential to provide faster response to victims needs before the arrival of external assistance (UNDESA, 2004) Understanding the contributing factors involving flooding within a community must be understood to effectively plan and manage risk (UNDESA, 2004). The management must include a multiple hazard mitigation approach of preventing or restricting new or inappropriate development, removal of certain structures, flood-proofing structures, constructing levees and dams, controlling the land use, utilizing flood forecasting and warning systems and linking them to effective response (UNDESA, 2004)

The flood plain management process concentrates on prevention through four categories of management measures. The four categories of flood plain management measures include; land use planning through zoning regulations, development and building controls such as flood level restrictions and flood proofing structures, constructing flood mitigation works such as levees and dams, and community awareness, warning systems, evacuation and recovery plans (Kelly and Parker, 2005). A balance must be attained between structural and non-structural measures to manage and reduce flood losses as the emphasis is shifting from construction of large structural flood prevention solutions to measures in flood proofing and land use regulation (UNDESA, 2004). UNDESA (2004) also contends that efforts should be made to flood proof critical facilities against the rarest of potential floods.

Maps of flood prone areas must be prepared and detailed impacts outlined (UNDESA, 2004). Flood maps will show the Special Flood Hazard Area (SFHA) also referred to as the 100-year flood plain. The 100-year flood plain is the area that has a one-percent chance of being equaled or exceeded each year (Ohio Department of Natural Resources [ODNR], 2005). The flood history will identify areas subject to flooding and mapping will identify the risk and serve as the basis for flood damage reduction programs. Maps will also serve to identify risk to

individuals and aid in preparation of emergency response plans. These maps must be readily available to emergency response agencies. Geographic Information Systems (GIS) provide computer based mapping information useful in support of flow forecasting and emergency response (UNDESA, 2004)

Risk management within the flood plain is designed to reduce risk but not to eliminate risk altogether (UNDESA, 2004). Risk management includes designing regulations to guide flood plain development to lessen the damaging effects of floods. The flood plain is therefore divided into two areas; the floodway and the flood fringe. The flood way is the part of the flood prone area having high velocity water flow where any development should not impede the free flow of flood water. The flood fringe is the remaining portion of the flood plain outside the flood way where development will not normally interfere with water flow (ODNR, n.d.). No development should be permitted within the floodway according to UNDESA (2004), and that the floodway should be reserved for the water. UNDESA (2004) also states that any development within the flood fringe must be protected using flood protection or flood proofing. Flood protection measures include raising the elevation of the buildings. Flood proofing requires the building to be designed so water cannot enter the structure (ODNR, n.d.).

Many agencies must give their approval prior to project construction within the flood plain. Those agencies include the USACE, the Building Department and the Department of Natural Resources (May, 1997). UNDESA (2004) recommends that building codes should ensure that flood damage is minimized by locating buildings above the designed flood elevation. The codes must include enforcement and penalties in order to ensure the flood prevention methods will work (UNDESA, 2004). Flood protective measures such as dams and levees tend to increase the level of development within a flood prone area due to the fact that developers

assume the area is now protected. At some time the design will be exceeded and catastrophic damage will occur (UNDESA, 2004).

Kelly and Parker (2005) discussed emergency risk management in terms of prevention, preparedness, response and recovery. Prevention includes zoning and land use, building codes, building use regulations, and safety improvements. Preparedness encompasses community awareness and education, training and test exercises, and evacuation plans and warning systems. The response portion of Kelly and Parker's model included implementation of the emergency response plan, issuing of warnings, activation of emergency operations centers, invoking mutual aid agreements, conducting search and rescue, and evacuation. Recovery involves activation of relief centers, provision of community and individual needs, reestablishment of essential services, financial assistance and insurance claims (Kelly and Parker, 2005). Kelly and Parker's emergency management correlated with Segerstrom's (2001) contention that flood events occur in four phases. The four phases are the pre-event, rescue, evacuation – search and safety, and recovery (Segerstrom, 2001). Segerstrom's pre-event phase correlates with Kelly and Parker's prevention and preparedness stages. Segestrom's rescue and evacuation – search and safety phases correlate with Kelly and Parker's response stage and both authors discuss the recovery phase.

A flood forecasting system is essential to the success of all other flood mitigation measures by providing lead time to the community (UNDESA, 2004). According to UNDESA (2004) a successful flood warning system is the most effective method for reducing loss of life and economic loss. The flood warning system was weakened in the 1990s when hundreds of river gauges nationwide were shut down due to budget cuts. The forecasters are reliant on the gauges to update forecasts for computer data. The discontinued river gauges hampered the

National Weather Service from analyzing massive flooding in Falmouth, Kentucky, in 1997 where five people were killed (Braykovich, 1997). An effective flood forecasting and warning system will combine reliable data, forecast tools and trained forecasters to provide a forecast that allows for sufficient lead time for communities to respond (UNDESA, 2004). The forecast and warning system must be able to disseminate the message to the population at risk in the simplest form possible. The seriousness of the message must be accurately perceived by the community with the appropriate level of urgency (UNDESA, 2004)

According to Slim Ray (2000), there is no plan, little equipment, and no training for local, regional or national responders leaving them unprepared to deal with the problems of flood rescue. Most national fire training curriculums do not include water safety or flood rescue training (Glassey, 2006). Emergency responders must be well trained in advance of the flood emergency and skills continually upgraded. It is too late once the emergency occurs to determine deficient expertise (UNDESA, 2004). If agencies will be responding to flood emergencies they must train and equip the responders for the task (Glassey, 2006). Responders must be trained to at least the water awareness level, and all responders within fifteen feet of the edge of moving water should be wearing a personal floatation device (PFD). There is only one PFD in service for every fifteen emergency response personnel in the United States (Segerstrom, 2001). Jim Segerstrom (2001) has conducted informal estimates comparing fire fighter fire ground fatalities and water rescue responses per 1000 fire and water responses. Segerstrom (2001) concludes the American firefighter's chance of drowning on duty is 40% higher than those of dying in a working fire. According to Glassey (2006) ten percent of the deaths during the flooding associated with Hurricane Floyd were rescue workers. These deaths can be attributed to a lack of training, lack of equipment or the emotional urgency of the incident (Segerstrom, 2001).

The events of Hurricane Katrina in 2005 are a reminder of the deficient flood rescue abilities and that the emergency service must work to develop effective flood and swift-water response capabilities (Glassey, 2006). Slim Ray (2001) recommends pre-deployment of flood rescue resources to potential flooded areas. Steve Glassey (2006) agrees stating that the pre-deployment of resources close to high-risk areas is a critical element of flood rescue. The high-risk areas can be determined by conducting vulnerability analysis and mapping considering the population and structures at risk. The vulnerability analysis, mapping and response plan with an inventory of available resources must be available to responders (UNDESA, 2004).

A vital task of response will be the evacuation of the affected area. Evacuation will not fall upon any single agency and to be successful, evacuation must be a planned event (Parker and Kelly, 2005). Evacuation routes, emergency shelters and other specific actions must be made available to the community in advance of the flood (UNDESA, 2004). Reliable storm warning, forecasting and communication links to the community will assist in the timely evacuation of families and personal effects reducing the loss of life and economic losses (UNDESA, 2004).

## Procedures

The procedures utilized in this research proposal included personal interviews, a mailed survey, an e-mail survey and an extensive literature review.

An interview was conducted with Mr. William Langevin, Director of the City of Cincinnati Building Department on April 6, 2006, at 3:00 p.m. Mr. Langevin was selected to be interviewed because he is the designated flood plain manager for the city. The interview with Mr. Langevin was conducted over the telephone. The following questions were asked of Mr. Langevin:

1. What areas of the city are susceptible to flooding?
2. What is the population of the affected areas?
3. What is the industry affected?
4. What is the location of the National Flood Insurance Program maps?
5. What is the Building Department's role in regulating the floodplain?

An interview was conducted with Mr. Bary Lusby, Operations Manager with Hamilton County Emergency Management. Mr. Lusby was selected to be interviewed as he is responsible for updating and revising the emergency operations plans for Hamilton County. The interview with Mr. Lusby was conducted on April 18, 2006, in Mr. Lusby's office. The following questions were asked of Mr. Lusby:

1. What is the Emergency Management Agency's role during a flood?
2. What prevention, evacuation and shelter plans are currently in place?
3. What are the shelter locations and their capacities?
4. What is the process the city must follow to request local, state and federal assistance?

An interview was also conducted with Mr. Steve Rager, Operations Manager for the United States Army Corps of Engineers (USACE) – Louisville District Office on April 6, 2006, at 1:00 p.m. Mr. Rager was selected as the USACE is responsible for flood protection measures along the Ohio River. The interview with Mr. Rager was conducted on the telephone. The following questions were asked of Mr. Rager:

1. What flood prevention measures are in place or are put in place to reduce the severity or impact of the flood waters?

An interview was conducted with Mr. Wes Wimmer with the Metropolitan Sewer District – Stormwater Management Unit on April 19, 2006. Mr. Wimmer was interviewed upon

recommendation of Mr. Langevin for further clarification of questions posed to Mr. Langevin. The interview was conducted at the Metropolitan Sewer District offices. The following questions were asked of Mr. Wimmer:

1. What areas of the city are susceptible to flooding?
2. What is the population of the affected areas?
3. How are the floodplain maps utilized?

An interview was conducted with Mr. Gary Miller, Director of Disaster Services for the American Red Cross in Cincinnati, on April 7, 2006. Mr. Miller was asked the following questions:

1. Does the Red Cross have flood-specific shelter plans or are the shelter plans independent of the emergency type?
2. What are the shelter locations and capacities?
3. What is the process for providing shelter to a displaced resident?
4. How long will the Red Cross provide shelter?

A phone interview was conducted with Chris Palafox from the United States Coast Guard (USCG) Marine Safety Detachment in Cincinnati on April 14, 2006. Mr. Palafox was asked the following questions:

1. What water resources are available from the USCG Cincinnati detachment?
2. What personnel resources are available?

In conducting the research for this project two surveys were generated and distributed. The first survey was sent to 52 fire departments across the United States. Thirty-six fire departments responded. The purpose of the survey was to determine whether the surveyed communities had a detailed flood preparedness plan as well as some of the components of the

plan as they related to the fire department. The fire departments were determined by identifying the major rivers in the United States (US Rivers, n.d.). Cities along the major rivers with populations greater than 25,000 were identified utilizing the Google search engine entering the city name and the word “population”. All population results and information derived were utilized from the Wikipedia Encyclopedia website (Wikipedia, n.d.). The cities with a population greater than 25,000 were then referenced to the United States Fire Administration Website – Fire Department Census information section to obtain mailing address information (“National Fire Department Census,” n.d.). The survey was conducted between March 6, 2006 and April 7, 2006. A self-addressed, stamped envelope was enclosed to return the survey; a detailed list of the departments surveyed is contained in Appendix A. The survey distributed to the departments is contained in Appendix B.

The second survey was distributed to Hamilton and Butler County fire departments. Hamilton County and Butler County are within reasonable mutual aid response distance to the City of Cincinnati. The purpose of this survey was to determine the water rescue resources available within the region. The survey was distributed via electronic mail through the Fire Chief’s Associations of both counties. Fire Chief Kevin Kaiser, President of the Hamilton County Fire Chief’s Association, distributed the survey to forty fire departments on March 20, 2006. The responses were returned via electronic mail by April 7, 2006. The surveys were also sent to Ohio Task Force One (OHTF-1) – Urban Search and Rescue and to the Hamilton County Urban Search and Rescue Team (HCUSAR). Twenty-three departments as well as OHTF-1 and HCUSAR returned the survey. A list of the departments surveyed is contained in Appendix C. Fire Chief Joe Schutte; President of the Butler County Fire Chief’s Association, distributed the

survey to 21 departments via electronic mail on March 24, 2006. The responses were returned via electronic mail by April 7, 2006. A list of departments surveyed is contained in Appendix C.

Research question one regarding the susceptible areas of the city was answered by from the interviews with Mr. Langevin of the Building Department, Mr. Lusby of Hamilton County Emergency Management, Mr. Wimmer from the Metropolitan Sewer District, as well a physical survey of the area and demographic data from the Cincinnati Home website (Cincinnati Home, n.d.). Research question two regarding prevention, evacuation and shelter plans was answered by interviews with Mr. Lusby, Mr. Miller from the American Red Cross, and examination of the City of Cincinnati Emergency Operations Plan. Research question three regarding available water resources was answered by interview with Mr. Lusby and the resource survey. Research question four regarding resource and flood preparedness plans in other flood prone cities was answered from the survey distributed to the fire departments along the major United States rivers. Research question five regarding the process to request local, state and federal resources was answered by interview with Mr. Lusby and examination of the mutual aid agreements within the City of Cincinnati.

Interviews were conducted with several occupancies along Kellogg Avenue in the East End within the flood fringe. Mr. Rick Miller with the Liquid Transfer Terminal was interviewed on June 12, 2006, at the offices of the Liquid Transfer Terminal. Mr. Gary Sampson of Kinder Morgan – Queen City Terminals – a bulk liquid storage facility – was interviewed on June 12, 2006 at his office on Kellogg Avenue in the East End of Cincinnati. Mr. Gary Keplinger, plant manager for Martin Marietta Aggregate was interviewed on June 12, 2006 at his office on Kellogg Avenue. Mr. Miller, Mr. Sampson, and Mr. Keplinger were asked what procedures were in place in the event of a flood at their facility.

The research was limited by identifying responsibility within the city for flood preparedness. Actually identifying the entity responsible for maintaining and producing plans and documents became quite confusing as it is not delineated within the Emergency Operations Plan (EOP). If entities were delineated for certain aspects of preparedness within the EOP some of the responsibilities had been re-assigned to other departments without updating the EOP. The research was also limited by the respondents returning both the local and national survey as well as sending copies of their preparedness plans.

## Results

The first research question was what areas of the city are susceptible to flood damage – the population and industry affected? An interview was conducted with Mr. William Langevin, Director of the Cincinnati Building Department and designated floodplain manager. Mr. Langevin was asked about the National Flood Insurance Program Maps for the city and if they could be reviewed to determine areas of the city at risk for flooding. Mr. Langevin stated that the floodplain maps were not in his possession and that they were maintained within the Metropolitan Sewer District (MSD). Mr. Langevin referred me to Mr. Wes Wimmer of MSD. Mr. Wimmer was interviewed upon the referral of Mr. Langevin. Mr. Wimmer was also asked about reviewing the National Flood Insurance Program Maps. Mr. Wimmer stated that he did not have them in his possession and that they were kept within the Building Department. Mr. Wimmer did however demonstrate the capabilities of the Cincinnati Area Geographic Information System (CAGIS). CAGIS contains many layers of geographical and infrastructure information within the City of Cincinnati and Hamilton County. Included within the geographical information of CAGIS is an overlay of the National Flood Insurance Program

Maps. Mr. Wimmer also provided a list of streets and when they are affected compared to the height of the river. This list is contained in Appendix D. Utilizing this list and the CAGIS data it is determined that the East End and California neighborhoods are the most susceptible areas within the City to flooding. The population of the East End and California neighborhoods total 3000 people (Cincinnati Home, n.d.). Sections of these neighborhoods begin to flood at a river level of 44.8 feet. The East End is comprised of residential and bulk storage type industry. The industry consists of bulk liquid storage facilities as well as solid commodities of rock salt, sand and gravel which are off-loaded from barges. The second area to begin flooding is the Sedamsville neighborhood. Sedamsville is populated by 2000 residents. The industry located in Sedamsville is centered along the river and consists mainly of river transportation companies very similar to the East End. Sedamsville begins to flood at a river level of 55.8 feet. The East End and Sedamsville also contain large recreational facilities with baseball fields and soccer fields within the flood fringe. The next area of the city to begin to flood is the downtown river front. This area is not populated with residential structures but does contain several parks, Great American Ballpark, Paul Brown Stadium (football), and the US Bank Arena. The downtown riverfront begins to flood at a river level of 56.1 feet.

Interviews were conducted with managers along the flood fringe in the East End. Mr. Rick Miller of the Liquid Transfer Terminal was asked what procedures were in place in the event of a flood. Mr. Miller responded that the procedures depended upon the level of product with the tanks. If the tanks were empty they would remove the manway and flood the tank with water to keep the tank in place.

Mr. Gary Sampson, Terminal Manager of Kinder Morgan – Queen City Terminals – Port of Cincinnati LLC was interviewed. Queen City Terminals is a large bulk liquid facility

comprised of twenty-six storage tanks. Mr. Sampson was also asked what procedures are in place within his facility in the event of a flood. Mr. Sampson responded that the Ohio River must reach 65 feet to breach the dikes which completely surround the storage facility. Mr. Sampson explained that the best case scenario would be if all of the tanks were completely full of product. If the tanks are empty, they will be cleaned and river water pumped into the tanks. All of the pumps and motors connected to the tanks would be removed and the piping and electric would be disconnected. The plant would be evacuated until the water receded. Mr. Sampson stated all of the procedures for flooding as well as other emergencies within the plant were contained in the *Integrated Emergency Plan (ICP)* for the terminal.

Mr. Gary Keplinger, plant manager for Martin Marietta Aggregate was interviewed. Martin Marietta Aggregate is a bulk outdoor storage facility for sand and gravel. Mr. Keplinger was asked what procedures were in place in the event of a flood. Mr. Keplinger responded that all employees are evacuated. The large piles of product are not affected by the flood waters and no precautions are taken to protect them.

The second research question was what prevention, evacuation and shelter plans are currently in place? An interview was conducted with Mr. Steve Rager from the USACE. Mr. Rager was asked about the flood prevention measures currently in place to reduce the severity or impact of flood water in Cincinnati. Mr. Rager stated that the USACE constructed the flood wall and levee system that protects the downtown business district of Cincinnati. The system was built to protect the city from a flood equal to the devastating flood of 1937 plus three additional feet. The 1937 flood crested at 80 feet thus the flood wall and levee system will protect the city to a water level of 83 feet. The 83 foot mark is equal to the 1000 year flood plain. The levee and flood wall system tie into high ground on either side of the downtown district. The USACE

conduct annual inspections of the wall and levee system and produce a report for the Metropolitan Sewer District who is responsible for their maintenance. Mr. Rager also discussed the function of the Mill Creek in relation to flood prevention within the City of Cincinnati. The Mill Creek was designed to remove the water from the city and discharge the water into the Ohio River. The mechanism of flow for the water discharge is gravity through ten – fourteen foot pipes, which is effective when the river level is low. When the river level is high, the gates on the pipes are closed preventing water from backing up from the Ohio into the Mill Creek. The Mill Creek pumping station then pumps the water out of the Mill Creek and into the Ohio River. Reservoirs located upstream of Cincinnati on the Mill Creek also aid in controlling the flow of water until the Ohio River can handle the discharge.

An interview was conducted with Mr. Langevin of the Building Department. Mr. Langevin was asked what the Building Department's role is in regulating the floodplain. Mr. Langevin discussed the building permit process and the determination if the proposed building would be built within the floodway or the flood fringe. Mr. Langevin stated the buildings built within the floodway could not impede water flow and must be elevated. The buildings built within the flood fringe must be elevated one to two board-feet above the 100-year floodplain.

An interview was conducted with Mr. Bary Lusby from Hamilton County Emergency Management. Mr. Lusby was asked what prevention, evacuation and shelter plans are utilized by the Hamilton County Emergency Management Agency? Mr. Lusby responded that a primary role of the Emergency Management Agency (EMA) is floodplain management and working with communities to adopt and enforce floodplain management. The EMA works with communities to ensure they have adopted the Natural Hazards Mitigation Plan for the County in order for the communities to be eligible for the National Flood Insurance Program. The EMA also assists the

communities with applying for mitigation grants to fund the construction of flood protection measures.

Mr. Lusby also discussed evacuation and notification procedures. Traditionally, public warning has been the role of the EMA. The EMA has utilized the Civil Defense warning sirens as the primary notification method for weather emergencies. Mr. Lusby discussed the need to de-emphasize the role of the warning sirens as they have become antiquated and over-used for multiple weather hazards. Mr. Lusby discussed the focus of utilizing the media and the Emergency Alert System through broadcasting media for more timely and specific notification. The Media and Emergency Alert System are more beneficial since they can provide warning as well as instructions for action and evacuation. Mr. Lusby also discussed the benefits of a "reverse 911" system that can call all of the residents within the area in danger and notify them of the possibility of danger and can provide instructions. While this technology is currently available it is not economically feasible within the city budget constraints at this time.

Examination of the City of Cincinnati Emergency Operations Plan (EOP) reveals the Fire Department is the primary agency responsible for emergency management. The also states the Fire Department shall have the primary responsibility for ordering evacuations when necessary. The Fire Department does not address evacuations within its Operations Manual. The EOP also delineates that the Building Department shall assist the Red Cross in locating and securing shelter for displaced victims. Mr. Lusby discussed the fact that the Red Cross has been chartered by Congress to provide shelter assistance in the event of a disaster.

Mr. Gary Miller, Director of Disaster Services with the Cincinnati Chapter of the American Red Cross, was interviewed. Mr. Miller was asked whether the Red Cross had disaster specific shelter plans or general shelter plans. Mr. Miller explained that the Red Cross shelter

program is based on the number of residents needing shelter and the location of the disaster. Mr. Miller also replied that the Red Cross uses the same shelters where floods occur often.

Mr. Miller was asked what are the locations and capacities of the shelters. The Cincinnati Chapter of the Red Cross maintains over 600 shelters in their twenty county region. The capacity varies with the size of the shelter.

Mr. Miller was asked what the process for providing shelter is and the length of time the Red Cross will provide shelter to a displaced resident. Mr. Miller responded that the Red Cross will provide shelter for up to three days from a residential structure fire and then the resident will be referred to a social service agency that will help the resident find rental property. The Red Cross will assist the resident with the first month's rent and security deposit. During and after large disasters the Red Cross will provide shelter for as long as necessary until suitable housing can be located. Mr. Miller stated the Red Cross administers the Transit Accommodations Act for FEMA for federally declared disasters and will place people in motels or rental property depending upon availability. During the recent Hurricane Katrina the Red Cross had shelters open for four months.

The third research question was what are the available resources for water rescue at the local, state and federal level? A survey was distributed to fire departments in Hamilton County and Butler County to determine the water rescue resources locally. The survey was distributed through the Fire Chief's Association of both counties by electronic mail with the survey attached. Of the 61 departments contacted 27 responded to the survey.

The first question of the local resource survey requested the number and type of boats available. Of the thirty departments responding to the survey (including Cincinnati Fire Department resources), 14 boats are maintained for water rescue response. Nine boats could

arrive to the Ohio River in the Downtown Business District within twenty minutes. Four additional boats could arrive within thirty minutes. The remaining boat would arrive within fifty minutes.

The second question of the local resource survey requested the number of personal flotation devices (PFD's) each department had available. A total of 249 PFD's could be available. Thirty-two PFD's could arrive within the first ten minutes. One hundred thirty three additional PFD's would be available within twenty minutes. An additional 52 PFD's would arrive at the thirty-minute mark. At fifty minutes six additional PFD's arrive on scene. At sixty minutes twenty additional PFD's will be available. Six final PFD's will arrive at the ninety-minute mark.

The Third survey question asked the number of water trained personnel. A total of 120 water trained personnel were identified by the respondents to the survey. Including the Cincinnati Fire Department response, sixteen water trained personnel could arrive within ten minutes of dispatch. An additional fifty-nine water trained personnel could arrive within twenty minutes of request. Thirty-two additional water trained personnel could arrive at the thirty minute mark. Additional seven and six personnel could arrive at the fifty and sixty minute intervals respectively.

*Table 1: Water Resources and Response Time to Ohio River at Cincinnati (All mutual aid resources available to respond)*

| Time (Minutes) | Number of Boats | Trained Personnel | PFD's |
|---|---|---|---|
| 10 | 2 | 16 | 32 |
| 20 | 7 | 59 | 133 |
| 30 | 4 | 32 | 52 |

*Table 1 continued:*

| Time (Minutes) | Number of Boats | Trained Personnel | PFD's |
|---|---|---|---|
| 40 | 0 | 0 | 6 |
| 50 | 1 | 7 | 6 |
| 60 | 0 | 6 | 20 |
| 70 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 |
| 90 | 0 | 0 | 6 |
| Total | 14 | 120 | 255 |

Hamilton County Urban Search and Rescue (HCUSAR) added 6 PFD's at the 40 minute interval. HCUSAR has no water rescue boats. HCUSAR would not add additional personnel as their members are comprised of Hamilton County Fire Department members already included in the survey.

The Ohio Task Force One (OHTF-1) – Urban Search and Rescue has limited water resources based in a warehouse in Dayton, Ohio. OHTF-1 maintains 35 PFD's for a Type-III (Hurricane) deployment for use by its members. OHTF-1 is an all volunteer organization made up of firefighters from all over the entire state of Ohio. In order to respond to Cincinnati OHTF-1 would have to activate its members and wait for them to respond to Dayton. This response could take up to two hours from notification. Once the members assembled in Dayton the trucks would need to be loaded and then respond. The Dayton headquarters is one hour and fifteen minutes away from Cincinnati.

A phone interview was conducted with Mr. Chris Palafox from the USCG Marine Safety Detachment located in Cincinnati. Mr. Palafox stated the USCG could provide three flat bottom

John Boats in the event of a flood. Mr. Palafox also stated the USCG at Cincinnati has seven active duty members working 7:30 A.M. to 4:00 P.M. Monday through Friday. The USCG has a duty Petty Officer available 24-hour a day. In addition to the seven active duty members the Cincinnati detachment also has twenty-five reservists assigned to the post.

The fourth survey question inquired whether the municipality has a potential flood hazard within their community that would render their water rescue resources unavailable for response outside their jurisdiction. Of the twenty-six respondents (Cincinnati not included) fourteen indicated they had a flood hazard within their community that would preclude their response outside of their jurisdiction.

*Table 2: Water Resources and Response Time to Ohio River at Cincinnati (Communities with flood hazards un-available to respond)*

| Time (Minutes) | Number of Boats | Trained Personnel | PFD's |
|---|---|---|---|
| 10 | 2 | 16 | 32 |
| 20 | 0 | 25 | 48 |
| 30-80 | 0 | 0 | 0 |
| 90 | 0 | 0 | 6 |

The fourth research question was what resources and flood preparedness plans are in place in other flood prone cities? A survey was distributed to 52 fire departments across the United States. Thirty – six fire departments responded.

The first survey question inquired if the community had a detailed flood preparedness plan? Of the 36 respondents 21 stated did have a detailed flood preparedness plan for their community. Fifteen departments responded that they did not have a detailed flood preparedness plan.

The second survey question inquired if the flood preparedness plan was incorporated into the Emergency Operations Plan (EOP) for the community or if each public service had their own plan. Twenty four of the respondents indicated that the flood preparedness plan was incorporated into the EOP. Five respondents indicated that each public service maintained their own plan. Seven respondents indicated that the flood preparedness plan was not contained within the EOP or the individual public service plan.

The third survey question asked if the fire department had a detailed flood preparedness plan. Five departments responded that they had a detailed flood preparedness plan while 31 responded that the fire department did not.

The fourth survey question asked if the fire department standard operating procedures (SOP's) specifically addressed a flood emergency. Eight fire department's standard operating procedures specifically address a flood emergency. Twenty-eight of the department's SOP's do not address a flood emergency.

The fifth survey question asked if the fire department trains regularly on the flood preparedness plan. Nine fire departments responded that they do train regularly on the flood preparedness plan. Twenty-seven departments do not train regularly on the flood preparedness plan.

The sixth survey question inquired as to what body of water resided in the department's jurisdiction. The following rivers are within the respondent's jurisdictions; Ohio River, Tennessee River, Missouri River, Mississippi River, Connecticut River, Brazos River, Yellowstone River, Rio Grande River, Sacramento River, Susquehanna River, Boise River, Columbia River, Illinois River, Chattahoochee River, and the Minnesota River.

*Table 3: Rivers Within the Survey Respondent's Jurisdiction*

| River | Number of Departments |
|---|---|
| Ohio | 4 |
| Tennessee | 3 |
| Missouri | 7 |
| Mississippi | 4 |
| Connecticut | 4 |
| Brazos | 1 |
| Yellowstone | 1 |
| Rio Grande | 4 |
| Sacramento | 1 |
| Susquehanna | 1 |
| Boise | 1 |
| Columbia | 2 |
| Illinois | 1 |
| Chattahoochee | 1 |
| Minnesota | 1 |
| Total | 36 |

Survey question number seven asked what water resources the department maintained. Thirty-one of the respondents replied that they have at least one boat available for water response. Three departments have limited ropes and PFD's. One department has no equipment at all and one department did not respond to this question. Eleven of the thirty-six respondents have an organized water rescue team.

Survey question eight asked if the department maintains a list of water rescue resources available through mutual aid. Twenty departments responded they do maintain a resource list and sixteen do not maintain a list of available resources.

Survey question nine asked what entity in your community is responsible for flood victim relocation. Eighteen departments responded the Emergency Management Agency is responsible for victim relocation. Fourteen departments responded the Red Cross is responsible for victim relocation. Two departments responded the Red Cross and the EMA are responsible for victim relocation. Two departments responded the Red Cross and the Salvation Army are responsible for victim relocation.

*Table 4: Agencies Responsible for Victim Relocation*

| Agency | Number of Departments |
|---|---|
| EMA | 18 |
| Red Cross | 14 |
| EMA & Red Cross | 2 |
| Red Cross & Salvation Army | 2 |

Survey question ten asked if the departments had pre-designated temporary shelter locations for displaced flood victims. Twenty-seven departments responded that they do have pre-designated shelter locations. Nine respondents do not have temporary shelter locations pre-designated.

Survey question eleven asked if their community had a person within their governmental structure that was designated as a FEMA liaison and if they did was this their primary job function. Twenty-five departments responded that they have a person designated as a FEMA

liaison and all twenty-five have other job functions. Ten respondents do not have a designated FEMA liaison and one respondent was unsure.

Survey question twelve inquired if the department had experienced a flood event what was the most critical need to fill in the first 12-24 hours, 24-72 hours, and greater than 72 hours. Twenty-three of the thirty-six fire departments who answered this surveyed responded to this question. Within the first twelve to twenty-four hours the critical needs identified were; temporary shelter, rescue, information dissemination, evacuation, protecting water and sewer, and sandbagging. In the 24-hour to 72-hour time frame respondents reported care of victims, damage assessment, and restoring utilities was the priority. After 72-hours, housing for displaced victims, responder fatigue, recover costs – reimbursement, and recovery/clean up were the priorities for that time frame. Thirteen respondents did not answer the question.

*Table 5: Critical Needs Timeline*

| Need | 12-24 hours | 24-72 hours | >72 hours |
|---|---|---|---|
| Temporary Shelter | 2 | | |
| Rescue | 5 | | |
| Information Dissemination | 4 | 1 | |
| Evacuation | 10 | 3 | |
| Protect water/sewer | 1 | | |
| Sandbag | 3 | | |
| Care of Victims/Shelter | | 12 | |
| Damage Assessment | | 3 | |
| Restore Utilities | | 1 | |
| Housing | | | 6 |

*Table 5 continued:*

| Need | 12-24 hours | 24-72 hours | >72 hours |
|---|---|---|---|
| Responder Fatigue | | | 1 |
| Recover Costs/reimbursement | | | 4 |
| Recovery | | | 4 |

The fifth research question was what is the process for the city to follow to request local, state and federal assistance? To receive local assistance the Fire Chief or his designee will request the assets through the local mutual aid agreements. An interview was conducted with Mr. Bary Lusby, Operations Manager for Hamilton County Emergency Management. Mr. Lusby was asked what process the city needed to follow to receive state and federal assistance. Mr. Lusby answered that the City of Cincinnati must first declare a state of emergency through City Council. The City Manager will contact the Director of the EMA and the County Commissioners. The County will then have to declare an emergency to the Governor of Ohio. The Governor will then provide State assets to be deployed into the region. The Governor can then declare a state of emergency and appeal to the President of the United States. The President of the United States can declare a disaster area and deploy federal assets into the State.

## Discussion

This study revealed that the flood preparedness plan information within the City of Cincinnati is somewhat disjointed. Floodplain maps were unavailable from the Building Department and the Metropolitan Sewer District and were finally located in a filing cabinet within the Hamilton County Emergency Management Agency. Upon further research with Mr. Wimmer of the Metropolitan Sewer District (MSD) the floodplain maps were viewed as part of

the Cincinnati Area Geographical Information System (CAGIS) however these layers of the system are not currently available to responders. UNDESA (2004) affirms the importance of floodplain maps to identify risk to individuals and that these maps must be available to emergency response agencies. The study also revealed MSD has information regarding the areas of the city most susceptible to flooding based on Ohio River levels. This information would assist responders in formulating a plan for evacuation of endangered residents.

The study revealed that the Cincinnati Building Department regulates construction within the floodplain through the building permit process. The Building Department determines whether the proposed structure will be erected within the floodway or flood fringe and imposes regulations depending on location. The Cincinnati Building Department will permit construction within the floodway as long as the water flow is not impeded and the building is elevated. The Ohio Department of Natural Resources (n.d.) agrees with the policy of the Cincinnati Building Department. No development, regardless of restriction of water movement should occur within the floodway according to UNDESA (2004). The ODNR (n.d.), UNDESA (2004) and the Cincinnati Building Department agree to permit construction within the flood fringe as long as the structure is protected.

Prevention measures for flood protection within Cincinnati have been constructed by the USACE. A levee and floodwall system is in place to protect the downtown business district to a water level of 83 feet. The height of 83 feet was determined by the level of the most disastrous flood in Cincinnati in 1937 (80 feet) plus an additional three feet. These protection measures were constructed during the Structural Era of flood response between 1917 and 1957 when the federal government assumed the cost of constructing flood protection (OEMA, 2004). Flood

plain management has now shifted back to a local responsibility and has focused on regulating development within the floodplain.

This study revealed that the warning and notification systems in place within Cincinnati are dependent upon the local media. The warning and notification systems are also dependent upon the reliability of river gauges to forecast river levels (Braykovich, 1997). Without reliable gauges tragedies similar to the deaths of five citizens in Falmouth, Kentucky could occur again. New warning and notification technology is available however it is cost prohibitive to the City of Cincinnati at this time.

Water resources are available within Hamilton County and Butler County. The majority of these resources could arrive at the Ohio River at Cincinnati within one-hour of request. Most of the resources however would not be available in the event of widespread flooding of the Ohio River Valley. UNDESA (2004) contends that a resource list be readily available to responders however this study revealed that mutual aid would not be available to the City of Cincinnati due to flooding within their home jurisdiction. The results of the national survey indicated that 20 of the 36 departments surveyed maintain an available resource list.

The Cincinnati Fire Department's water resources were considered within the local resource survey. The CFD accounted for only twenty-four PFD's and twelve water trained personnel on duty daily. PFD's are only carried on the two heavy rescue units and the fire boats. The remaining thirty-eight fire companies who may be dispatched to a water emergency do not have PFD's or water training at any level. These circumstances concur with Slim Ray (2000) who found there are no plans, little equipment and no training for local responders leaving them unprepared to deal with the problems of flood rescue. The fact that most firefighters in Cincinnati do not have water training agrees with Glassey (2006) regarding the fact that most

national fire curriculums do not include water rescue training. The lack of training places firefighters in danger as Segerstrom (2001) estimates that a firefighter's chance of drowning is 40% higher than those of dying in a working fire.

This study revealed a majority of the communities surveyed place general flood preparedness plans within the Emergency Operations Plan for the community. Twenty eight of the departments responded that the fire department's standard operating procedures do not address a flood emergency. The survey also revealed that departments do not train regularly on flood preparedness plans. The Cincinnati Fire Department standard operating procedures do not address flood emergencies and there is no training on flood preparedness. Without procedures or training the responder is left without a guide to respond appropriately or safely.

Within the first twelve to twenty-four hours the primary emergency function is rescue and evacuation of endangered occupants according to the national department survey. Parker and Kelly (2005) concur considering evacuation a vital task. Key elements to a timely evacuation include reliable storm warning, forecasting and communication links to the community (UNDESA, 2004).

The implication of these results is that the most susceptible areas of the city have been defined and a prioritized evacuation plan can be created based on Ohio River level data created by MSD and CAGIS. An additional implication is the fire department will need to commit personnel and resources to develop procedures, conduct training and properly equip firefighters to safely respond to flood emergencies.

## Recommendations

The City of Cincinnati and the Cincinnati Fire Department need to pursue the following recommendations:

- Flood plain information needs to be accessible to all emergency responders through the Cincinnati Area Geographical Information System. Current flood level information needs to be disseminated to all responders.
- The reverse 911 notification system should be considered in future budget plans to provide early notification and direction to affected residents.
- The City of Cincinnati Building Department must continue to regulate development within the floodplain.
- The Cincinnati Fire Department needs to provide PFD's for all personnel on duty.
- The Cincinnati Fire Department must provide water rescue equipment available to conduct water rescue and evacuation of residents within the first twenty-four hours of the flood event.
- Develop a comprehensive water resource list.
- Provide water training for Cincinnati Fire Department members.
- Update the Emergency Operations Plan to include a hazard specific annex for flood emergencies.
- Update the Cincinnati Fire Department S.O.P.'s to include flood emergencies and integrate these procedures into the City E.O.P.

The Cincinnati Fire Department has been charged with the responsibility as the lead agency for emergency management and must designate an individual to update and revise the Emergency Operations Plan. This individual needs to coordinate all levels of City management

to produce a coordinated flood plan and to disseminate pertinent information to all city departments. The result will be a better prepared response prioritizing the emergency actions to the most severely threatened portions of the city.

The recommended changes such as capital equipment purchases and extensive training will have a significant budgetary impact and will need to be planned for over several budget cycles. The personnel costs for the individual tasked with updating and implementing the E.O.P. will also need to be included within the budget. Further research into the possibility of obtaining Federal grants to fund these changes needs to be conducted.

Research regarding a firefighter's required level of water training and ability and the necessity of including basic water survival training into firefighting curriculum need to be conducted. Additional research regarding the effectiveness of resident notification systems should also be conducted.

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# Appendix A

## National Fire Department Survey Respondents

The following thirty-six fire departments responded to the national survey:

| | |
|---|---|
| Billings Fire Department | Billings, Montana |
| Boise Fire Department | Boise, Idaho |
| Sacramento Fire Department | Sacramento, California |
| Pittsburgh Fire Department | Pittsburgh, Pennsylvania |
| Louisville Fire Department | Louisville, Kentucky |
| Albuquerque Fire Department | Albuquerque, New Mexico |
| El Paso Fire Department | El Paso, Texas |
| Brownsville Fire Department | Brownsville, Texas |
| Great Falls Fire Department | Great Falls, Montana |
| Bismarck Fire Department | Bismarck, North Dakota |
| Sioux City Fire Department | Sioux City, Iowa |
| Kansas City Fire Department | Kansas City, Missouri |
| Minneapolis Fire Department | Minneapolis, Minnesota |
| Moline Fire Department | Moline, Illinois |
| Memphis Fire Department | Memphis, Tennessee |
| Waco Fire Department | Waco, Texas |
| Las Cruces Fire Department | Las Cruces, New Mexico |
| Portland Fire Department | Portland, Oregon |
| Vancouver Fire Department | Vancouver, Washington |
| Peoria Fire Department | Peoria, Illinois |
| Huntington Fire Department | Huntington, West Virginia |

| | |
|---|---|
| Council Bluffs Fire Department | Council Bluffs, Iowa |
| Kansas City Fire Department | Kansas City, Kansas |
| St. Joseph Fire Department | St. Joseph, Missouri |
| Wheeling Fire Department | Wheeling, West Virginia |
| Davenport Fire Department | Davenport, Iowa |
| Baton Rouge Fire Department | Baton Rouge, Louisiana |
| Atlanta Fire Department | Atlanta, Georgia |
| Chattanooga Fire Department | Chattanooga, Tennessee |
| Decatur Fire Department | Decatur, Alabama |
| Knoxville Fire Department | Knoxville, Tennessee |
| City of Binghamton Fire Dept. | Binghamton, New York |
| Holyoke Fire Department | Holyoke, Massachusetts |
| Springfield Fire Department | Springfield, Massachusetts |
| Middletown Fire Department | Middletown, Connecticut |
| North Hampton Fire Department | North Hampton, Massachusetts |

# Appendix B

## National Fire Department Survey

March 6, 2006

My name is Thomas Lakamp and I am a District Chief with the Cincinnati Fire Department. I am currently enrolled in the Executive Fire Officer Program at the National Fire Academy. As a requirement to complete the Leading Community Risk Reduction Course I must complete an Applied Research project. My project topic is to identify current resources and flood preparedness methods available to the City of Cincinnati. I would greatly appreciate if you would complete the attached survey and return it in the enclosed addressed stamped envelope by April 7, 2006.

Thank you for your time completing this survey.

Sincerely,

Thomas C. Lakamp – District Chief
Cincinnati Fire Department
7982 Countfleet Ct.
North Bend, Ohio 45052

513-357-7503
513-368-1384

1. Do you have a detailed flood preparedness plan for your community? (If possible please send an electronic copy to thomas.lakamp@cincinnati-oh.gov)

   YES NO

2. Is the flood preparedness plan incorporated into the Emergency Operations Plan for your community or does each public service have their own plan?

   Incorporated into EOP Each Service has individual plan

3. Does the Fire Department have a detailed flood preparedness plan?

   YES NO

4. Do the Fire Department S.O.P.'s specifically address a flood emergency?

   YES NO

5. Does your community train regularly on the flood preparedness plan?

   YES NO

6. What is the body of water and/or waterway in your jurisdiction?

7. What are the water rescue resources within your department?

8. Do you maintain a detailed list of water rescue resources available through mutual aid?

   YES NO

9. What entity in your community is responsible for flood victim relocation?

10. Do you have pre-designated temporary shelter locations for displaced flood victims?

11. Do you have a person within your community government designated as the FEMA liaison?

YES NO

If yes, is this their primary job function or do they have other job responsibilities as well?
YES NO

12. If you have experienced a flood event what was the most critical need to fill in the first:

12-24 hours?

24-72 Hours:

After 72 Hours:

NOT APPLICABLE

Department:
Number of firefighters in department:
Population served:
Would you like a copy of this ARP? (Include e-mail address please)

YES NO

Thank you for your time completing this survey.

Thomas C. Lakamp
District Chief
Cincinnati Fire Department

# Appendix C

## Local Fire Department Resource Survey

1. What water response resources does your department/organization currently operate?

   Boats:
   Number _____
   Type of Boat(s): _____
   Victim capacity per boat _____

   Personal Floatation Devices Available: _____

   Number of trained water rescue personnel: _____

2. Response time to downtown Cincinnati with water resources: _____

3. Does your community have a potential flood hazard that may render your water rescue resources unavailable for response outside your jurisdiction? Yes No

Department:
Number of firefighters in department:
Population served:

Thank you for your time completing this survey.

Thomas C. Lakamp
District Chief
Cincinnati Fire Department
Thomas.lakamp@cincinnati-oh.gov

The following Ohio fire departments responded to the local resource survey:

Amberly Village Fire Department

Anderson Township Fire Department

City of Blue Ash Fire Department

Cheviot Fire Department

Cincinnati Fire Department

Delhi Township Fire Department

Forest Park Fire Department

Green Township Fire Department

Harrison Fire Department

Little Miami Joint Fire District

Lockland Fire Department

Loveland-Symmes Joint Fire District

Madeira-Indian Hill Joint Fire District

Montgomery Fire Department

Reading Fire Department

St. Bernard Fire Department

Springfield Township Fire Department

Sycamore Township Fire Department

Wyoming Fire Department

Mt. Healthy Fire Department

Miami Township Fire Department

Liberty Township Fire Department

Morgan Township Fire Department

Oxford Fire Department

Ross Township Fire Department

Middletown Fire Department

Miami Township Fire Department – Clermont

Hamilton County Urban Search and Rescue

Ohio Task Force One - USAR

# Appendix D

## Cincinnati Streets Affected by River Height

## OHIO RIVER FLOOD STAGE: 49.4 TO 80

| STREET | LOCATION | STAGE |
|---|---|---|
| Eldorado Avenue | Harbor Street | 44.8 |
| Harbor Street | Eldorado Avenue | 44.8 |
| Delta Avenue | Wool Street | 48.7 |
| Croslin Street | Waits Avenue | 49.4 |
| Humbert Avenue | St. Peters Street | 49.4 |
| St. Peters Street | Humbert AVenue | 49.4 |
| Panama Street | Waits Avenue | 49.8 |
| Humbert Avenue | Setchell Street | 50 |
| Setchell Street | Humbert Avenue | 50 |
| Brown Street | Humbert Avenue | 50.2 |
| Humbert Avenue | Brown Street | 50.2 |
| Brown Street | Eastern Avenue, (S.of) | 50.5 |
| Eastern Avenue, (S.of) | Brown Street | 50.5 |
| Eldorado Avenue | Valley Ford Street | 50.5 |
| Pennsylvania Avenue | Bet. Winter Street and Hoadly Street | 50.9 |
| Humbert Avenue | Watson Street | 51 |
| Humbert Avenue | Wenner Street | 51.5 |
| Carroll Street | Holbrook Avenue | 52.2 |
| Holbrook Avenue | Carroll Street | 52.2 |
| Humbert Avenue | Ridgley Street | 52.4 |
| Ridgely Avenue | Humbert Avenue | 52.4 |
| Humbert Avenue | Mayapple Street | 52.5 |
| Mayapple Street | Humbert Avenue | 52.5 |
| Eldorado Avenue | Panama Street | 52.6 |
| Panama Street | Eldorado Avenue | 52.6 |
| Beechmont Avenue, (Under) | Ramp to S.R. 74 | 53.4 |
| State Route 74 Ramp | Under Beechmont Avenue | 53.4 |
| Humbert Avenue | Worth Street | 53.6 |
| Corbin Street | Humbert Avenue | 54.2 |
| Donham Avenue | Mead Avenue | 54.2 |
| Humbert Avenue | Corbin Street | 54.2 |
| Keck Street | Munson Street | 54.2 |
| Mead Avenue | Donham Street | 54.2 |
| Munson Street | Keck Street | 54.2 |
| Eastern Avenue, (S.of) | St. Peters Street | 54.6 |
| St. Peters Street | Eastern Avenue. (S.of) | 54.6 |
| Kellogg Avenue | McAdams Street | 55 |
| McAdams Street | Kellogg Avenue | 55 |
| Pennsylvania Avenue | Pennsylvania Avenue Connection | 55 |
| Kellogg Avenue | McCullough Street | 55.1 |
| McCullough Street | Kellogg Avenue | 55.1 |
| Kellogg Avenue | Tennyson Street, (W.of) | 55.2 |
| Panama Street | Rohde Avenue | 55.2 |
| Rohde Avenue | Panama Street | 55.2 |
| Anchorage Road, (W. of) | Kellogg Avenue | 55.3 |
| Gassaway Road | Kellogg Avenue | 55.3 |

| | | |
|---|---|---|
| Haney Street | Renslar Avenue | 55.3 |
| Kellogg Avenue | Anchorage Road, (W.of) | 55.3 |
| Kellogg Avenue | Gassaway Road | 55.3 |
| Renslar Avenue | Haney Street | 55.3 |
| Croslin Street | Renslar Avenue | 55.4 |
| Gassaway Road, (W. of) | Kellogg Avenue | 55.4 |
| Kellogg Avenue | Gassaway Road, (W.of) | 55.4 |
| Renslar Avenue | Croslin Street | 55.4 |
| Foster Street | Kack Street | 55.5 |
| Keck Street | Foster Street | 55.5 |
| Kellogg Avenue | Water Works | 55.5 |
| Haney Street | Kenwood Avenue | 55.6 |
| Kellogg Avenue | C.G.&P.Elec.R.R. | 55.6 |
| Kenwood Avenue | Haney Street | 55.6 |
| Carpenter Street | Southside Avenue | 55.8 |
| Carroll Street, (E.of) | Kellogg Avenue | 55.8 |
| Kellogg Avenue | Carroll Street, (E.of) | 55.8 |
| Southside Avenue | Carpenter Street | 55.8 |
| Carroll Street | Kellogg Avenue | 55.9 |
| Donham Avenue | Kellogg Avenue | 55.9 |
| Kellogg Avenue | Carroll Street | 55.9 |
| Kellogg Avenue | Donham Avenue | 55.9 |
| Kellogg Avenue | Three Mile Road | 55.9 |
| Mehring Way | Plum Street | 56.1 |
| Plum Street | Mehring Way | 56.1 |
| Kellogg Avenue | Tennyson Street | 56.2 |
| Butler Street | Front Street | 56.3 |
| Front Street | Butler Street | 56.3 |
| Linneman Street | Renslar Avenue | 56.3 |
| Renslar Avenue | Linneman Street | 56.3 |
| Anchorage Road | Kellogg Avenue | 56.4 |
| Gassaway Road, (End of) | Kellogg Avenue | 56.4 |
| Kellogg Avenue | Along Kellogg Ave. W. of Bridge Over Little Miami River at driveway | 56.4 |
| Kellogg Avenue | Anchorage Road | 56.4 |
| Kellogg Avenue | End of Gassaway Road | 56.4 |
| Donham Avenue | Knicely Alley | 56.5 |
| Kellogg Avenue | Wilmer Avenue, (E.of) | 56.5 |
| Knicely Alley | Donham Avenue | 56.5 |
| McCullough Street | Holbrook Avenue | 56.5 |
| Holbrook Avenue | McCullough Street | 56.6 |
| Smith Street | Water Street | 56.6 |
| Kellogg Avenue | Lumsdon Street | 56.7 |
| Kenwood Avenue | Linneman Street | 56.7 |
| Linneman Street | Kenwood Avenue | 56.7 |
| Lumsden Street | Kellogg Avenue | 56.7 |
| Central Avenue | Mehring Way | 56.9 |
| Mehring Way | Central Avenue | 56.9 |
| Bryson Street | Waits Avenue | 57 |
| Croslin Street | Kenwood Avenue | 57.1 |

| | | |
|---|---|---|
| Keck Street | West Extention of Street | 57.1 |
| Kenwood Avenue | Croslin Street | 57.1 |
| Linneman Street | Waits Avenue | 57.1 |
| Baymiller Street | Mehring Way | 57.2 |
| Berte Street | Renslar Avenue | 57.2 |
| Mehring Way | Baymiller Street | 57.2 |
| Mehring Way | North Ramp, West of Stadium | 57.2 |
| Renslar Avenue | Berte Street | 57.2 |
| Haney Street | Waits Avenue | 57.3 |
| Mehring Way | Rose Street, (E.of) | 57.3 |
| Haney Street | Rohde Avenue | 57.4 |
| Rohde Avenue | Haney Street | 57.4 |
| Mehring Way | North Ramp, East of Stadium | 57.5 |
| Fifth Street | Freeman Avenue | 57.7 |
| Fifth Street | Mehring Way | 57.7 |
| Freeman Avenue | Fifth Street | 57.7 |
| Mayapple Street | Front Street, (S.of Eastern Avenue) | 57.7 |
| Mehring Way | Fifth Street | 57.7 |
| Carpenter Street, (E.of) | Southside Avenue | 57.8 |
| Eastern Avenue, (S.of) | Setchell Street | 57.8 |
| Mehring Way | Ramsey Street, (W.of) | 57.8 |
| Ramsey Street, (W.of) | Mehring Way | 57.8 |
| Setchell Street | Eastern Avenue, (S.of) | 57.8 |
| Southside Avenue | Carpenter Street, (E.of) | 57.8 |
| Gest Street | Mehring Way | 57.9 |
| Kellogg Avenue, (N.of) | Wilmer Avenue | 57.9 |
| Mehring Way | W. Second Street | 57.9 |
| Mehring Way | Smith Street | 57.9 |
| Rose Street, (W.of) | Second Street | 57.9 |
| W. Second Street | Gest Street | 57.9 |
| W. Second Street | Mehring Way | 57.9 |
| W. Second Street | Rose Street (W.of) | 57.9 |
| Smith Street | Mehring Way | 57.9 |
| Panama Street | Renslar Avenue | 58 |
| Renslar Avenue | Panama Street | 58 |
| Berte Street | Kenwood Avenue | 58.1 |
| Holbrook Avenue | Tennyson Street | 58.1 |
| Kenwood Avenue | Berte Street | 58.1 |
| Baymiller Street | Third Street | 58.2 |
| Bryson Street | Renslar Avenue | 58.4 |
| Renslar Avenue | Bryson Street | 58.4 |
| Central Avenue | Produce Drive | 58.5 |
| John Street | Water Street | 58.5 |
| Kellogg Avenue | Wilmer Avenue | 58.5 |
| Plum Street | Produce Drive | 58.5 |
| Produce Drive | Central Avenue | 58.5 |
| Produce Drive | Plum Street | 58.5 |
| Stanley Avenue | Wool Street | 58.5 |
| Freeman Avenue | Sargent Street | 58.6 |
| Rose Street | Second Street | 58.6 |

| | | |
|---|---|---|
| Sargent Street | Freeman Avenue | 58.6 |
| W. Second Street | Rose Street | 58.6 |
| Freeman Avenue | Sargent Street, (S.of) | 58.7 |
| Sargent Street, (S.of) | Freeman Avenue | 58.7 |
| Augusta Street | Ross Street | 58.8 |
| Augusta Street | Smith Street | 58.8 |
| Evans Street | River Road | 58.8 |
| River Road | Evans Street | 58.8 |
| Rose Street | Augusta Street | 58.8 |
| Smith Street | Augusta Street | 58.8 |
| Augusta Street | John Street | 58.9 |
| Corbin Street | Eastern Avenue, (S.of) | 58.9 |
| Eastern Avenue, (S.of) | Corbin Street | 58.9 |
| Eldorado Avenue | Haney Street | 58.9 |
| Haney Street | Eldorado Avenue | 58.9 |
| John Street | Augusta Street | 58.9 |
| Stadium Drive | Mehring Way | 58.9 |
| Croslin Street | Eldorado Avenue | 59 |
| Eldroado Avenue | Croslin Street | 59 |
| Berte Street | Waits Avenue | 59.1 |
| Bryson Street | Eldorado Avenue | 59.1 |
| Eldorado Avenue | Bryson Street | 59.1 |
| Kenwood Avenue | Panama Street | 59.1 |
| Panama Street | Kenwood Avenue | 59.1 |
| Augusta Street | Central AVenue | 59.2 |
| Beechmont Avenue Connection | Eastern Avenue | 59.2 |
| Central Avenue | Augusta Street | 59.2 |
| Croslin Street | Rhode Avenue | 59.2 |
| Eastern Avenue | Beechmont Ave.Connection (End of) | 59.2 |
| Rohde Avenue | Croslin Street | 59.2 |
| Main Street | Second Street | 59.3 |
| Panama Street | Reservoir Avenue | 59.3 |
| Reservoir Avenue | Panama Street | 59.3 |
| Broadway | Mehring Way | 59.4 |
| Elm Street | Second Street | 59.4 |
| Gas Alley | Second Street | 59.4 |
| Mehring Way | Broadway | 59.4 |
| W. Second Street | Gas Alley | 59.4 |
| W. Second Street | Gest Street, (E.of) | 59.4 |
| Kellogg Avenue | Two Mile Road | 59.5 |
| Eastern Avenue, (S.of) | Wenner Street | 59.6 |
| Commerce Street | Plum Street | 59.7 |
| Corrigan Alley | Plum Street | 59.7 |
| Gas Alley | Mehring Way | 59.7 |
| Mehring Way | Gas Alley | 59.7 |
| Mehring Way | Produce Court | 59.7 |
| Bryson Street | Kenwood Avenue | 59.8 |
| Kenwood Avenue | Bryson Street | 59.8 |
| Manser Alley | Sedam Street | 59.8 |
| Plum Street, (E.of) | Produce Drive | 59.8 |

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|---|---|---|
| Produce Drive | Plum Street, (E.of) | 59.8 |
| Sedam Street | Manser Alley | 59.8 |
| Mehring Way | Produce Drive | 59.9 |
| Plum Street | Corrigan Alley | 59.9 |
| Produce Drive | Mehring Way | 59.9 |
| Baymiller Street, (W.of) | Mehring Way | 60 |
| Berte Street | Eldorado Avenue | 60 |
| Congress Avenue | Kellogg Avenue | 60 |
| Eldorado Avenue | Berte Street | 60 |
| Kellogg Avenue | Congress Avenue | 60 |
| Mehring Way, (W.of) | Baymiller Street | 60 |
| W. Second Street | Elm Street | 60 |
| Eldorado Avenue | Linneman Street | 60.3 |
| Linneman Street | Eldorado Avenue | 60.3 |
| W. Second Street | Smith Street | 60.3 |
| Smith Street | Second Street | 60.3 |
| Central Avenue | Second Street | 60.4 |
| Rose Street, (E.of) | Mehring Way | 60.6 |
| Kellogg Avenue | Salem Road | 60.7 |
| Plum Street | Second Street | 60.7 |
| E. Second Street | Sycamore Street | 60.7 |
| Sycamore Street | Second Street | 60.7 |
| Butler Street, (E.of) | Front Street | 60.8 |
| Front Street | Butler Street, (E.of) | 60.8 |
| John Street | Second Street | 60.9 |
| W. Second Street | John Street | 60.9 |
| W. Second Street | Central Avenue | 61 |
| Pennsylvania Avenue | Kellogg Avenue | 61.1 |
| Race Street | Second Street | 61.3 |
| W. Second Street | South Ramp, East of Stadium | 61.5 |
| E. Second Street | Walnut Street | 61.6 |
| Second Street | Stadium Drive | 61.8 |
| Stadium Drive | Second Street | 61.8 |
| Donham Avenue, (W.of) | Mead Avenue | 61.9 |
| Mead Avenue | Donham Street, (W.of) | 61.9 |
| E. Second Street | South Ramp, West of Stadium | 61.9 |
| Pennsylvania Avenue, (W.of) | Kellogg Avenue | 62.1 |
| Hutton Street | Winter Street | 62.3 |
| Congress Avenue | Wool Street | 62.4 |
| Kellogg Avenue | Two Mile Road, (E.of) | 62.4 |
| Second Street | Broadway | 62.4 |
| Broadway | Second Street | 62.6 |
| Maag Street | River Road | 62.7 |
| River Road | Maag Street | 62.7 |
| Eggleston Avenue | Second Street | 62.8 |
| Kellogg Avenue | Pennsylvania Avenue | 63 |
| Pomeroy Street | Renslar Avenue | 63 |
| Renslar Avenue | Pomeroy Street | 63 |
| Austin Alley | Eastern Avenue | 63.2 |
| Eastern Avenue | Austin Alley | 63.2 |

| | | |
|---|---|---|
| E. Second Street | at Ramp East of Broadway | 63.3 |
| Columbia Parkway | Hoge Street | 63.6 |
| Hoge Street | Columbia Parkway | 63.6 |
| Gest Street | Third Street | 63.7 |
| Collard Street | Eastern Avenue | 63.8 |
| Eastern Avenue | Collard Street | 63.8 |
| Eastern Avenue Connection | Hutton Street | 63.9 |
| Hutton Street | Eastern Avenue Connection | 63.9 |
| Baymiller Street | Fifth Street | 64.2 |
| Burns Street | River Road | 64.2 |
| Fifth Street | Baymiller Street | 64.2 |
| River Road | Burns Street | 64.2 |
| Church Street | English Street | 64.4 |
| English Street | Church Street | 64.4 |
| English Street | River Road | 64.4 |
| River Road | English Street | 64.4 |
| Morris Place | Stanley Avenue | 64.8 |
| Stanley Avenue | Morris Place | 64.8 |
| Gest Street, (E.of) | Third Street | 64.9 |
| River Road | Cathcart Street | 65.2 |
| Eggleston Avenue | Third Street | 65.5 |
| Pennsylvania Avenue | Winter Street | 65.6 |
| Anderson Ferry Road | River Road | 65.7 |
| Corbin Street | Eastern Avenue | 65.7 |
| Eastern Avenue | Corbin Street | 65.7 |
| River Road | Anderson Ferry Road | 65.7 |
| Columbia Parkway | Strafer Street | 65.8 |
| Strafer Avenue | Columbia Parkway | 65.8 |
| Brown Street | Eastern Avenue | 65.9 |
| Eastern Avenue | Brown Street | 65.9 |
| Eastern Avenue | Setchell Street | 65.9 |
| Eastern Avenue | Stanley Avenue | 65.9 |
| Eastern Avenue | Watson Street | 65.9 |
| Kellogg Avenue | Rhode Avenue | 65.9 |
| Kellogg Avenue | Waits Avenue, (E.of) | 65.9 |
| Rohde Avenue | Kellogg Avenue | 65.9 |
| Rohde Avenue | Linneman Avenue | 65.9 |
| Setchell Street | Eastern Avenue | 65.9 |
| Stanley Avenue | Eastern Avenue | 65.9 |
| Beechmont Avenue | Bloor Street | 66 |
| Bloor Street | Beechmont Avenue | 66 |
| Eastern Avenue | Ridgley Street | 66 |
| Ridgely Avenue | Eastern Avenue | 66 |
| Collins Avenue | Eastern Avenue | 66.2 |
| Darby Road | River Road | 66.2 |
| Eastern Avenue | Collins Avenue | 66.2 |
| Eastern Avenue | Page Street | 66.2 |
| Page Street | Easter Avenue | 66.2 |
| River Road | Darby Road | 66.2 |
| Eastern Avenue | Gotham Place | 66.4 |

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|---|---|---|
| Gotham Place | Eastern Avenue | 66.4 |
| Muddy Creek Bridge | River Road | 66.5 |
| River Road | Muddy Creek Bridge | 66.5 |
| River Road | State Avenue | 66.6 |
| State Avenue | River Road | 66.6 |
| Eastern Avenue | Stow Place | 66.7 |
| Stow Place | Easter Avenue | 66.7 |
| Barkley Avenue | River Road | 66.9 |
| River Road | Barkley Avenue | 66.9 |
| Bayou Street | Eastern Avenue | 67 |
| Eastern Avenue | Bayou Street | 67 |
| Eastern Avenue | Wenner Street | 67 |
| Mt. Hope Avenue | River Road | 67 |
| River Road | Mt. Hope Avenue | 67 |
| River Road | Thorton Avenue | 67 |
| Eastern Avenue | Lumber Street | 67.2 |
| Lumber Street | Eastern Avenue | 67.2 |
| Old Rapid Run Road | River Road | 67.2 |
| River Road | Old Rapid Run Road | 67.2 |
| Eastern Avenue | Whittaker Street, (W.of) | 67.3 |
| Eastern Avenue | St. Peters Street | 67.4 |
| St. Peters Street | Eastern Avenue | 67.4 |
| Eastern Avenue | Parsons Street, (E.of) | 67.7 |
| Hampton Place | River Road | 67.7 |
| Parsons Street, (W.of) | Eastern Avenue | 67.7 |
| River Road | Hampton Place | 67.7 |
| Austin Alley, (E.of) | Eastern Avenue | 67.8 |
| Eastern Avenue | Austin Alley, (E.of) | 67.8 |
| Eastern Avenue | Lewis Street | 67.9 |
| Lewis Street | Eastern Avenue | 67.9 |
| Lilienthal Street | River Road | 67.9 |
| Monastery Street | Ramp J to Columbia Parkway | 67.9 |
| River Road | Lilienthal Street | 67.9 |
| Bloor Street | Kenilworth Place | 68 |
| Idaho Street | River Road | 68 |
| Kenilworth Place | Bloor Street | 68 |
| River Road | Idaho Street | 68 |
| Columbia Parkway | Stanley Avenue | 68.1 |
| Stanley Avenue | Columbia Parkway | 68.1 |
| River Road | Wisconsin Avenue | 68.2 |
| Broughton Street, (W.of) | Eastern Avenue | 68.3 |
| Eastern Avenue | Broughton Street, (W.of) | 68.3 |
| Burns Street | St. Michael Street | 68.4 |
| St. Michael Street | Burns Street | 68.4 |
| Eastern Avenue | Power Street | 68.6 |
| Ivanhoe Avenue | River Road | 68.6 |
| Power Street | Eastern Avenue | 68.6 |
| Revere Avenue | River Road | 68.6 |
| River Road | Ivanhoe Avenue | 68.6 |
| River Road | Revere Avenue | 68.6 |

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|---|---|---|
| Baymiller Street | Carlisle Street | 68.7 |
| Carlisle Avenue | Baymiller Street | 68.7 |
| Eastern Avenue | Ferry Street | 68.8 |
| Ferry Street | Eastern Avenue | 68.8 |
| McGinnis Avenue | River Road | 68.9 |
| River Road | McGinnis Avenue | 68.9 |
| Dart Street | River Road | 69.1 |
| River Road | Dart Street | 69.1 |
| Cathcart Street | River Road | 69.2 |
| Congress Avenue | Eastern Avenue | 69.2 |
| Easter Avenue | Congress Avenue | 69.2 |
| Kellogg Avenue | Waits Avenue | 69.2 |
| Eastern Avenue | Foster Street | 69.3 |
| Foster Street | Eastern Avenue | 69.3 |
| Mehring Way | E. Second Street | 69.3 |
| E. Second Street | Mehring Way | 69.3 |
| Cist Street | Gracely Drive | 69.6 |
| Delta Avenue | Eastern Avenue (S.) | 69.6 |
| Eastern Avenue, (S) | Delta Avenue | 69.6 |
| Gracely Drive | Cist Street | 69.6 |
| McWilliams Street | River Road | 69.6 |
| River Road | McWilliams Street | 69.6 |
| Ivanhoe Avenue | Nokomis Avenue | 69.8 |
| Nokomis Avenue | Ivanhoe Avenue | 69.8 |
| Hartman Street | Sedam Street | 69.9 |
| Sedam Street | Hartman Street | 69.9 |
| Eldorado Avenue | Kellogg Avenue | 70 |
| Kellogg Avenue | Eldorado Avenue | 70 |
| Delhi Avenue | Manser Alley | 70.1 |
| Manser Alley | Delhi Avenue | 70.1 |
| Broad Street | Ham Alley | 70.2 |
| Ham Alley | Broad Street | 70.2 |
| Leland Avenue | River Road | 70.2 |
| River Road | Leland Avenue | 70.2 |
| Elco Street | River Road | 70.4 |
| River Road | Elco Street | 70.4 |
| Butler Street | Pearl Street | 70.5 |
| Delta Avenue | Eastern Avenue (N.) | 70.5 |
| Delta Avenue | Walworth Avenue | 70.5 |
| Eastern Avenue, (N) | Delta Avenue | 70.5 |
| E. Second Street | Central Bridge Approach | 70.5 |
| Fourth Street | Gest Street | 70.7 |
| Gest Street | Fourth Street | 70.7 |
| Gracely Drive | Revere Avenue | 70.7 |
| Revere Avenue | Gracely Drive | 70.7 |
| Beechmont Levee | | 71 |
| Monitor Avenue | River Road | 71 |
| River Road | Monitor Avenue | 71 |
| Ham Alley | Reed Street | 71.1 |
| Reed Street | Ham Alley | 71.1 |

| | | |
|---|---|---|
| Rose Street | Third Street | 71.1 |
| Eastern Avenue | Power Street, (W.of) | 71.2 |
| Power Street, (W.of) | Eastern Avenue | 71.2 |
| River Road | Wilkins Short Road | 71.2 |
| Eastern Avenue | Kelly Alley | 71.5 |
| Kelley Alley | Eastern Avenue | 71.5 |
| Fairbanks Avenue | River Road | 71.6 |
| River Road | Fairbanks Avenue | 71.6 |
| Edgar Street | River Road | 71.9 |
| River Road | Edgar Street | 71.9 |
| Eastern Avenue | Strader Avenue | 72 |
| Strader Avenue | Eastern Avenue | 72 |
| Culvert Street | Third Street | 72.2 |
| Maryland Avenue | River Road | 72.4 |
| River Road | Maryland Avenue | 72.4 |
| Kellogg Avenue | Bridge Over Little Miami River | 72.5 |
| Anderson Ferry Road | Dennison Street | 72.8 |
| Dennison Street | Anderson Ferry Road | 72.8 |
| Carroll Street | Pennslvania R.R., (N.of) | 72.9 |
| Handman Avenue | Hoge Street | 72.9 |
| Hoge Street | Handman Avenue | 72.9 |
| Pennsylvania R.R., (N.of) | Carroll Street | 72.9 |
| Delhi Avenue | River Road | 73 |
| Gracely Drive | East of Ivanhoe Avenue | 73 |
| Ivanhoe Avenue, (E.of) | Gracely Drive | 73 |
| River Road | Delhi Avenue | 73 |
| Eastern Avenue | Hazen Street | 73.1 |
| Eastern Avenue | Merivale Street | 73.1 |
| Eastern Avenue | Miami Avenue | 73.1 |
| Eggleston Avenue | Fourth Street | 73.1 |
| Fourth Street | Eggleston Avenue | 73.1 |
| Hazen Street | Eastern Avenue | 73.1 |
| Merivale Street | Eastern Avenue | 73.1 |
| Miami Avenue | Easter Avenue | 73.1 |
| Eggleston Avenue, (E.of) | Second Street | 73.2 |
| Carroll Street | Pennsylvania R.R. | 73.3 |
| McCullough Street | Pennsylvania R.R. | 73.3 |
| Pennsylvania R.R. | Carroll Street | 73.3 |
| Pennsylvania R.R. | McCullough Street | 73.3 |
| Mt. Echo Road | River Road | 73.7 |
| River Road | Mt. Echo Road | 73.7 |
| Pennsylvania R.R. | Tennyson Street | 73.8 |
| Eastern Avenue | Lancaster Street | 73.9 |
| Lancaster Street | Eastern Avenue | 73.9 |
| Baymiller Street | Sixth Street | 74.1 |
| Columbia Parkway | Stanley Avenue. (E.of) | 74.1 |
| Eastern Avenue | Columbia Pkwy.Ramp (NE Russel St) | 74.1 |
| Sixth Street | Baymiller Street | 74.1 |
| Stanley Avenue, (E.of) | Columbia Parkway | 74.1 |
| Corbin Street, (W.of) | Eastern Avenue | 74.4 |

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|---|---|---|
| Eastern Avenue | Corbin Street, (W.of) | 74.4 |
| Fifth Street | Stone Street | 74.4 |
| Kenwood Avenue | Pomeroy Street | 74.4 |
| Pomeroy Street | Kenwood Avenue | 74.4 |
| Stone Avenue | Fifth Street | 74.4 |
| Smith Street | Third Street | 74.7 |
| McCullough Street | Pennsylvania R.R., (N.of) | 74.8 |
| Pennsylvania R.R., (N.of) | McCullough Street | 74.8 |
| Eastern Avenue | Columbia Pkwy.Ramp (W.Beechmont Ave) | 74.9 |
| Eastern Avenue | Kemper Lane, (S. of) | 75 |
| Eastern Avenue | Vance Street | 75 |
| Edward Waldvogel Mem. Via. | Neave Street | 75 |
| Kemper Lane, (S.of) | Eastern Avenue | 75 |
| Neave Street | Edward Waldvogel Memorial Viaduct | 75 |
| Ansonia Avenue | River Road | 75.1 |
| Culvert Street | Fourth Street | 75.1 |
| Fourth Street | Culvert Street | 75.1 |
| Ivanhoe Avenue | Revere Avenue | 75.1 |
| Kellogg Avenue | Kenwood Avenue | 75.1 |
| Kenwood Avenue | Kellogg Avenue | 75.1 |
| Revere Avenue | Ivanhoe Avenue | 75.1 |
| River Road | Ansonia Avenue | 75.1 |
| Eastern Avenue | Foster Street, (E.of) | 75.2 |
| Foster Street, (E.of) | Eastern Avenue | 75.2 |
| English Street | Neave Street | 75.4 |
| Koehler Street | Renslar Avenue | 75.4 |
| Neave Street | English Street | 75.4 |
| Renslar Avenue | Koehler Street | 75.4 |
| Delta Avenue | Empress Street | 75.5 |
| Delta Avenue | Widman Place | 75.5 |
| Eastern Avenue | Third Street | 75.5 |
| Empress Street | Delta Avenue | 75.5 |
| Archer Avenue | Leonard Street (S.of) | 75.6 |
| Eastern Avenue | Waldon Street, (E.of) | 75.6 |
| Leonard Street, (S.of) | Archer Street | 75.6 |
| Hutton Street | Morse Street | 75.8 |
| Morse Street | Hutton Street | 75.8 |
| Fenimore Street | River Road | 75.9 |
| River Road | Fenimore Street | 75.9 |
| Cutter Street | Fourth Street | 76.2 |
| Fourth Street | Cutter Street | 76.2 |
| Church Street | St. Michael Street | 76.3 |
| St. Michael Street | Church Street | 76.3 |
| Columbai Parkway(N.of) | Delta Avenue | 76.6 |
| Delta Avenue | Columbia Parkway (N.of) | 76.6 |
| Donham Avenue, (W.of) | Eastern Avenue | 76.6 |
| Eastern Avenue | Donham Avenue, (W. of) | 76.6 |
| Eastern Avenue | Tusculum Avenue | 76.6 |
| John Street | Third Street | 77.4 |
| Morse Street | Pennsylvania Avenue | 77.4 |

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|---|---|---|
| Pennsylvania Avenue | Morse Street | 77.4 |
| Neave Street | St. Michael Street | 77.7 |
| St. Michael Street | Neave Street | 77.7 |
| Kirkwood Lane | Lowland Road | 77.9 |
| Lowland Road | Kirkwood Lane | 77.9 |
| Smith Street, (W.of) | Fourth Street | 78.6 |
| Cutter Street, (E.of) | Fourth Street | 78.7 |
| Fourth Street | Cutter Street, (E.of) | 78.7 |
| Ingall Street, (W.of) | Lilienthal Street | 78.8 |
| Lilienthal Street | Ingall Street, (W.of) | 78.8 |
| Baymiller Street | Hathaway Street | 79 |
| Hathaway Street | Baymiller Street | 79 |
| Eastern Avenue | Miami Avenue, (E.of) | 79.2 |
| Miami Avenue, (E.of) | Eastern Avenue | 79.2 |
| Beechmont Avenue. (E.of) | Easter Avenue | 79.3 |
| Eastern Avenue | Beechmont Avenue, (E.of) | 79.3 |
| Hoge Street | Widman Place | 79.5 |
| Neave Street | Storrs Street | 79.5 |
| Storrs Avenue | Neave Street | 79.5 |
| Eastern Avenue | Tennyson Street | 79.8 |
| Leland Avenue | Lilienthal Street | 79.8 |
| Lilienthal Street | Leland Avenue | 79.8 |
| River Road | Striker Avenue, (E.of) | 79.8 |
| Striker Avenue, (E.of) | River Road | 79.8 |
| Donham Avenue | Eastern Avenue | 79.9 |
| Eastern Avenue | Donham Avenue | 79.9 |
| River Road | Steiner Street | 79.9 |
| Steiner Avenue | River Road | 79.9 |