

EMERGENCY PREPAREDNESS

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In the previous sections, impacts from specific symptoms of climate change have been addressed. When considered together, these environmental hazards – floods, heat waves, droughts, deteriorated air, and water quality – have the potential to lead to a greater number of natural disasters in our community. In addition to the changing climate, increases in urbanization, population, and poverty add to the rising disaster risk. According to the FCEM&HS *Risk Assessment for Franklin County 2016*, all of the noted environmental hazards are among the 19 threats and hazards that have been evaluated for Franklin County.¹ Fortunately, only three risks related to environmental hazards were ranked among the top 10: Flooding (4), Dam Failure (6), and Utility/Energy Interruption or Failure (7). A fourth risk, Severe Winter Weather (9) is likely to remain even in a warmer world as an enhanced water cycle may produce large, crippling snow and ice storms and variability in winter temperatures may cause infrastructure damage. Still, it is necessary to ensure that Columbus communities are best prepared to handle the immediate and long-term effects of the potential disasters that result from these hazards.

The actions proposed in this section support the idea that preparedness is the best way to manage the effects of a natural disaster. The best prepared communities are not only able to mitigate and withstand disasters, but they also have plans in place to make sure that the recovery process is as smooth as possible. The three proposed necessary actions cover the three main phases that lead to a resilient community: (1) understanding which people and infrastructure will be most affected and developing strategies that will protect them, (2) educating and training everyone that is involved in

¹ “Risk Assessment for Franklin County 2016.” *Franklin County Emergency Management and Homeland Security*. <https://fcmhs.org/Planning/Risk-Management>. Accessed Jan. 2018.

disaster response, and (3) ensuring a swift and effective recovery plan. Many of the aspirational actions discussed in this chapter focus on public involvement in disaster preparedness as well. Whether it is through new hazard alert tools, creating Community Health Action Teams (CHATs), or increasing public awareness regarding the costs associated with environmental hazards, it is critical that everyone in the community play a role. Through these actions, we can ensure that Columbus will be best suited to deal with the potential hazards projected to affect our community.

N16. USE GIS TO MAP FIXED CRITICAL ASSETS AND VULNERABLE POPULATIONS SUSCEPTIBLE TO ENVIRONMENTAL HAZARDS

As was noted in other sections of this document, Columbus should develop GIS tools that tag critical assets, transportation infrastructure, and vulnerable populations, allowing this information to be used for planning, queried during emergencies, and shared with appropriate stakeholders. GIS resources should be used to identify both critical assets (e.g., hospitals, fire stations, shelters, and distribution centers) and transportation routes (e.g., primary and secondary routes and alternates). For instance, AEP currently prioritizes facilities, such as hospitals, for re-establishment of service when there is an outage. A tool identifying critical city facilities, such as fire stations and shelters, would allow utilities to also prioritize these locations. The GIS tool should identify critical routes, not just major arteries but also roads in close proximity to hospitals or those that serve as solitary routes between shelters and emergency services. During the windstorm of 2008 resulting from the remnants of Hurricane Ike, Columbus experienced significant electrical service outages and road closures due to downed trees.² Transportation routes, including some major arteries, were unusable for days after the storm. The proposed tool should identify neighborhoods that are likely to be isolated under various scenarios, flooding being the easiest to anticipate. Once developed, utilities could be invited to review the GIS tool and provide feedback about facilities and routes based on their knowledge of the surrounding infrastructure. Also of note, the ODOT Infrastructure Resiliency Plan recently identified transportation infrastructure that is most at risk due to climate change; information from this report relevant to transportation in Columbus should be included within the city's GIS tool.³

Particularly vulnerable populations, such as those in close proximity to a floodplain or those unlikely to relocate due to inaccessibility, should be identified on the GIS tool. Thus, transportation can be arranged if the impacts of the environmental hazard overlap with the vulnerable population. COTA should be engaged in planning as many of their assets would be critical to moving people, if not on normal routes under special arrangements. Similar arrangements have provided free transportation for the public when the city is under certain levels of snow emergency.⁴ In addition to moving people, plans need to be in place to provide transportation and logistics for critical resources, such as medical supplies and bottled water. In the case of a large-scale, regional event, plans should make considerations for procurement of supplies from outside the region via reliable transportation routes. Knowledge of these

² "Wind storm leaves 1 million without power in Ohio." *The Columbus Dispatch*. Sep. 15, 2008. <http://www.dispatch.com/content/stories/local/2008/09/15/million.html>. Accessed Jan. 2018.

³ Ohio Department of Transportation. Division of Planning. Office of Environmental Services. "Ohio DOT Infrastructure Resiliency Plan." May 6, 2016. <https://tinyurl.com/yacpj8aj>. Accessed Jan. 2018.

⁴ "Winter Weather." *Central Ohio Transit Authority*. <https://www.cota.com/rider-service-alerts/winter-weather/>. Accessed Jan. 2018.

prioritized transportation routes could inform subsequent city investment in infrastructure such as LED street lights and traffic controls with battery backup.

During disaster events, such as floods, it may become necessary to protect citizens by moving or relocating them from areas of the county which are threatened to areas which are more secure. Conducting these types of movement are directed by the Franklin County Engineer's Office and COTA, with support from other agencies and transportation industry entities, through Emergency Support Function 1 (ESF1) Transportation of the Franklin County Emergency Operations Plan.⁵ ESF1 also includes the City of Columbus Downtown Evacuation Plan and the MORPC Evacuation Framework.^{6,7} Transportation encompasses all transit surface modes, including land-based wheeled vehicles, trucks, and buses traveling on streets, roads, highways, and bridges; air travel, rail routes; transportation infrastructures (roads, routes, and bridges) and assets that move people and supplies in and out of Franklin County.

GIS staff knowledgeable in the tools that have been developed should be available during the entirety of an emergency to provide information to decision makers and emergency services in addition to being able to generate updated maps to share with the public. For instance, in July 2016, Columbus issued a warning for high nitrates in drinking water in a portion of the region.⁸ The city was able to quickly post a map to its website, which was subsequently distributed to media outlets, showing the affected properties. The ability to efficiently generate such products, both for emergency responders and the public, is underpinned by robust GIS tools.

Some facets of the GIS tool to map fixed critical assets and vulnerable populations has already been created by FCEM&HS and the Franklin County Emergency Operations Center staffs a GIS position for generation of real-time maps. Since this agency already handles emergency preparedness and response for Columbus, in addition to other jurisdictions, it makes sense to determine what partnership between the City of Columbus or FCEM&HS can best fulfill various parts of this effort, how information can flow between the city and county, and how duplication of services can be avoided.

N17. REVIEW INTERAGENCY AND CITY-WIDE TRAINING AND RESPONSE TO ENVIRONMENTAL HAZARD EMERGENCIES

N18. EVALUATE CAPACITY TO CLEAN UP, RESTORE SERVICES, AND CARE FOR CITIZENS FOLLOWING ENVIRONMENTAL EMERGENCIES

The timeline of onset varies by hazard. Air quality and drought have relatively long onsets, floods and heat waves have relatively short onsets, and water quality has a relatively long onset that can manifest as an acute problem with a toxic algal bloom. Nonetheless, plans should be developed, and training should be completed, well in advance of an emergency. Environmental hazard emergencies currently prompt responses from various agencies:

⁵ Franklin County Emergency Management and Homeland Security. *"Franklin County Emergency Operations Plan."* Document not available to the general public.

⁶ City of Columbus. *"Downtown Evacuation."*

<https://www.columbus.gov/WorkArea/DownloadAsset.aspx?id=15442>. Accessed Jan. 2018.

⁷ Mid-Ohio Regional Planning Commission. *"The Planning Framework for the Evacuation of the Transportation Needs Populations of Central Ohio."* Sept. 30, 2010.

⁸ Lori Kurtzman. "City of Columbus issues nitrate warning for tap water." *The Columbus Dispatch*. Jul. 1, 2016. <http://www.dispatch.com/content/stories/public/2016/0630-city-issues-nitrate-warning.html>. Accessed Jan. 2018.

Air Quality: MORPC and OEPA

Drought: OEMA and Columbus Division of Water

Flood: NWS and OEMA

Heat Waves: NWS and OPH

Water Quality: Columbus Division of Water and FCPH

FCEM&HS currently keeps a Training and Exercise Plan into which training for environmental hazard emergencies could be incorporated. Including such training in the county planning brings greater awareness to the threat of environmental hazards, reduces the likelihood of training being neglected, and allows this training to be incorporated with other programs already in place.

In addition, severe floods and heat waves might necessitate local emergency services and severe heat waves and water quality emergencies might necessitate local emergency services and deployment of the Ohio National Guard by the Ohio Governor's Office. Responses need to be well-planned and calibrated to the severity of the event. Coordination needs to occur between city departments and external agencies. During an event, incident management structure should be established between city leadership to facilitate communication and decision-making. FCEM&HS already serves as the emergency management agency for the City of Columbus and 41 other jurisdictions in Franklin County, streamlining communication between local municipalities and state agencies.

Once the emergency has ended and basic services have been restored, much of the long-term work of clean up, restoring services, and caring for citizens falls to the city. In the case of particularly damaging events, a disaster declaration at the state or federal level can bring additional long-term support. Services such as but not limited to debris removal, food and water distribution, and establishment of temporary shelters, when in context of a disaster, are coordinated through the Franklin County Emergency Operations Center as written in the Franklin County Emergency Operations Plan.⁹ With regard to flooding, postmortem analyses of the emergency response and post event actions taken by Nashville in 2010 and Houston in 2017 could inform planning.^{10,11,12} Likewise, Chicago in 1995 and Toledo in 2014 are cases to examine for emergency response to heat and water quality, respectively.^{13,14},¹⁵ Chicago is a case of how planning and decision making broke down and led to tragic consequences.

⁹ Franklin County Emergency Management and Homeland Security. "Franklin County Emergency Operations Plan." Document not available to the general public. REPEATED

¹⁰ Karen Grigsby. "20 things to know about the 2010 Nashville flood." *Tennessean*. Apr. 30, 2015. <http://www.tennessean.com/story/news/local/2015/04/30/nashville-flood-20-things-to-know/26653901/>. Accessed Jan. 2018.

¹¹ Tom Wilemon. "5 years after epic flood, Nashville at risk to repeat." *USA Today*. May 3, 2015. <https://www.usatoday.com/story/news/nation/2015/05/03/nashville-flood-anniversary/26832927/>. Accessed Jan. 2018.

¹² Neena Satija and Kiah Collier. "Houston's flood czar says Harvey has brought the city to a decision point on flood control." *The Texas Tribune*. Sep. 15, 2017. <https://www.texastribune.org/2017/09/13/follow-conversation-houstons-flood-czar/>. Accessed Jan. 2018.

¹³ Eric Klinenberg. *Heat wave: a social autopsy of disaster in Chicago*. (Chicago: University of Chicago Press, 2002).

¹⁴ "Toledo's Water Crisis." *The Blade*. <http://www.toledoblade.com/watercrisis>. Accessed Jan. 2018.

¹⁵ Tom Henry. "Town hall makes 3rd anniversary of Toledo's water crisis." *The Blade*. Aug. 2, 2017. <http://www.toledoblade.com/local/2017/08/02/Town-hall-to-mark-3rd-anniversary-of-water-crisis.html>. Accessed Jan. 2018

A19. TRACK AND COMMUNICATE COSTS ASSOCIATED WITH PREPARING FOR AND RESPONDING TO ENVIRONMENTAL HAZARDS

While failure to mitigate and adapt to climate change can, on the surface level, appear to be free of costs, individuals working in the climate resilience community know that expenses are paid over the long-term rather than immediately. Without an appreciation for the number and magnitude of changes and inertia in the climate system, it is easy to discount the inevitable cost to communities and individuals. In order to understand the full costs of responding to environmental hazards, expenses associated with both preparing for and responding to these events should be tracked. Knowing these expenses allows policy makers and planners to better understand long-term costs associated with the decisions they are making. As additional cost information is collected over time, policies and plans, in addition to funding allocations, can be adjusted accordingly.

In a budgetary sense, costs within specific departments of city government should have options of being tagged as associated with responding to particular threats, of which climate change is one. During reporting periods, department and city leadership would be able to examine costs not just by department but by tagged themes that extend between multiple departments. Similarly, if all planning for climate change adaptation was paid by one budget allocation that needed to be divided among a number of departments, portions could then be tracked and linked with results to provide for accountability. Expenses for responding to emergencies would be a bit more complex with the necessary step of rating various emergencies and disasters as being fully or partly attributable to climate change. The city could elect to also track metrics, like costs incurred by the private sector and the percentage of those that were insured versus uninsured. If the city is unable to track costs associated with preparing for and responding to environmental hazards, weather hazards could be substituted as these are likely to be more readily tracked in both the public and private sectors. FCEM&HS has a procedure and federal forms that are required for tracking costs related with events that rise to the level of a disaster. For significant events, these procedures and documents could be used to estimate costs. For smaller events, the procedures and documents might provide the city with guidance on what could be efficiently tracked.

Examples of costs that could be tracked include the city's contingency contract for \$1 million for reagents and \$3 million for upgrades to a water treatment facility to address taste associated with algal blooms.¹⁶ These blooms are expected to become more common under a warming climate.¹⁷ In addition, we have seen neighborhood flooding associated with increasingly common intense rainfall events, such as the event that struck near Ohio State in July 2017 and resulted in the flooding of High Street and stranding of vehicles.¹⁸ In this case, the costs fell on stranded motorists and businesses along High Street.

Costs associated with preparing for and responding to environmental hazard emergencies should be communicated with the public to maintain transparency and capitalize on an opportunity to

¹⁶ Lucas Sullivan. "Columbus earmarks \$1 million to fight smelly water." *The Columbus Dispatch*. Nov. 23, 2014. <http://www.dispatch.com/article/20141123/NEWS/311239753>. Accessed Jan. 2018.

¹⁷ D. Cressey. "Climate change is making algal blooms worse." *Nature*, (2017): <https://www.nature.com/news/climate-change-is-making-algal-blooms-worse-1.21884>. Accessed Jan. 2018

¹⁸ Kayla Beard. "Flooding from onslaught of storms forces evacuations." *The Columbus Dispatch*. Jul. 13, 2017. <http://www.dispatch.com/news/20170713/flooding-from-onslaught-of-storms-forces-evacuations>. Accessed Jan. 2018.

educate individuals, business, and organizations about planning for resilience. Sharing this information could also help dispel the myth held by some individuals that inaction on climate change comes at no cost. Information could be shared online or curated for inclusion in an annual report.

A20. ESTABLISH CONTINGENCY CONTRACTS SO THAT SUFFICIENT RESOURCES ARE AVAILABLE IN CASE OF ENVIRONMENTAL HAZARD EMERGENCIES

Based on the capacity to clean up, restore services, and care for citizens following environmental emergencies, contingency contracts should be established for services and assets that the city might need but otherwise might not be readily available. These contracts have pre-negotiated costs for procurement of particular services or assets, with included delivery schedules. In many cases, there are primary and secondary suppliers to hedge against disruptions to supply chains. Examples of contracts appropriate for environmental hazard emergencies include, but are not limited to, sandbags, bottled water, generators, and technical services for repair of HVAC and pumping systems. Each environmental hazard plan should account for services and assets that will be needed so that contracts can be established well in advance of an emergency.

With emergencies for which the city will seek reimbursement from FEMA, it is important to remember that procurement rules from FEMA must be followed. Under these rules, pre-negotiated contracts may be utilized during an emergency (with justification of the emergency), but regular procurement procedures must be reverted to once the emergency has ended. Regular procurement procedures also require that the most restrictive procurement process be followed, regardless of whether it is at the local or federal level. FCEM&HS and OEMA have extensive knowledge of assets available from state and federal agencies and experience with planning and procurement for emergencies.

A21. DEVELOP NEW APP OR INTEGRATE WITH EXISTING APP FOR ENVIRONMENTAL HAZARD ALERTS

Digital tools are allowing individuals to receive timely and customizable information during emergencies and provide updates to emergency services, in essence streamlining the flow of information in both directions. Over the past few years, we have seen mobile applications gain popularity for such tasks as neighborhood communication to real-time traffic alerts. During the recent flooding in Houston, we saw some mobile applications emerge as novel communication vehicles between citizens and first responders when traditional communications vehicles (e.g., phone and emergency alerts) broke down. With cellular phone access at 95% and smartphone access 77% in the United States and the resilience of the cellular network being demonstrated in circumstances such as Hurricane Harvey, mobile apps can serve as a robust communication tool in emergencies.¹⁹ Alert Franklin County is an app already developed and available for all Franklin County residents.²⁰

CHAPTER INSET: While there have been considerable improvements to emergency communication during disasters in the United States over the past decade, additional changes that have been requested by emergency managers and have been deployed elsewhere in the world have yet to become standard in the United States. For instance, the FCC does not require wireless carriers to direct wireless emergency alerts to specific, geographically targeted recipients. This is particularly important

¹⁹ "Internet and Technology: Mobile Fact Sheet." *Pew Research Center*. <http://www.pewinternet.org/fact-sheet/mobile/>. Accessed Jan. 2018.

²⁰ "Alert Franklin County. Emergency Notification System." <https://alertfranklincounty.org/>. Accessed Jan. 2018.

when individuals in two adjacent locations need to be given different instructions, such as individuals in one location needing to shelter in place while individuals in an adjacent location need to evacuate. Likewise, wireless emergency alerts do not allow inclusion of images, such as photographs or maps, that might be useful to recipients.²¹ While mobile carriers were able to preposition fuel for backup generators, portable cell sites, and additional assets during Hurricane Harvey, individuals that called 911 often received busy signals or long hold times as there was not sufficient capacity to answer calls. While this was an improvement from Hurricane Katrina, when much of the cellular network was incapacitated, overloaded 911 call centers could be alleviated by allowing excess calls to be distributed to other locations, potentially outside disaster zones, where additional infrastructure and staffing is present to absorb the demand.²²

The City of Columbus currently has a mobile application, MyColumbus, designed to provide information to residents and serve as a conduit to submit 311 requests.²³ Rather than create another mobile application for hazard alerts, the city should build on the MyColumbus platform. Additional features, either coded from scratch or resulting from integration with third party systems, can be added while maintaining the current audience. With one location for information, the city can prioritize what is displayed during emergencies to draw attention to particular resources. Rather than wait for an emergency to curate information with which to populate the app, content collections should be created for each environmental hazard with pre-established templates. These templates, developed for the target audiences of the information, will thus be readily deployable during emergencies. Alerts can take advantage of GPS technology within smartphones to target information to individuals within a hazard zone. Information provided to users can include the hazard details, timing, and recommended actions. This system also eases the ability of emergency service to receive information from individuals within these zones. Columbus needs to carefully consider the role of MyColumbus and its websites during an emergency. Because many of the environmental hazard emergencies extend beyond city boundaries and FCEM&HS is the emergency management agencies for the city, it might be best to utilize the website of FCEM&HS and Alert Franklin County as the default websites and mobile applications for communication during an emergency. City websites and the MyColumbus app could all include a header to point visitors seeking out emergency information to those sites.

Any digital solutions will require regular maintenance and updating of features to remain secure and relevant. Likewise, similar to GIS services, staff needs to be on call during an emergency to assist with content curation and note areas for improvement. FCEM&HS is best positioned to deliver these continually evolving services. Since not everyone has access to a smartphone, especially among some vulnerable populations, more traditional methods of communication (television, radio, text alerts, etc.) will still need to be maintained for the foreseeable future. Thus, mobile applications are not a panacea for emergency communication. Similarly, there is a growing body of knowledge in the social science research community that individuals in disaster situations, such as hurricanes and flash floods, do not

²¹ Tom Wheeler. "Hurricane Harvey shows it is time for FCC to improve emergency alerts." <https://www.brookings.edu/blog/techtank/2017/09/06/harvey-hurricane-shows-it-is-time-for-fcc-to-improve-emergency-alerts>. Accessed Jan. 2018.

²² Issie Lapowsky. "Harvey Shows Progress on Emergency Communications Since Katrina." <https://www.wired.com/story/harvey-shows-progress-on-emergency-communications-since-katrina>. Accessed Jan. 2018.

²³ "MyColumbus." *City of Columbus, Department of Technology*. <https://www.columbus.gov/technology/innovation/Mobile-Application>. Accessed Jan. 2018.

respond to emergency notifications in ways that would be expected.^{24,25} Therefore, effective communication should take into account how people receive and respond to these messages. For instance, during the flash floods in California in January 2018, only 10-15% of residents in Santa Barbara County evacuated when told to do so, suggesting that there was a disconnect between the messaging and the desired behavior.²⁶

A22. WORK WITH COMMUNITY HEALTH ACTION TEAMS (CHATs) FOR ENVIRONMENTAL HAZARDS

Community Health Action Teams (CHATs) partner with FCPH to address specific health issues facing a particular community. Based on the idea that the people in the community have the most knowledge regarding the issues they face, these organizations are led by community members representing several different sectors (e.g., teachers, business leaders, faith-based leaders, doctors). The goal for the CHATs is to identify the most impactful health issues, and then create a plan of action that both creates awareness and begins to address the problem. Through these programs, communities can ensure that they are engaged with health planning for their residents. Currently, there are five CHATs in Franklin County, dealing with issues ranging from increasing healthcare coverage in Whitehall, to senior health in Grandview Heights and Marble Cliff, to healthy eating behaviors and physical fitness in Prairie Township.²⁷

One of the major benefits of having community members lead these CHATs is that they help shape the messaging of the information so that it is personal and most effective for that community. Therefore, they provide a potential opportunity to raise awareness on environmental hazards and the ways in which climate change can impact public health. This can be done by either partnering with an existing CHAT or creating a new one that focuses on environmental health issues. For example, information regarding the ways in which seniors are disproportionately affected by heat-related illnesses and death could be disseminated through a partnership with the Grandview Heights and Marble Cliff CHAT. With either option, this action can help create a better understanding of environmental issues throughout Columbus communities, and it could be one aspect of the many educational campaigns proposed throughout this document.

A23. IMPLEMENT EDUCATIONAL CAMPAIGN TO INFORM THE PUBLIC ABOUT INSURANCE AND OTHER SHARED RISK PROGRAMS AVAILABLE FOR ENVIRONMENTAL HAZARDS

The public is likely not aware of risks associated with deteriorated air and water quality, floods, heat waves, and droughts, or ways to insure themselves for personal, business, and organizational losses. Probably the best known program for shared risk is the National Flood Insurance Program (NFIP).

²⁴ R. E. Morss, R. E., K. J. Mulder, J. K. Lazo, and J. L. Demuth. "How do people perceive, understand, and anticipate responding to flash flood risks and warnings? Results from a public survey in Boulder, Colorado, USA." *Journal of Hydrology* 541, (2016): 649-664. <http://dx.doi.org/10.1016/j.jhydrol.2015.11.047>. Accessed Jan. 2018.

²⁵ C. L. Cuite, R. L. Shwom, W. K. Hallman, R. E. Morss, and J. L. Demuth. "Improving coastal storm evacuation messages." *Weather, Climate, and Society* 9, (2017): 155-170. <https://doi.org/10.1175/WCAS-D-16-0076.1>.

²⁶ Merrit Kennedy. "Thousands Evacuate In Southern California As Mudslides Turn Deadly." *National Public Radio*. Jan. 9, 2018.

<https://www.npr.org/sections/thetwo-way/2018/01/09/576743025/after-fires-thousands-evacuate-in-southern-calif-over-risk-of-mudslides>. Accessed Jan. 2018.

²⁷ "Community Health Action Teams." *Franklin County Public Health*.

<http://franklin.oh.networkofcare.org/ph/content.aspx?id=6012>. Accessed Jan. 2018.

²⁸ Depending on the type of loan sought by a homeowner and the home's location relative to an established floodplain, lenders require homeowners to purchase a policy from the NFIP. But, the current program is underfunded, not all property owners understand its limitations, and the nature of the program often incentivizes property owners rebuilding on the same site without significant design changes. With climate change increasing the frequency and intensity of extreme rainfall events, we are seeing events more often than would be expected by historical standards.²⁹ While, there has been a recent effort to update floodplain maps to better reflect the best available science, the process is costly and contentious. Without access to updated information, property owners are therefore bound to make decisions based on understated risk. Likewise, costs associated with supplemental insurance and trends in rate structures must be considered when accounting for comprehensive long-term costs.

Each of these environmental hazards - deteriorated air and water quality, floods, heat waves, and droughts - would impact individuals, business, and organizations in different ways. Therefore, an educational campaign needs to target particular audiences, communicate information in formats tailored to those audiences, and offer solutions appropriate to audience needs. For instance, deteriorating air quality would be a cost borne by individuals and hospitals. While individuals could reduce their risk through behaviors, such as when to go outdoors and what strenuous activity to perform, costs associated with reduced air quality, such as visits by individuals to emergency departments, would be paid through health insurance. Individuals without health insurance personally bear the costs or transfer the costs to hospitals through unpaid or underpaid bills. Heat waves, droughts, and deteriorating water quality are risks to businesses in particular sectors. For instance, a heatwave or drought could increase costs for plant nurseries. A regional water quality emergency could result in the temporary closure of food processors, restaurants, and businesses associated with tourism. In each of these cases, individuals and groups need to take steps to understand, reduce, and pool their particular risks. For large companies, experts can be hired to analyze risk in more sophisticated ways, reduce risk where possible, and distribute the remaining risk over the entire company. Smaller companies and individuals might require guidance through such a process and their consideration of additional coverage in the traditional insurance marketplace, novel insurance options that spread risk over different sectors or a geographic area, and/or public-private partnerships. An educational campaign needs to be delivered by a trusted source that has deep knowledge of both the problem and options available.

²⁸ "The National Flood Insurance Program." FEMA. <http://www.fema.gov/national-flood-insurance-program>. Accessed Jan. 2018.

²⁹ Great Lakes Integrated Sciences and Assessment (GLISA) and the University of Michigan Climate Center. "Climate Change in Columbus Ohio: An assessment of Columbus' Key Climate Changes, Impacts, and Vulnerabilities of Concern." Mar. 2016. http://research.bpcrc.osu.edu/education/greenteam/FINAL_ColumbusFinalReport_3.0.pdf. Accessed Dec. 2017.