The Ohio State University - Hazard Mitigation Plan 2022

Hazard Mitigation Plan

Division of Emergency Management

The Ohio State University

11/28/2022

U.S. Department of Homeland Security
FEMA Region 5
536 S. Clark St. 6th Floor
Chicago, IL 60605

FEMA

April 20, 2023

Mr. Steve Ferryman
Mitigation and Recovery Branch Chief
Ohio Emergency Management Agency
2855 W. Dublin-Granville Road
Columbus, Ohio 43235-2206

Dear Mr. Ferryman:

Thank you for submitting adoption documentation for The Ohio State University Hazard Mitigation Plan. The plan was reviewed based on the local plan criteria contained in 44 CFR Part 201, as authorized by the Disaster Mitigation Act of 2000. The plan met the required criteria for a multi-jurisdictional hazard mitigation plan and the plan is now approved for The Ohio State University.

The approval of this plan ensures continued availability of the full complement of Hazard Mitigation Assistance (HMA) Grants. All requests for funding, however, will be evaluated individually according to the specific eligibility and other requirements of the program under which the application is submitted.

We encourage The Ohio State University to follow the plan's schedule for monitoring and updating the plan, and to continue their efforts to implement the mitigation measures. The expiration date of The Ohio State University Hazard Mitigation Plan is five years from the date of this letter. To continue project grant eligibility, the plan must be reviewed, revised as appropriate, resubmitted and approved no later than the expiration date.

Please pass on our congratulations to The Ohio State University for completing this significant action. If you or the university have any questions, please contact Steve Greene at (312) 408-5343 or Steven.Greene@fema.dhs.gov.

Sincerely,

John Wethington
Chief (acting), Risk Analysis Branch
Mitigation Division

THE OHIO STATE UNIVERSITY

Office of the Senior Vice President
Administration & Planning

101 Bricker Hall
190 North Oval Mall
Columbus, OH 43210

614-292-3080 Phone
614-292-3036 Fax

ap.osu.edu

Adoption of The Ohio State University Hazard Mitigation Plan

In recognition of the importance of reducing risks and enhancing the safety of our campus community, The Ohio State University approves and adopts The Ohio State University - Hazard Mitigation Plan (2022).

The plan outlines potential hazards to Ohio State's Columbus campus and recognizes that various natural, technological, and human-caused events may create physical and financial impacts to our university's campus. Effective mitigation measures should, when possible, and to the best of our abilities, be implemented to reduce the vulnerabilities and risks associated with hazards identified in the plan. These hazards include, but are not limited to:

- Public Health-related Emergency
- Geologic Hazards
- Flooding
- Tornados
- Severe Summer Storms
- Severe Winter Storms
- Drought
- Extreme Temperatures
- Hazardous Materials Release
- Utility Failures
- Cyber-Threats
- Terrorism
- Active Aggressors
- Civil Disturbances

The Ohio State University – Hazard Mitigation Plan (2022) provides a framework for activities and is structured to serve as a basis for specific emergency management mitigation and preparedness efforts. The plan will be reviewed and updated regularly.

Jay Kasey, Senior Vice President
Administration & Planning

2/3/23
Date

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PLANNING PROCESS

PRIORITIES

When conducting emergency operations at The Ohio State University, special considerations are given to the following priorities in this order:

- Protecting life (highest priority), property, and environment.
- Meeting the immediate needs of students, staff, faculty, visitors, and those with special needs during an emergency at OSU to include rescue, evacuation, medical care, food, and shelter.
- Restoration of critical infrastructure and key resources that are essential the health, safety, and welfare of all students, staff, faculty, and visitors (such as sanitation, hospitals, water, electricity, building systems).
- Mitigating hazards to protect life, property, and the environment.
- Resumption of business processes and normal operations.

PLANNING CONSIDERATIONS

Comprehensive emergency management is a process that involves consideration and preparedness for all individuals including those with access and functional needs. During all emergency operations on campus, attention to those with access and functional needs will be incorporated into all University and Departmental level operations, planning and response activities.

The hazard mitigation planning process is coordinated by the Division of Emergency Management and reviewed by the Emergency Operations Center (EOC) group on a 5-year cycle. The HMP may be reviewed more often, at the direction and discretion of the Director of Emergency Management.

PLANNING STEPS

The Division of Emergency Management has adopted the FEMA standards for local mitigation planning outlined in the "Local Mitigation Planning Handbook (March 2013)". This handbook identifies the steps or tasks necessary to complete comprehensive hazard mitigation planning at the local level.

PLANNING TEAM

The planning team consists of members of the Ohio State University's Emergency Operations Center (EOC) group, which consists of faculty and staff from across the university's departments. Meetings were held in May 02, 2022, June, and October 2022 to review and gather feedback for this plan. The plan was also posted online at [dps.osu.edu webpage](dps.osu.edu) and shared to the general public via social media for feedback and review of the community at large.

Table 1 Planning Team				
Last Name	First Name	Email	Title	Department
Baldwin,	Matthew	<baldwin.89@osu.edu>;	Business Continuity Coordinator	Risk Management
Balogh,	Kevin	<balogh.5@osu.edu>;	Sr. Security & Risk Analyst	OCIO Infrastructure Services
Coy	Bradley	<bradleycoy@engie.com>;		ENGIE
Calamari,	Peter	<calamari.2@osu.edu>;	Associate Vice President	Facilities, Operations & Development
Kovitya	Chris	<ckovitya@campusparc.com>;		CampusParc
Conway,	Julie	<conway.12@osu.edu>;	Compensation Analyst	Human Resources
Eringman,	Joey	<eringman.4@osu.edu>;	Security Manager	Public Safety
Evans,	Roy	<evans.2202@osu.edu>;	Emergency Management Coordinator	Public Safety
Gable,	Michael	<gable.24@osu.edu>;	Assistant Registrar	University Registrar

Garrett,	Brett	<garrett.194@osu.edu>;	Senior Director of Engineering and Infrastructure	FOD Design and Construction
Garrett,	Vella	<garrett.564@osu.edu>;	Business Continuity Manager	Risk Management
Gregory,	Michael	<michael.gregory@osumc.edu>;	Director of Safety and Emergency Preparedness	Wexner Medical Center - Safety and Emergency Preparedness
Hedman,	Dan	<hedman.11@osu.edu>;	Director of Marketing & Communications	A&P Communication Services
Holman,	Nicole	<holman.126@osu.edu>;	Assistant Director of Marketing & Communications	A&P Communication Services
Holman,	Tom	<holman.30@osu.edu>;	Associate Director	TTM
Jones,	Tami	<jones.5403@osu.edu>;	Sr. Director HR Comm. & Cultr Intgrtn.	Communications
Komlanc,	Lindsay	<komlanc.2@osu.edu>;		
Kulik,	Lauren	<kulik.10@osu.edu>;	Director, Public Affairs	University Communications
McClain,	Ross	<mcclain.31@osu.edu>;	Associate Director	Environmental Health & Safety
Moll,	Monica	<moll.43@osu.edu>;	Director of Public Safety	Public Safety
Novotny,	Tom	<novotny.66@osu.edu>;	Director	Environmental Health & Safety
Phillips,	Bill	<phillips.77@osu.edu>;	Chief Relationship Officer	OCIO Customer Solutions
Phillips,	Margaret	<phillips.2252@osu.edu>;	Admin Services Manager	Public Safety
Renker,	Stacey	<renker.5@osu.edu>;	Director - Risk & Emergency Mgmt	Student Life
Scheerle,	Chuck	<scheerle.2@osu.edu>;	Emergency Management & Fire Prev. Specialist 1	Public Safety
Seymour,	Joshua	<seymour.222@osu.edu>;	Emergency Management Planning Coordinator	Public Safety
Shockley,	Keith	<shockley.5@osu.edu>;	Assistant Direct - Central Maintenance	Facilities, Operations & Development

Shrader,	John	<shrader.3@osu.edu>;	Field Logistics Coordinator	TTM
Shreve,	Crystal	<shreve.14@osu.edu>;	Security Programs Manager	Environmental Health & Safety
Smith,	Fitzroy	<smith.15247@osu.edu>;	Associate Vice President & Chief Risk Officer	Business & Finance - Risk Management
Snoke,	Beth	<snoke.27@osu.edu>;	Director - Transportation & Traffic	TTM
Tartt,	Preston	<tartt.7@osu.edu>;	Security Systems Manager	Student Life
Winkler,	Kyle	<winkler.104@osu.edu>;	Industrial Hygienist	Environmental Health & Safety
Wolfzorn,	Matthew	<wolfzorn.4@osu.edu>	Senior Systems & Operations Manager	Public Safety

May 2, 2022, EOC Group Monthly Meeting Agenda

- Hazard Mitigation Assessment
    - Review past risk assessment (2017)
    - Review current risk assessment (2022)
- Upcoming Training Opportunity
    - MGT-412 Sport Venue Evacuation and Protective Actions class being held on March 15&16, 2022
- Covid-19 Updates

June 6, 2022, EOC Group Monthly Meeting Agenda

- Water Main Break AAR
- Emergency Management and Fire Prevention relocating
- Hazard Mitigation Plan
    - Finalized and ready for submission for Ohio EMA review

October 3, 2022, EOC Group Monthly Meeting Agenda

- Wooster Power Outage
- 2022 Football Season
- Hazard Mitigation Assessment
    - Plan review – additional feedback from Ohio EMA
    - Next steps for resubmission

PLAN IMPLEMENTATION AND AUTHORITY

The authority to revise, implement, or distribute aspects of this plan remains solely at the direction and discretion of the Director of the Division of Emergency Management via promulgated authority of the Office of Director of Public Safety. In the event that individuals, departments, or the general public desire to amend or revise portions of this plan or implementation strategy, forward all requests through the Division of Emergency Management for approval and coordination.

This plan will be promulgated annually and any revisions to this plan will be shared among all emergency response entities involved in emergency operations or mentioned in this plan.

COMMUNITY PROFILE

The Community Profile summarizes the university's history and existing environmental and socioeconomic conditions. Environmental and socioeconomic factors include geography, topography, climate, population, economic, and land use and development trends.

THE OHIO STATE UNIVERSITY HISTORY

The Ohio State University is a dynamic community of diverse resources, where opportunity thrives and where individuals transform themselves and the world. Founded in 1870, Ohio State is a world-class public research university and the leading comprehensive teaching and research institution in the state of Ohio. With more than 67,000 students (including 61,677 in Columbus), the Wexner Medical Center, 15 colleges, 80 centers and more than 200 undergraduate majors and 278 post-graduate degree programs, the university offers its students tremendous breadth and depth of opportunity in the liberal arts, the sciences and the professions.

GEOGRAPHY, TOPOGRAPHY, AND CLIMATE

GEOGRAPHIC BOUNDARY

This plan is being written for The Ohio State University Columbus Campus. The university system has several branch campuses; however, they are not the focus of this plan.

GEOGRAPHY

The Ohio State University is located in an urban setting within the City of Columbus, Ohio. Columbus is a municipality within Franklin County, Ohio. The university is approximately 2.5 miles north of downtown Columbus and is located along the Olentangy River. The Columbus campus consists of 630 buildings spanning 1,693 acres of land.

The confluence of the Scioto and Olentangy rivers occurs just west of downtown Columbus. Several smaller tributaries course through the Columbus metro area, including Alum Creek, Big Walnut Creek, and Darby Creek. The Olentangy River flows through the university and is a possible source of riverine flooding.

TOPOGRAPHY

Columbus is considered to have relatively flat topography due to a large glacier that covered most of Ohio during the Wisconsin Ice Age. However, there are sizable differences in elevation through the area, with the high point of Franklin County being 1132 ft (345 m) above sea level near New Albany, and the low point being 670 ft (207 m) where the Scioto River leaves the county near Lockbourne. Numerous ravine areas near the rivers and creeks also help give some variety to the landscape. Tributaries to Alum Creek and the Olentangy River cut through shale, while tributaries to the Scioto River cut through limestone. Deciduous trees are common, including maple, oak, hickory, walnut, poplar, cottonwood, and of course, buckeye.

Columbus, and The Ohio State University sit in the Loamy, High Lime Till Plains ecoregion contains soils that developed from loamy, limy, glacial deposits of Wisconsinan age; these soils typically have better natural drainage than other nearby ecoregions. Beech forests, oak-sugar maple forests, and elm-ash swamp forests grew on the nearly level terrain. Today, corn, soybean, and livestock production is widespread.

CLIMATE

Franklin County receives precipitation in line with national averages. The number of days with any measurable precipitation is approximately 123 days a year, and on average there are 175 sunny days per year in Franklin County. The July average high temperature is around 85 degrees, and the January average low temperature is 21 degrees. The Franklin County comfort index[3], which is based on humidity during the hot months, is 46 out of 100, while the average comfort index for the U.S. is 44. See Table 2-1 for a complete summary of average climate information.

Table 2-1 Franklin County Climate Summary Table

Climate Measurements	Franklin County, Ohio	United States
Avg. Rainfall (in.)	36.4	36.5
Avg. Snowfall (in.)	24	25
Avg. Precipitation Days	123	100
Avg. Sunny Days	175	205
Avg. July High	85.1	86.5
Avg. Jan. Low	21.7	20.5
Comfort Index (higher=better)	46	44
UV Index	5.6	4.3
Avg. Elevation FT.	832	1,443

Source: http://www.bestplaces.net/climate/county/ohio/franklin

POPULATION, OCCUPANCY, AND DEMOGRAPHICS

Population and demographic information provide baseline data about the university. This community consists of several key groups, most specifically, students, faculty, and staff[4]. Maintaining and reviewing up-to-date data on demographics will allow the university to better assess magnitudes of hazards and develop more specific mitigation plans.

POPULATION

Table 2-2 University Baseline Student Demographics

Demographic	Autumn 2021
Total Population	**67,772**
Male	32,622
Female	35,150
Student Year	
Undergraduates	53,189
Graduate Students	11,278
Professional students	3,305
Ohioans	49,233
Non-Ohioans	18,539
Foreign Students	5,596

Table 2-3 University Baseline Employee Demographics	
Demographic	**Autumn 2021**
Total employees	**49,325**
Executives	178
Regular Tenure Track Faculty	2,767
Regular Clinical Faculty	2,178
Regular Research Faculty	108
Associated Faculty	2,759
Unclassified Staff	18,332
Classified Staff	3,089
Union Staff	5,662
Post-Doctoral	583
Student Employees	13,669

Table 2-4 Previous Population Figures		
Previous Years' Populations	**Students**	**Employees**
2021	67,772	49,325
2020	67,957	49,325
2019	68,262	49,030
2018	68,100	47,686
2017	66,444	43,322
2016	66,046	44,023

Based on figures from the Office of Institutional Research, The Ohio State University has a campus population of over 117,000 persons, consisting of students, faculty, and staff, with a varying number of patients and visitors on campus daily, as well. Overall student enrollment numbers have been steadily increasing annually. As of autumn 2021, a total of 5,596 international students attend The Ohio State University from over 30 countries around the world.

UNIVERSITY UTILITIES

FOD Utilities provides utility services – steam and condensate, heating hot water, electricity, natural gas, domestic cold and hot water, chilled water, compressed air and fire hydrants – necessary to maintain university operations. Some of these utilities are purchased from public utility vendors (electricity and natural gas) and processed through university systems. Utility services are produced and delivered to customers by an extensive utility infrastructure system that is undergoing significant renewal, upgrade, and expansion as part of the Infrastructure Master Plan. Utilities' activities focus on maintaining reliable utilities, ensuring appropriate project designs and installations, minimizing construction impacts and maximizing efforts to facilitate university business throughout construction, renewal, and expansion activities.

LAND USE AND FUTURE DEVELOPMENT AREAS

The university completed the original One Ohio State Framework Plan in 2010. Since, Ohio State has implemented (or are in the process of implementing) more than 3,000 capital projects, which have all delivered on the strategies of the Framework Plan. The Framework continues to guide change over time at the university, serving as a strategic blueprint for expansion and renovation. In 2015, the university began work on Framework 2.0. The update will focus on the physical planning of the campus and its changes and build upon the previous and current projects implemented through the original One Ohio State Framework Plan. Integrated with the university's academic and financial planning, the framework will provide a structure for guiding changes in the physical environment over the coming years.

Figure 1 Potential Future Development

HAZARD IDENTIFICATION & RISK ASSESSMENT (HIRA)

Hazard identification & risk assessment is the process of measuring the potential impact to life, property and economic impacts resulting from natural and non-natural hazards. The intent of the risk assessment is to identify, as much as practicable given existing/available data, the qualitative and quantitative vulnerabilities of a community. The results of the risk assessment provide a framework for a better understanding of potential impacts to the community and a foundation on which to develop and prioritize mitigation actions (see Section 6). Mitigation actions can reduce damage from natural disasters and an implementation strategy can direct scarce resources to areas of greatest vulnerability described in this section.

This risk assessment follows the methodology described in FEMA publication, *Threat and Hazard Identification and Risk Assessment (THIRA) and Stakeholder Preparedness Review (SPR) Guide Comprehensive Preparedness Guide (CPG) 201* (FEMA, 2018), which outlines a four-step process:

1) Identify Hazards
2) Profile Hazard Events
3) Inventory Assets
4) Estimate Losses

Information gathered during The Ohio State University planning process related to the above four steps are incorporated into the following discussions in this chapter.

Hazard Identification identifies and prioritizes the identified natural and non- natural hazards that threaten the campus. The reasoning for omitting some hazards from further consideration is also provided in this discussion.

Hazard Profiles describe each of the natural hazards that pose a threat to the campus. Information includes the location, extent/magnitude/severity, previous occurrences, and the likelihood of future occurrences.

IDENTIFYING THE HAZARDS

Per FEMA Guidance, the first step in developing the Risk Assessment is identifying the hazards. The HMP Planning Committee reviewed a number of previously prepared hazard mitigation plans and other relevant documents to determine the universe of natural hazards with potential to affect the campus.

Hazards were ranked in order to provide structure and prioritize the mitigation goals and actions discussed in this plan. Ranking was both quantitative and qualitative. The quantitative analysis considered all the GIS data available. Then, a qualitative approach, the Risk Factor (RF) approach, was used to provide additional insights on the specific risks associated with each hazard. This process can also be a valuable cross-check or validation of the quantitative analysis performed.

RF Value = [(Likelihood x .30) + (Consequence x .30) + (Resilience x .20) + (Warning Time x .10) + (Duration x .10)]

The RF approach combines historical data, local knowledge, and consensus opinions to produce numerical values that allow identified hazards to be ranked against one another. During the planning process, The Ohio State University Mitigation Planning Committee compared the results of the hazard profile against their local knowledge to generate a set of ranking criteria. These criteria were used to evaluate hazards and identify the highest risk hazard.

RF values are obtained by assigning varying degrees of risk to five categories for each hazard: *Likelihood, Consequence, Resilience, Warning Time*, and *Duration*. Each degree of risk is assigned a value ranging from 1 to 4 and a weighing factor for each category was agreed upon by the Mitigation Planning Committee. Based upon any unique concerns for the planning area, the Mitigation Planning Committee may also adjust the RF weighting scheme. To calculate the RF value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation below:

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

According to the default weighting scheme applied, the highest possible RF value is 4.0. The methodology illustrated above lists categories that are used to calculate the variables for the RF value.

Table 1-1 provides the risk factor table that details the hazards profiled in this plan, as well as the numerical value assigned to that hazard. That Risk Factor is developed through assessing the likelihood, consequence, resilience, warning time, and duration of each hazard type.

Table 1-1 Risk Factor Table

Natural Hazards	Likelihood		Consequence		Resilience		Warning Time		Duration		Risk Factor
Public Health-Related Emergency	4	1.2	4	1.2	3	0.6	2	0.2	4	0.4	3.6
Geologic Hazards	2	0.6	4	1.2	4	0.8	4	0.4	3	0.3	3.3
Flooding	4	1.2	4	1.2	2	0.4	4	0.4	3	0.3	3.5
Tornado	4	1.2	4	1.2	2	0.4	4	0.4	3	0.3	3.5
Severe Weather (Summer)	4	1.2	3	0.9	1	0.2	3	0.3	2	0.2	2.8
Severe Winter Storm	4	1.2	3	0.9	1	0.2	3	0.3	2	0.2	2.8
Drought	2	0.6	3	0.9	2	0.4	1	0.1	3	0.3	2.3
Extreme Heat	4	1.2	2	0.6	1	0.2	3	0.3	3	0.3	2.6
Extreme Cold	4	1.2	2	0.6	1	0.2	3	0.3	3	0.3	2.6
Technological Hazards	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Dam Failure (See Flooding)	3	0.9	4	1.2	3	0.6	3	0.3	3	0.3	3.3
Hazardous Materials Incident (Fixed Facility)	4	1.2	4	1.2	2	0.4	4	0.4	4	0.4	3.6
Hazardous Materials Incident (Transportation)	4	1.2	4	1.2	2	0.4	4	0.4	4	0.4	3.6
Utility Failure	3	0.9	4	1.2	3	0.6	3	0.3	2	0.2	3.2
Human-Caused Hazards	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Cyber-Threat	4	1.2	4	1.2	4	0.8	4	0.4	3	0.3	3.9
Terrorist Incident	4	1.2	4	1.2	3	0.6	4	0.4	3	0.3	3.7
Active Aggressor Incident	4	1.2	3	0.9	3	0.6	4	0.4	3	0.3	3.4
Civil Disturbance	4	1.2	3	0.9	1	0.2	3	0.3	2	0.2	2.8

Previous hazard occurrences were used to validate existing hazards and identify new hazard risks. Previous hazard occurrences provide a historical view of hazard risk, and a window into potential hazards that can affect The Ohio State University Columbus Campus and its facilities in the future. Information about Federal and State disaster declarations in Franklin County[9] was compiled from FEMA and Ohio databases, as shown in Table 1-2.

Though not a complete snapshot of hazard incidences in Franklin County (since not all hazard events are federally or state declared), Table 1-2 provided the HMP Planning Committee with solidified accounts of disasters affecting areas around Franklin County dating back to 1956.

Table 1-2 Federal and State Declared Disasters

Year	Disaster	Disaster#	Public Assistance Grant Award
31-Mar-20	Ohio - COVID-19 PANDEMIC - (DR-4507-OH)	DR-4507-OH	
13-Mar-20	Ohio Covid-19	EM-3457-OH	
18-Jun-19	Ohio Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides, And Mudslide	DR-4447-OH	$ 9,443,353.00
8-Apr-19	Ohio Severe Storms, Flooding, And Landslides	DR-4424-OH	$ 41,483,552.00
17-Apr-18	Ohio Severe Storms, Landslides, And Mudslides	DR-4360-OH	$ 44,006,057.00
3-Jan-13	Ohio Hurricane Sandy	DR-4098-OH	$ 17,819,456.00
20-Aug-12	Severe Storms and Straight-Line Winds	DR-4077	$ 2,118,635.00
24-Oct-08	Severe Windstorm Associated with Tropical Depression Ike	DR-1805	$ 4,612,691.75
4-Apr-08	Snow	EM-3286	$ 1,568,327.42
13-Sep-05	Hurricane Katrina Evacuation	EM-3250	$ 93,343.00
15-Feb-05	Severe Winter Storms, Flooding and Mudslides	DR-1580	$ 905,711.62
11-Jan-05	Ohio Snow	EM-3198	$ 673,968.38

Table 1-2 Federal and State Declared Disasters			
26-Jan-04	Severe Storms, Flooding, Mudslides, and Landslides	DR-1507	
1-Aug-03	Tornadoes, Flooding, Severe Storms, and High Winds	DR-1484	
14-Mar-03	Severe Winter Storm	DR-1453	$ 814,006.17
30-Jun-98	Severe Storms, Flooding and Tornadoes	DR-1227	
4-Aug-92	Flooding, Severe Storm, Tornadoes	DR-951	$ 433,411.00
6-Jun-90	Flooding, Severe Storm, Tornado	DR-870	
10-Jun-89	Severe Storms, Flooding	DR-831	
26-Jan-78	Ohio Blizzards & Snowstorms	EM-3055	
4-Apr-74	Tornadoes	DR-421	
5-Jun-68	Heavy Rains, Flooding	DR-243	
24-Mar-64	Severe Storms & Flooding	DR-167	
23-Jan-59	Floods	DR-90	

Source: FEMA: State Disaster History; Emergency & Disaster Proclamations and Executive Orders by Date

Based on the review of hazards identified in similar and relevant documents, previous incidents, historical knowledge of localized events, and natural hazard trends, the HMP Planning Team developed a preliminary list of hazards of eight natural hazards and seven non-natural hazards with significant potential to occur in on or near the Ohio State Columbus campus: Flooding, Severe Summer Storms, Severe Winter Storms, Infestation, Extreme Temperatures, Tornadoes, Seismic Events, Drought, Utility Failure, Terrorism, Health Related Emergency, Fire, HazMat Release, Transportation Incident, and Civil Disturbance. Originally, the list of non-natural hazards included: temporary IT failure, active shooter and radiological releases. However, as the risk assessment was developed, it became clear that these three hazards should be combined with other hazards. Temporary IT failure was combined with utility failure. The active shooter hazard was combined with the terrorism hazard. Radiological releases were discussed in the hazardous materials release profile.

HAZARD EVENT DATA

In developing the hazard profiles within this plan, a variety of information sources were researched. In order to develop a pattern of historical occurrences for identified hazards, sites like the National Oceanic and

Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) and sites associated with the regional National Weather Service (NWS) locations. These sites traditionally break down information on a county-wide level, or by municipality. The university does not frequently appear on these lists detailing hazard events. As a result, in compiling histories for each hazard, only events with a recorded countywide impact, or an impact in a neighborhood directly adjoining the university (i.e. Grandview and Upper Arlington) were included as historical events.

EVENT NARRATIVES

Within each hazard's section there are a series of narratives that provide greater detail into specific events that have either impacted the campus, or the surrounding area. This section (Historical Occurrences or in some cases Hazard Events/Historical Occurrences) is not meant to be a comprehensive list of events that have occurred on campus. Rather, these incidents are included to provide context as to why this hazard was included in the plan.

HAZARD PROFILES

Hazards are profiled individually in this section in order of priority. The profiles in this section provide a baseline definition and description in relation to The Ohio State University. Hazard profiles are used to develop a vulnerability assessment, where natural hazard vulnerability to the community is quantified in terms of population and assets affected for each hazard deemed significant by the Planning Committee.

PUBLIC HEALTH-RELATED EMERGENCY

Hazard Assessment Chart											
Non-Natural Hazard	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Public Health-Related Emergency	3	0.9	2	0.6	2	0.4	1	0.1	3	0.3	**2.3**
MEDIUM RISK HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

Public health emergency preparedness (PHEP) is the capability of the public health and health care systems, communities, and individuals, to prevent, protect against, quickly respond to, and recover from health emergencies, particularly those whose scale, timing, or unpredictability threatens to overwhelm routine capabilities. Preparedness involves a coordinated and continuous process of planning and implementation that relies on measuring performance and taking corrective action.

Public health-related emergencies are defined as much by their health consequences as by their causes and precipitating events. A situation becomes emergent when its health consequences have the potential to overwhelm routine community capabilities to address them. Thus, the proposed definition focuses on situations "whose scale, timing, or unpredictability threatens to overwhelm routine capabilities." The definition is also aligned with the all-hazards approach to preparedness instead of focusing on a "disaster du jour" and thus allows for the optimal development of capabilities across scenarios and better prepares communities for the broad spectrum of potential risks.

Public health-related emergencies can take many forms, from worldwide pandemics, or the more common local epidemic outbreaks. Consequences of these emergencies can have cascading effects outside of the toll it takes on the health systems, as people affected by these emergencies can cause disruptions to critical infrastructure in the community and surrounding areas.

PANDEMIC

Pandemic is defined as a disease affecting or attaching the population of an extensive region which may include several countries and/or continents. It is further described as extensively epidemic. Generally, pandemic events cause sudden, pervasive illness in all age groups on a global scale, though some age groups may be more at risk. As such, pandemic events cover a wide geographic area and can affect large populations, depending on the disease. The exact size and extent of the infected population is dependent upon how easily the illness is spread, the mode of transmission, and the amount of contact between infected and non-infected persons.

Three of the most common issues viewed as pandemics are the Covid-19 Virus, West Nile Virus, and Influenza.

COVID-19 (coronavirus disease 2019) is a disease caused by a virus named SARS-CoV-2 and was discovered in December 2019 in Wuhan, China. It is very contagious and has quickly spread around the world. COVID-19 most often causes respiratory symptoms that can feel much like a cold, a flu, or pneumonia. COVID-19 may attack more than your lungs and respiratory system. Other parts of your body may also be affected by the disease. COVID-19 is caused by a virus called SARS-CoV-2. It is part of the coronavirus family, which include common viruses that cause a variety of diseases from head or chest colds to more severe (but rarer) diseases like severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS).

West Nile Virus is a vector-borne disease that can cause headache, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and, in its most serious form, death. The virus spreads via mosquito bite and is aided by warm temperatures and wet climates conducive to mosquito breeding. West Nile Virus has been detected in Delaware County every year from 2000-2010. The virus is highly temporal with most cases occurring between April and October.

Influenza, also known as "the flu", is a contagious disease that is caused by the influenza virus and typically presents with fever, headache, sore throat, cough, and muscle aches. Influenza is considered to have pandemic potential if it is novel, meaning that people have no immunity to it, virulent, meaning that it causes deaths in normally healthy individuals, and easily transmittable from person-to-person. Influenza spreads via the air in crowded populations in enclosed spaces, and it may persist on surfaces and in the air. Individuals are communicable for 3-5 days after clinical onset. Pandemic influenza planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. H5N1 did not reach pandemic proportions in the United States, but the County began actively planning for an occurrence of an influenza pandemic in 2007. As stated in the Pennsylvania Department of

Health Influenza Pandemic Response Plan, “an influenza pandemic is inevitable and will probably give little warning,” underscoring the importance of planning for this hazard.

EPIDEMIC

Epidemic is defined as something affecting many persons at the same time, and spreading from person to person in a locality where the disease is not permanently prevalent. The amount of a particular disease that is usually present in a community is referred to as the baseline or endemic level of the disease. This level is not necessarily the desired level, which may in fact be zero, but rather is the observed level. In the absence of intervention and assuming that the level is not high enough to deplete the pool of susceptible persons, the disease may continue to occur at this level indefinitely. Thus, the baseline level is often regarded as the expected level of the disease.

While some diseases are so rare in a given population that a single case warrants an epidemiologic investigation (e.g., rabies, plague, polio), other diseases occur more commonly so that only deviations from the norm warrant investigation. Sporadic refers to a disease that occurs infrequently and irregularly. Endemic refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.

Hyperendemic refers to persistent, high levels of disease occurrence.

Occasionally, the amount of disease in a community rises above the expected level. Epidemic refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area. Outbreak carries the same definition of epidemic, but is often used for a more limited geographic area. Cluster refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known. Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

Epidemics occur when an agent and susceptible hosts are present in adequate numbers, and the agent can be effectively conveyed from a source to the susceptible hosts. More specifically, an epidemic may result from:

- A recent increase in amount or virulence of the agent,
- The recent introduction of the agent into a setting where it has not been before,
- An enhanced mode of transmission so that more susceptible persons are exposed,
- A change in the susceptibility of the host response to the agent, and/or
- Factors that increase host exposure or involve introduction through new portals of entry

REGULATORY ENVIRONMENT

There are a variety of regulations which drive the health industry, and as a result, the treatment of pandemics and epidemics. The Ohio Revised Code, Chapter 3701-59 specifically deals with hospitals. The Ohio State University Hospital, University Hospital East and The James Cancer Hospital are all accredited by The Joint Commission. The Joint Commission is an independent, not-for-profit organization, The Joint Commission accredits and certifies nearly 21,000 health care organizations and programs in the United States. Joint Commission accreditation and certification is recognized nationwide as a symbol of quality that reflects an organization’s commitment to meeting certain performance standards.

HAZARD EVENTS/HISTORICAL OCCURRENCES

2009 H1N1 INFLUENZA PANDEMIC

The 2009 H1N1 influenza (flu) pandemic occurred against a backdrop of pandemic response planning at all levels of government including years of developing, refining and regularly exercising response plans at the international, federal, state, local, and community levels. At the time, experts believed that avian influenza A (H5N1) viruses posed the greatest pandemic threat. H5N1 viruses were endemic in poultry in parts of the world and were infecting people sporadically, often with deadly results. Given that reality, pandemic preparedness efforts were largely based on a scenario of severe human illness caused by an H5N1 virus. Despite differences in planning scenarios and the actual 2009 H1N1 pandemic, many of the systems established through pandemic planning were used and useful for the 2009 H1N1 pandemic response.

2009 H1N1 was first detected in the United States in April 2009. This virus was a unique combination of influenza virus genes never previously identified in either animals or people. The virus genes were a combination of genes most closely related to North American swine-lineage H1N1 and Eurasian lineage swine-origin H1N1 influenza viruses. Because of this, initial reports referred to the virus as a swine origin influenza virus. However, investigations of initial human cases did not identify exposures to pigs and quickly it became apparent that this new virus was circulating among humans and not among U.S. pig herds.

Infection with this new influenza A virus (then referred to as ‘swine origin influenza A virus’) was first detected in a 10-year-old patient in California on April 15, 2009, who was tested for influenza as part of a clinical study. Laboratory testing at Centers for Disease Control (CDC) confirmed that this virus was new to humans. Two days later, CDC laboratory testing confirmed a second infection with this virus in another patient, an 8-year-old living in California about 130 miles away from the first patient who was tested as part of an influenza surveillance project.

There was no known connection between the two patients. Laboratory analysis at CDC determined that the viruses obtained from these two patients were remarkably similar to each other, and different from any other influenza viruses previously seen either in humans or animals.

2014-2015 EBOLA EPIDEMIC

2014/2015: The 2014 Ebola epidemic is the largest in history, affecting multiple countries in West Africa. There were a small number of cases reported in Nigeria and Mali and a single case reported in Senegal; however, these cases were contained, with no further spread in these countries.

Two imported cases, including one death, and two locally acquired cases in healthcare workers were reported in the United States. CDC and its partners are taking precautions to prevent additional Ebola cases in the United States. CDC is working with other U.S. government agencies, the World Health Organization (WHO), and other domestic and international partners and has activated its Emergency Operations Center to help coordinate technical assistance and control activities with partners. CDC has also deployed teams of public health experts to West Africa and will continue to send experts to the affected countries.

At the time, the general public and media feared that the epidemic would spread to Ohio after a nurse from Texas traveled to the Akron, Ohio area in advance of a wedding.

2019-2022 COVID-19 PANDEMIC

The COVID-19 pandemic, also known as the coronavirus pandemic, is a global pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The novel virus was first identified from an outbreak in Wuhan, China, in December 2019. Attempts to contain it there failed, allowing the virus to spread worldwide. The World Health Organization (WHO) declared a Public Health Emergency of International Concern on 30 January 2020 and a pandemic on 11 March 2020. As of 21 June 2022, the pandemic had caused more than 539 million cases and 6.32 million confirmed deaths, making it one of the deadliest in history.

COVID-19 symptoms range from undetectable to deadly, but most commonly include fever, dry cough, and fatigue. Severe illness is more likely in elderly patients and those with certain underlying medical conditions. COVID-19 transmits when people breathe in air contaminated by droplets and small airborne particles containing the virus. The risk of breathing these in is highest when people are in close proximity, but they can be inhaled over longer distances, particularly indoors. Transmission can also occur if contaminated fluids reach the eyes, nose or mouth, and, rarely, via contaminated surfaces. Infected persons are typically contagious for 10 days, and can spread the virus even if they do not develop symptoms. Mutations have produced many strains (variants) with varying degrees of infectivity and virulence.

COVID-19 vaccines have been approved and widely distributed in various countries since December 2020. Other recommended preventive measures include social distancing, wearing masks, improving ventilation and air filtration, and quarantining those who have been exposed or are symptomatic. Treatments include monoclonal antibodies, novel antiviral drugs, and symptom control. Governmental interventions include travel restrictions, lockdowns, business restrictions and closures, workplace hazard controls, quarantines, testing systems, and tracing contacts of the infected.

The pandemic triggered severe social and economic disruption around the world, including the largest global recession since the Great Depression. Widespread supply shortages, including food shortages, were caused by supply chain disruption. The resultant near-global lockdowns saw an unprecedented pollution decrease. Educational institutions and public areas were partially or fully closed in many jurisdictions, and many events were cancelled or postponed. Misinformation circulated through social media and mass media, and political tensions intensified. The pandemic raised issues of racial and geographic discrimination, health equity, and the balance between public health imperatives and individual rights.

MAGNITUDE/SEVERITY

The magnitude of a health-related emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is more easily transmitted from person-to-person and is more easily transmitted than West Nile, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined. The 1918 Spanish flu pandemic remains the worst-case pandemic event on record.

In contrast, the severity of illness from the 2009 H1N1 influenza flu virus has varied, with the gravest cases occurring mainly among those considered at high risk. High risk populations considered more vulnerable include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 have recovered without needing medical treatment.

According to the CDC, about 70% of those who have been hospitalized with the 2009 H1N1 flu virus in the United States have belonged to a high-risk group (CDC, 2009).

The magnitude of a health-related emergency may be exacerbated by the fact that outbreaks across the United States could limit the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventative and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available.

There are no true environmental impacts in pandemic disease outbreaks, but there may be significant economic and social costs beyond the possibility of deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. Social and economic disruptions could be temporary but may be amplified in today's closely interrelated and interdependent systems of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCE

The precise timing of a health-related emergency is uncertain. Pandemic occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or "novel" virus to which the population has no immunity. Epidemic occurrences are more likely when there are ecological changes, the pathogen mutates, or the pathogen is introduced into an unprepared host population.

INVENTORY ASSETS EXPOSED TO HEALTH-RELATED EMERGENCIES

All university assets can be considered at risk to health-related emergencies. The university has a population of over 117,000 student, faculty, and staff. This diverse population comes from a variety of cities, states, and countries. In general, areas that are more densely populated are more vulnerable to pandemic when the disease is directly spread from human to human. The university hospital system would be the most likely point of introduction for an epidemic or pandemic to enter the university's area.

Overall, the hospital system is comprised of seven hospitals and 1,882 beds. Those hospitals are responsible for (as of 8/26/2021):

- 62,921 admissions
- 2.12 million outpatient visits
- 5,293 births
- 279,296 telehealth visits
- 112,035 Emergency Department visits
- 50,740 Surgeries
- $4.33 billion in Revenue

POTENTIAL LOSSES FROM HEALTH-RELATED EMERGENCIES

Health related emergencies are unlikely to directly impact buildings and infrastructure. However, the losses can be measured in lost productivity from employees unable to perform their job duties and students not able to attend classes.

MITIGATION STRATEGY

The Ohio State University Wexner Medical Center has a Pandemic Emergency Operations Plan, which is an appendix to the university's Comprehensive Emergency Management Plan (CEMP). The pandemic plan is intended to guide the response and recovery actions of the entire campus and has been completed in coordination with Columbus Public Health to provide the best strategy for mitigation efforts surrounding a public health-related emergency.

PUBLIC HEALTH-RELATED EMERGENCY MITIGATION ACTIONS

Public Health-Related Emergency Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 11: Understand the impact of and recovery from health-related emergencies					
Objective 11.1: Develop additional planning mechanisms related to health-related emergencies					
11.1.1 Continue to conduct an annual exercise for pandemic /epidemic response	Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$35,000 per year	Operating Budget	Completed 2020-2021
11.1.2 Provide staff education and outreach concerning health related emergencies	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$25,000 per Year	Operating Budget	Completed 2020-2021

Public Health-Related Emergency Mitigation Actions					
11.1.3 Conduct annual updates to the Ohio State WMC Master Pandemic Plan	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Completed 2020-2021
Objective 11.2: Develop and deploy public education campaigns related to health-related emergencies					
11.2.1 Conduct public education and outreach regarding emerging health emergencies to the student population	Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026
11.2.2 Conduct public education and outreach regarding emerging health emergencies to faculty and staff	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026

PUBLIC HEALTH-RELATED EMERGENCIES HIRA SUMMARY

Pandemic and infectious disease events cover a wide geographical area and can affect large populations. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in denser areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness.

GEOLOGIC HAZARDS

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Geologic Hazards	**1**	**0.3**	**2**	**0.6**	**4**	**0.8**	**4**	**0.4**	**3**	**0.3**	**2.4**
MEDIUM RISK HAZARD (2.0 – 2.9)											

Geologic hazards pose a substantial danger to people, property and infrastructure. Geologic hazards exist in Franklin County due to naturally occurring geologic events and geologic hazards accelerated by human development. Common geologic hazards present throughout Franklin County include seismic shaking or "earthquake."

HAZARD IDENTIFICATION

The term "earthquake" refers to the vibration of the Earth's surface caused by movement along a fault, by a volcanic eruption, or even by environmental explosions. The vibration can be violent and cause widespread damage and injury, or may be barely felt. Most destructive earthquakes are caused by movements along faults. An earthquake is both the sudden slip on an active earth fault and the resulting shaking and radiated seismic energy caused by the slip (USGS 2009). Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. Seismic shaking is typically the greatest cause of loss to structures during earthquakes.

Earthquakes may also cause landslides, particularly during the wet season, in areas of high water or saturated soils. The most likely areas for earthquake-induced landslides correlate to areas of high landslide potential discussed later in this section.

Ohio lies on the outermost boundaries of the New Madrid fault, centrally located at New Madrid, Missouri. This particular fault has created significant activity over the last 200 years. The most intense activity occurred in the years 1811-1812. Two earthquakes estimated to be 7's on the Richter scale hit the New Madrid Fault. Damage to chimneys was reported as far north as Cincinnati, Ohio.

Ohio has recorded 212 earthquakes with a magnitude of 2.0 or greater since 1900. Of these earthquakes, 15 were reported to have caused noticeable to moderate damage. Two (2) major centers of seismic activity in Ohio are 1) the Anna Seismogenic Area located in Shelby and Auglaize Counties, and 2) the northeast area of the state on the eastern side of Lake Erie, which is referred to as the Akron Magnetic Boundary. The Anna area has been home to 40 earthquakes since the late 1770's while northeastern Ohio has recorded 60. None of these earthquakes were reported to cause major damage or loss of life. Most sources in the geology science predict that the largest magnitude earthquake that might occur in the state of Ohio would register no higher than five (5). However, some sources state that a magnitude of six (6), maybe higher, could be registered in the Anna region. An event of this intensity would most probably be felt at the university. However, predicting the amount of damage would be difficult due to lack of historic activity in the area.

The lack of noticeable activity in Franklin County can be partly attributed to the Peak Ground Acceleration (PGA). PGA is partly determined by what soils and bedrocks are present in the area. In regard to Franklin County, the PGA is relatively low.

As noted by the Ohio Seismic Network, when the peak acceleration nears 0.1g, damage may be caused to poorly constructed buildings while acceleration nearing 0.2 would create loss of balance and greater damage to lesser quality structures. As mentioned previously, Franklin County has peak acceleration much below that number, thus providing a buffer from most seismic activity. On a local basis, community members within Franklin County have made reports of ground shakings. With this in mind, seismic activity will be a lessened priority in this plan. Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts are considered. Some examples are shown below, but are unlikely to occur in Franklin County:

- Induced flooding and landslides;
- Poor water quality;
- Damage to vegetation; and
- Breakage in sewage or toxic material containments

EARTHQUAKE MECHANICS

Regardless of the source of the earthquake, the associated energy travels in waves radiating outward from the point of release. When these waves travel along the surface, the ground shakes and rolls, fractures form, and water waves may be generated. Earthquakes generally last a matter of seconds, but the waves may travel for long distances and cause damage well after the initial shaking at the point of origin has subsided.

Breaks in the crust associated with seismic activity are known as "faults" and are classified as either active or inactive. Faults may be expressed on the surface by sharp cliffs or scarps or may be buried below surface deposits.

"Foreshocks," minor releases of pressure or slippage, may occur months or minutes before the actual onset of the earthquake. "Aftershocks," which range from minor to major, may occur for months after the main earthquake. In some cases, strong aftershocks may cause significant additional damage, especially if the initial earthquake impacted emergency management and response functions or weakened structures.

FACTORS CONTRIBUTING TO DAMAGE

The damage associated with each earthquake is subject to four primary variables:

- The nature of the seismic activity
- The composition of the underlying geology and soils
- The level and quality of development of the area struck by the earthquake
- The time of day

Seismic Activity: The properties of earthquakes vary greatly from event to event. Some seismic activity is localized (a small point of energy release), while other activity is widespread (e.g., a major fault letting lose all at once). Earthquakes can be very brief (only a few seconds) or last for a minute or more. The depth of release and type of seismic waves generated also play roles in the nature and location of damage; shallow quakes will hit the area close to the epicenter harder, but tend to be felt across a smaller region than deep earthquakes.

Geology and Soils: The surface geology and soils of an area influence the propagation (conduction) of seismic waves and how strongly the energy is felt. Generally, stable areas (e.g., solid bedrock) experience less destructive shaking than unstable areas (e.g., fill soils). The siting of a community or even individual buildings plays a strong role in the nature and extent of damage from an event.

Development: A small earthquake in the center of a major city can have far greater consequences than a major event in a thinly populated place.

Time of Day: The time of day of an event controls the distribution of the population of an affected area. On workdays, the majority of the community will transition between work or school, home, and the commute between the two. The relative seismic vulnerability of each location can strongly influence the loss of life and injury resulting from an event.

TYPES OF DAMAGE

While damage can occur by movement at the fault, most damage from earthquake events is the result of shaking. Shaking also produces a number of phenomena that can generate additional damage:

- Ground displacement
- Landslides and avalanches
- Liquefaction and subsidence
- Seiches

Shaking: In minor events, objects fall from shelves and dishes are rattled. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, constructed, or designed in all but the largest quakes. Un-reinforced masonry buildings and wood frame homes not anchored to their foundations are typical victims.

Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These “non-structural falling hazard” objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and property damage.

Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life. In areas of severe seismic shaking hazard, Intensity VII or higher can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk.

Ground Displacement: Often, the most dramatic evidence of an earthquake results from displacement of the ground along a fault line. Utility lines and roads may be disrupted but damage directly attributable to ground displacement is generally limited. In rare instances, structure located directly on the fault line may be destroyed by the displacement.

Landslides and Avalanches: Even small earthquake events can cause landslides. Rock falls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landslide activity, hampering response and recovery operations.

Liquefaction and Subsidence: Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage. The oscillation and failure of the soils may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like waterspouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

Seiches: Seismic waves may rock an enclosed body of water (e.g., lake or reservoir), creating an oscillating wave referred to as a "seiche." Although not a common cause of damage in past Ohio earthquakes, there is a potential for large, forceful waves similar to tsunami ("tidal waves") to be generated on the large lakes of the state. Such a wave would be a hazard to shoreline development and pose a significant risk on dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding.

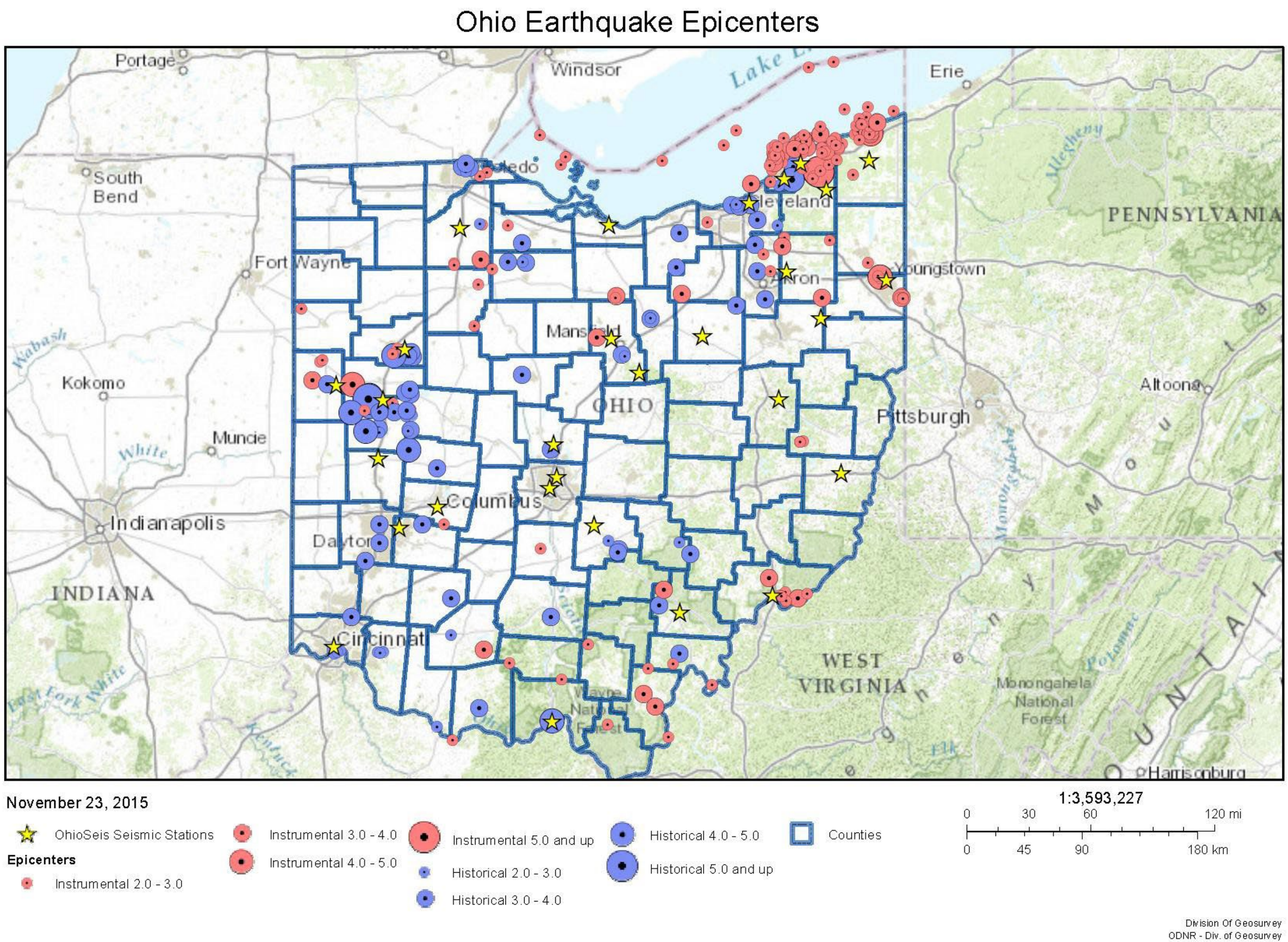
REGULATORY ENVIRONMENT

Ohio building codes generally do not focus on construction relative to earthquake loads. In such instances where earthquakes of seismic events are mentioned, it is usually in relation to truss design and anchoring of appliances in structures.

HAZARD EVENTS

Franklin County has not been the site of an earthquake epicenter. However, the effects from earthquakes in other parts of the state, as well as other parts of the nation have been felt within central Ohio.

Figure 1-19 shows epicenters in the State of Ohio from 1970 – 2015.



MAGNITUDE/SEVERITY

EARTHQUAKE

The most common method for measuring earthquakes is magnitude, which measures the strengths of earthquake. Although the Richter Scale is known as the measurement for magnitude, the majority of scientists currently use either the M_W Scale or Modified Mercalli Intensity (MMI) Scale. The effects of an earthquake in a particular location are measured by intensity. Earthquake intensity decreases with increasing distance from the epicenter of the earthquake.

The magnitude of an earthquake is related to the total area of the fault that ruptured, as well as the amount of offset (displacement) across the fault. As shown in Table 1-25, there are seven earthquake magnitude classes, ranging from great to micro. A great class of magnitude can cause tremendous damage to infrastructure at the university, compared to a micro class, which results in minor damage to infrastructure.

Table 1-25 Moment Magnitude Scale

Magnitude Class	Magnitude Range (M = Magnitude)	Probable Damage Description
Great	M > 8	Tremendous damage
Major	7 <= M < 7.9	Widespread heavy damage
Strong	6 <= M < 6.9	Severe damage
Moderate	5 <= M < 5.9	Considerable damage
Light	4 <= M < 4.9	Moderate damage
Minor	3 <= M < 3.9	Rarely causes damage.
Micro	M < 3	Minor damage

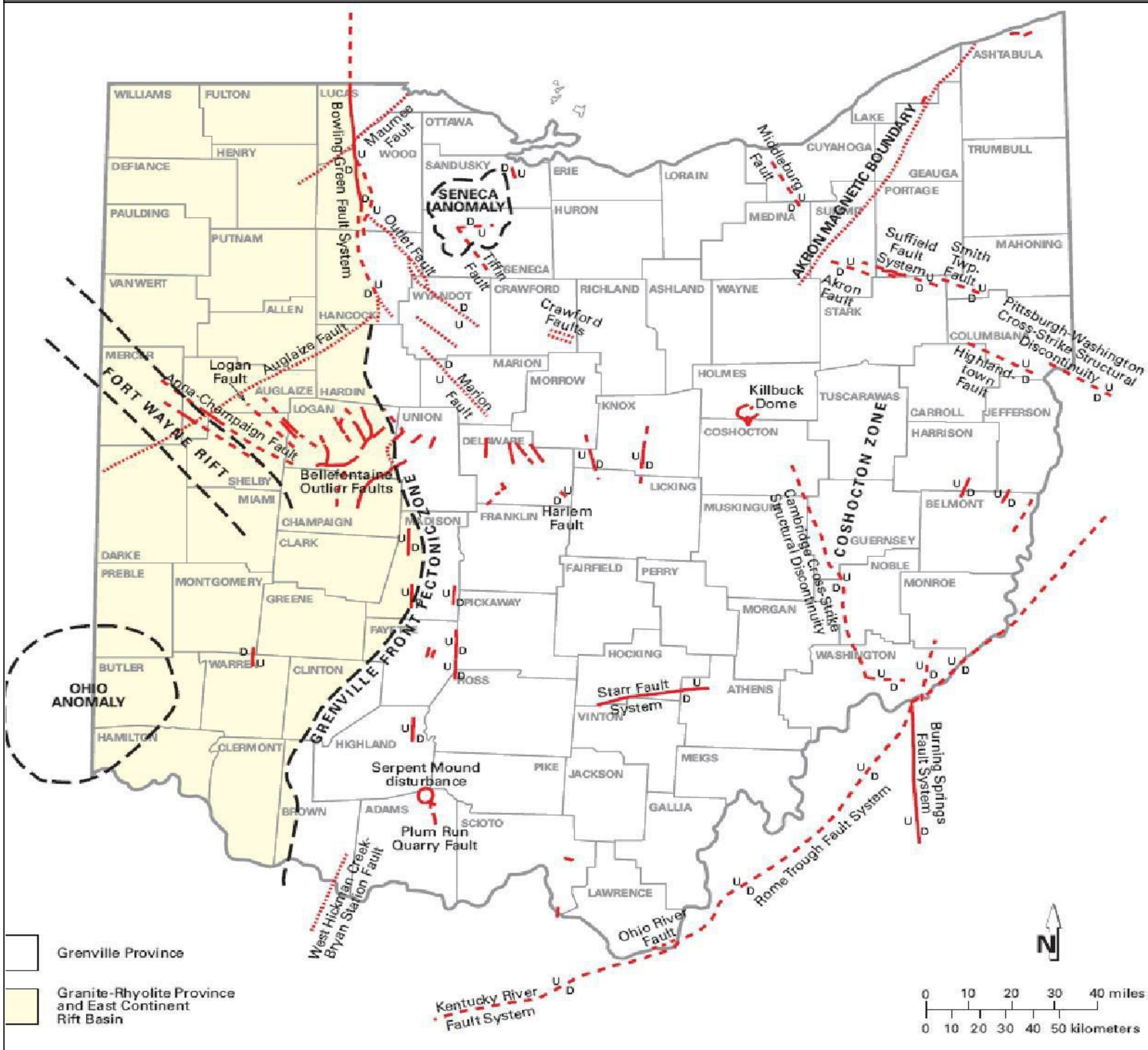
The MMI Scale measures earthquake intensity as shown in Table 1-26, the MMI Scale has 12 intensity levels. Each level is defined by a group of observable earthquake effects, such as ground shaking and/or damage to infrastructure. Levels I through VI describe what people see and feel during a small to moderate earthquake. Levels VII through XII describe damage to infrastructure during a moderate to catastrophic earthquake.

Table 1-26 Modified Mercalli Scale: Earthquake Magnitude and Intensity		
Magnitude (M_w)	**Intensity (Modified Mercalli Scale)**	**Description**
1.0 – 3.0	I	I. Not felt except by very few people under especially favorable conditions.
3.0 – 3.9	II – III	II. Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
		III. Felt quite noticeably indoors. Many do not recognize it as an earthquake. Standing motorcars may rock slightly.
4.0 – 4.9	IV – V	IV. Felt by many who are indoors; felt by a few outdoors. At night, some awakened. Dishes, windows, and doors rattle.
		V. Felt by nearly everyone; many awakened. Some dishes and windows broken; some cracked plaster; unstable objects overturned.
5.0 – 5.9	VI – VII	VI. Felt by everyone; many frightened and run outdoors. Some heavy furniture moved; some fallen plaster or damaged chimneys.

Earthquake Magnitude and Intensity		
Magnitude (M_w)	Intensity (Modified Mercalli Scale)	Description
		VII. Most people alarmed and run outside. Damage negligible in well-constructed buildings; considerable damage in poorly constructed buildings.
6.0 – 6.9	VII – IX	VIII. Damage slight in special designed structures; considerable in ordinary buildings; great in poorly built structures. Heavy furniture overturned. Chimneys, monuments, etc. may topple.
		IX. Damage considerable in specially designed structures. Buildings shift from foundations and collapse. Ground cracked. Underground pipes broken.
7.0 and Higher	VIII and Higher	X. Some well-built wooden structures destroyed. Most masonry structures destroyed. Ground badly cracked. Landslides on steep slopes.
		XI. Few, if any, masonry structures remain standing. Railroad rails bent; bridges destroyed. Broad fissure in ground.
		XII. Virtually total destruction. Waves seen on ground. Objects thrown into the air.

As indicated earlier, just as there are multiple sources of seismic activity in Ohio, the location of seismic activity varies as well. Many earthquakes do occur along faults. Information about faults can be obtained from the Ohio Seismic Network at: http://www.dnr.state.oh.us/geosurvey/default/tabid/8144/Default.aspx

Ohio Fault lines



Basement structures in Ohio (modified from Division of Geological Survey Map PG-23, 2002). This map portrays a number of deep faults and other structures that have been identified by a variety of geologic studies. Some faults are well known, whereas others are speculative. Very few of them are visible at the surface. The Fort Wayne (Anna) rift in western Ohio is the site of numerous historic earthquakes.

Figure 1-20 Fault Lines in the State of Ohio

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

There are no recorded epicenters in Franklin County. Movement or shaking as a result of an epicenter in other parts of the state or country have not generated damages sufficient enough to be recorded. As such, it is impossible to analyze the frequency of past events in order to extrapolate a future probability. Based on the lack of recorded events, the occurrence of earthquakes is deemed to be unlikely but possible.

INVENTORY ASSETS EXPOSED TO SEISMIC/EARTHQUAKE ACTIVITY

The method used in determining the types and numbers of potential assets exposed to earthquake damage was conducted using a loss estimation model called HAZUS-MH. HAZUS- MH is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Buildings Sciences (NIBS). This program was conducted at the census block level, and so it includes damages to non-university structures as well. For this Plan, a 5.5 magnitude earthquake was modeled, and the results are presented below.

Although a 5.5 magnitude has never occurred within the planning area for this document, this is the accepted baseline for simulating potential losses due to seismic events. The software takes into account the depth of the epicenter, as well as its location. In addition, the program helps to determine the potential losses based on the prevailing soil types in the region.

Franklin County is historically at an exceptionally low vulnerability to seismic activity. The nearest major fault (New Madrid) is hundreds of miles away. Most sources indicate that even a major event on this fault (8.0 on Richter scale) would not be felt in Franklin County. The lack of historical events in the County, along with the relatively low PGA associated with the lands around the area put seismic events extremely low in the category of probability of occurrence. With this in mind, the probability for a seismic event in the County is low. However, if for some reason an event was to occur with the County near the epicenter, there is no way to comprehend the amount of damage that could be sustained by the municipalities within the County.

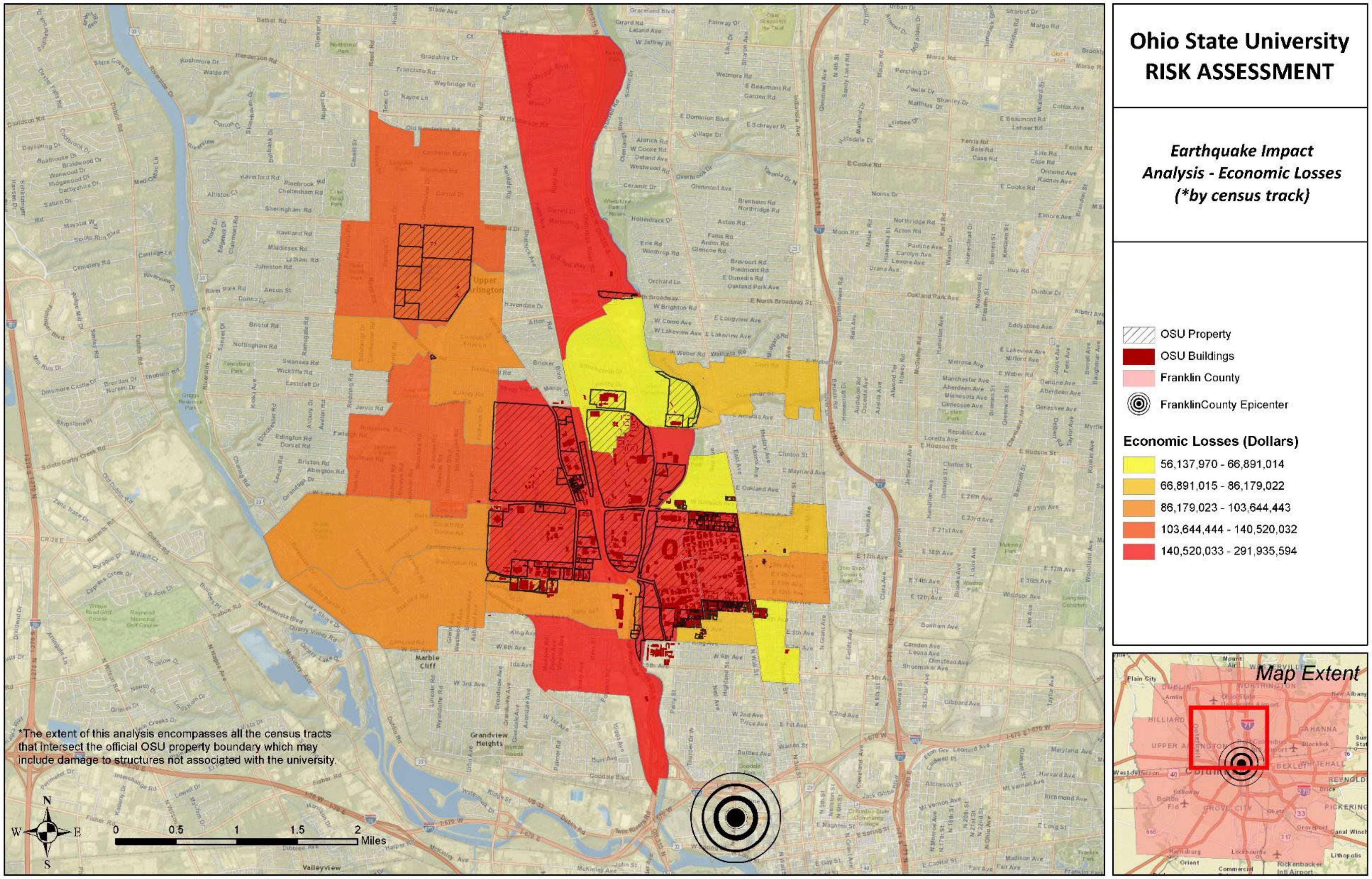


Figure 1-21 Potential Losses from a 5.5 Magnitude Event in Franklin County

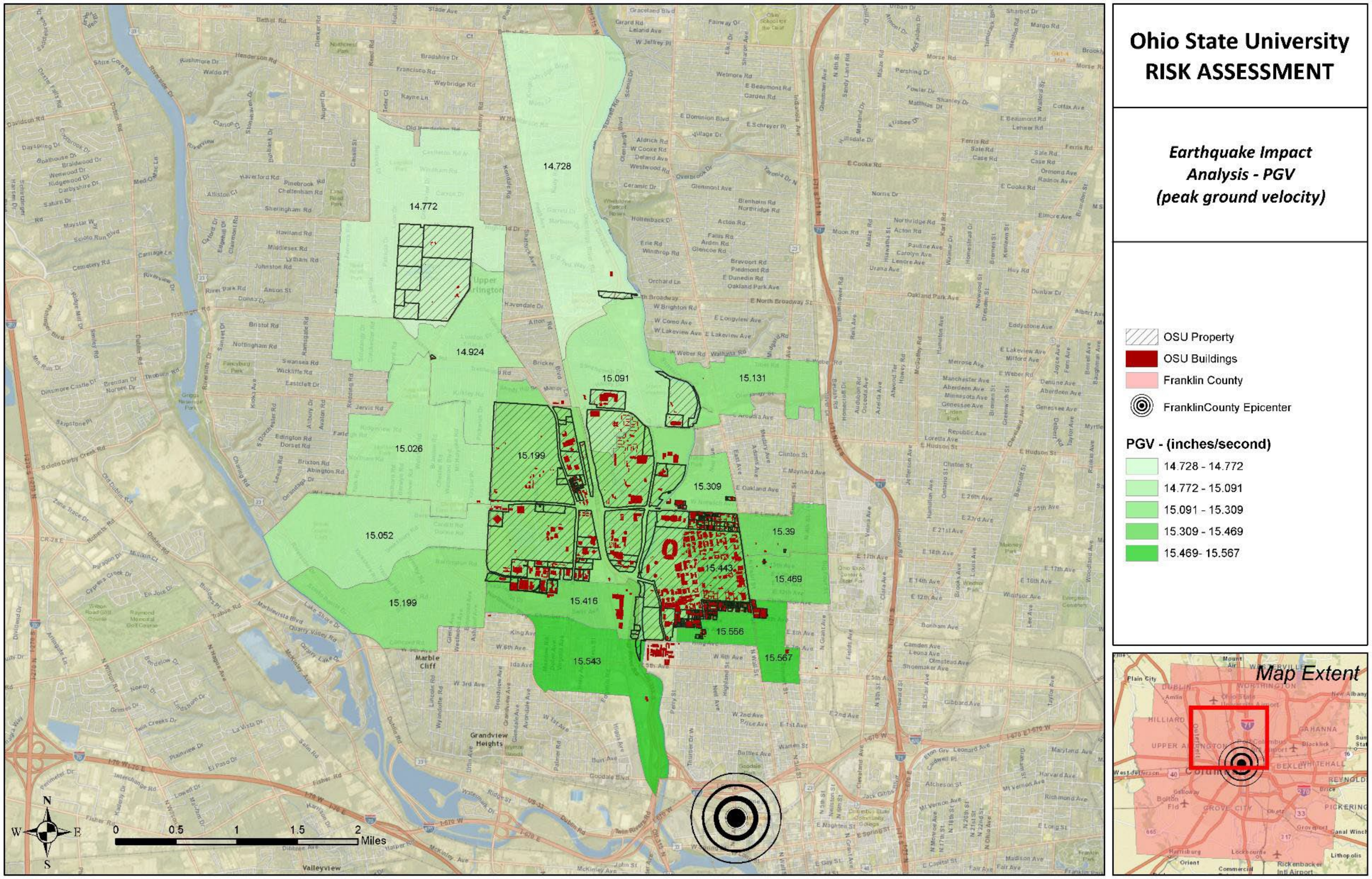


Figure 1-22 Peak Ground Velocity Resulting from a 5.5 Magnitude Event in Franklin County

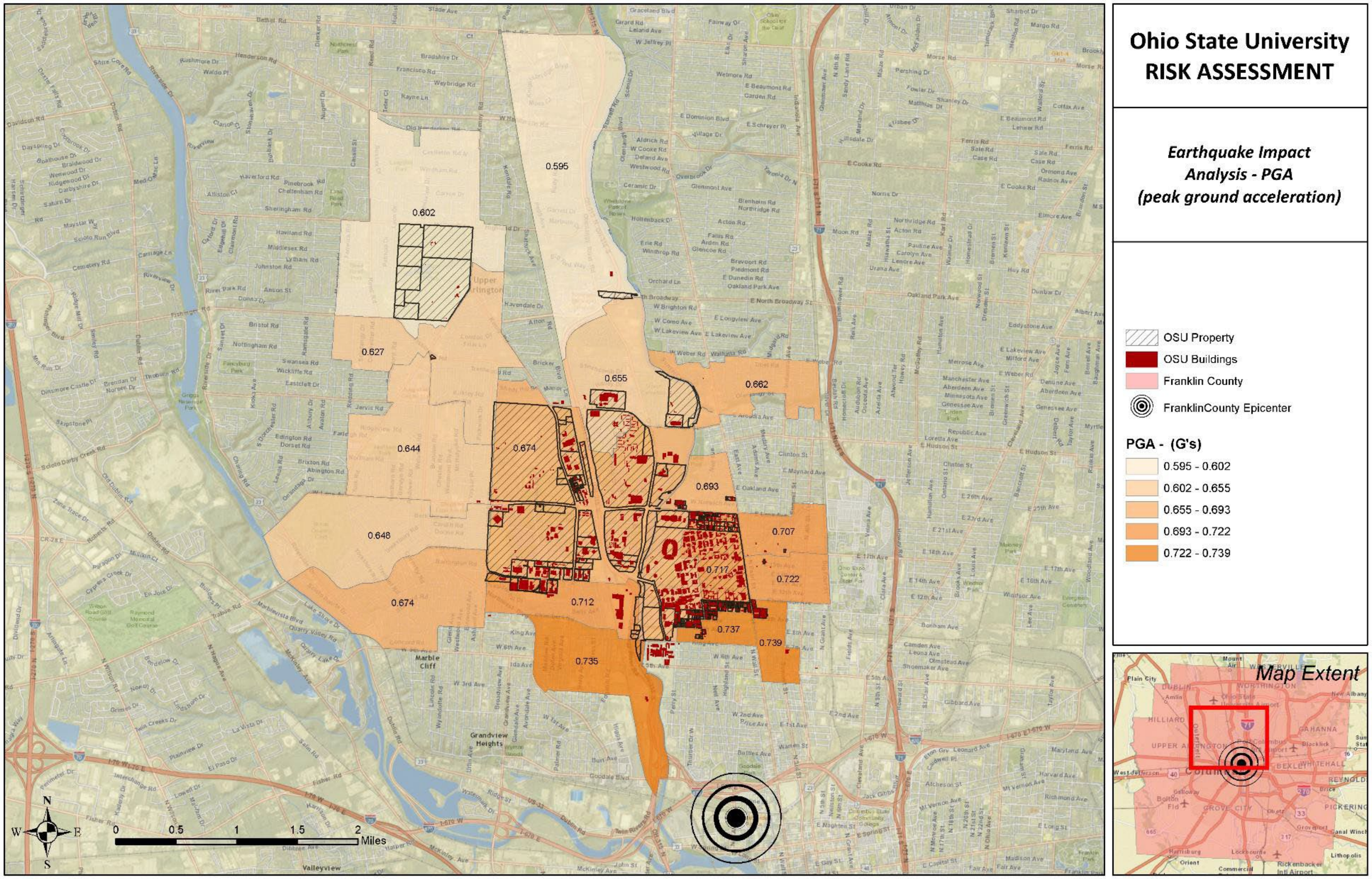


Figure 1-23 Peak Ground Acceleration Resulting from a Magnitude 5.5 Event in Franklin County

MITIGATION STRATEGIES

The effects of an earthquake (if the hazard exists) could potentially be anything from detected only on seismographs to ground water wells collapsing to total destruction, trees falling, ground rises and falls in waves. Continued enforcement of the unified construction code should mitigate this vulnerability.

SEISMIC EVENT MITIGATION ACTIONS

Seismic Event Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 7: Understand the impact of, and increase resiliency to, seismic events					
Objective 7.1: Undertake structural and infrastructure improvements to increase resilience to seismic events					
7.1.1 Evaluate current building standards and evaluate changes to increase resilience to seismic events	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$300,000	Operating Budgets	Canceled
7.1.2 Install leak detection systems on utility infrastructure	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	TBD by Scope, $300,000 for Initial Study	Operating Budgets	Canceled
Objective 7.2: Develop and deploy public education campaigns related to seismic events					
7.2.1 Develop a public education campaign to be delivered throughout the university **conveying seismic risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	Ongoing. 06/01/2021-06/01/2026

EARTHQUAKE HIRA SUMMARY

Most sources in the geology science predict that the largest magnitude earthquake that might occur in the state of Ohio would register no higher than five (5). However, some sources state that a magnitude of six (6), maybe higher, could be registered in the Anna region. An event of this intensity would likely be felt at the university. However, since the area has not been the epicenter to an earthquake or seismic event it is difficult to estimate the damage that could occur.

FLOOD HAZARD PROFILE

Hazard Assessment Chart											
Natural Hazards	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Flooding	4	1.2	4	1.2	3	0.6	4	0.4	3	0.3	**3.5**
HIGH RISK HAZARD (3.0 – 3.9)											

HAZARD IDENTIFICATION

The university is bisected by the Olentangy River, which originates in Crawford County 50 miles to the North of Columbus. The total drainage area supplying surface runoff to the Olentangy River is 543 sq. mi. The river system is a tributary of the Scioto River, and a part of the Scioto River Watershed.

A flood is a natural event for rivers and streams and occurs when a normally dry area is inundated with water. Excess water from snowmelt or rainfall accumulates and overflows onto the stream banks and adjacent floodplains. As illustrated in the figure below, floodplains are lowlands, adjacent to rivers, streams and creeks that are subject to recurring floods. Flash floods, usually resulting from heavy rains or rapid snowmelt, can flood areas not typically subject to flooding, including urban areas. Extreme cold temperatures can cause streams and rivers to freeze, causing ice jams and creating flood conditions.

The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps (FIRM) are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the Special Flood Hazard Area (SFHA) and identify Base Flood Elevations. Figure 1-2 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA.

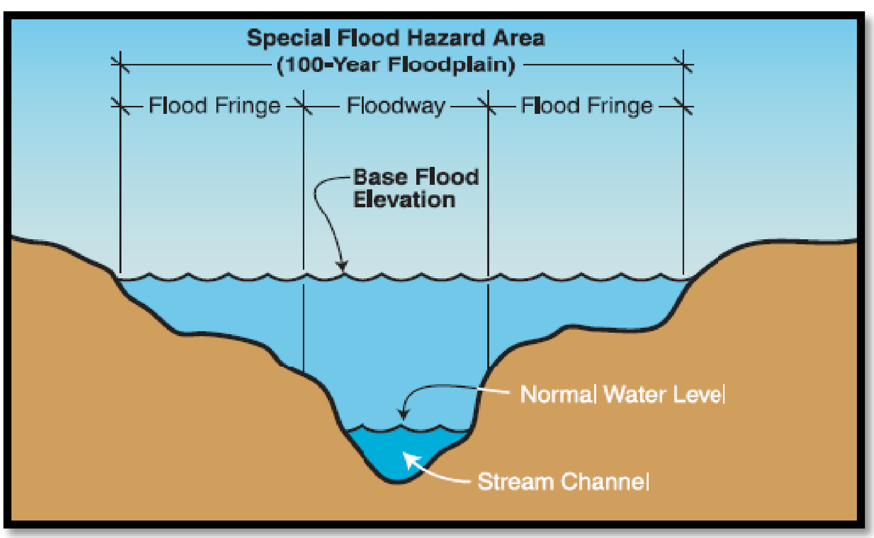


Figure 1-2 Diagram identifying Special Flood Hazard Area, 1% annual chance (100-Year) floodplain, floodway and flood fringe, FEMA.

Floods are considered hazards when people and property are affected. Nationwide, hundreds of floods occur each year, making it one of the most common hazards in all 50 states and U.S. territories. In Ohio, flooding occurs commonly and can occur during any season of the year from a variety of sources. Most injuries and deaths from flooding happen when people are swept away by flood currents and most property damage results from inundation by sediment- filled water. Fast-moving water can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can cause extensive damage. Flooding can cause extensive damage to crop lands and bring about the loss of livestock. Several factors determine the severity of floods, including rainfall intensity and duration, topography, and ground cover.

Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. Water from snowmelt, rainfall, freezing streams, ice flows, or a combination thereof, causes the river or stream to overflow its banks into adjacent floodplains. Winter flooding usually occurs when ice in the rivers creates dams or streams freeze from the bottom up during extreme cold spells. Spring flooding is usually the direct result of melting winter snowpacks, heavy spring rains, or a combination of the two.

Flash floods can occur anywhere when a large volume of water flows or melts over a short time period, usually from slow moving thunderstorms or rapid snowmelt. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Most flood deaths result from flash floods.

Urban flooding is the result of development and the ground’s decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. Urbanization can increase runoff two to six times more than natural terrain. (National Oceanic and Atmospheric Administration, 1992) The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.

Stream Bank Erosion is measured as the rate of the change in the position or horizontal displacement of a stream bank over a period of time. It is generally associated with riverine flooding and discharge, and may be exacerbated by human activities such as bank hardening and dredging.

Ice Jams are stationary accumulations of ice that restrict flow. Ice jams can cause considerable increases in upstream water levels, while at the same time, downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood or dam failure. Ice jam flooding generally occurs in the late winter or spring.

Flood reduction, prevention, and mitigation are major challenges to the university. Localized flooding occurs in the university area when rainfall runoff volumes exceed the design capacity of drainage facilities or due to a lack of flood control structures in place. Heavy seasonal rainfall can result in stream overflows.

REGULATORY ENVIRONMENT

The university falls within the FEMA regulatory Special Flood Hazard Area (SFHA) along the Olentangy River. The Firm panels covering the university were made effective on June 17, 2008. However, a recent project conducted downstream from the university, resulting in the removal of low head dams from the Olentangy, resulted in a Letter of Map Revision (LOMR) being filed. The effective date of this LOMR and its revised data is May 14, 2015. In conjunction with the Ohio State University’s Framework 3.0, the Cannon Drive Project involves the straightening and elevating of Cannon Drive (to create a class 1 levee) which will support future growth of the university and the Medical Center by:

- Creating 12 acres of developable land
- Serving as future flood protection
- Creating an eventual north-south connection between King and Lane Avenues

- Enhancing green space in the Olentangy River corridor

The project began September 5, 2017, and the first phase of construction was completed in autumn 2019. The second phase of the project is scheduled to begin in 2023. Completion of this project will protect campus and medical center infrastructure from both 100 year and 500-year floods.

The Ohio State University (Columbus campus) is situated within the City of Columbus. The City of Columbus' status in the NFIP can be seen in Table 1-3.

Table 1-3 City of Columbus Community Status in the NFIP						
CID	**COMMUNITY NAME**	**COUNTY**	**INITIAL FHBM IDENTIFIED**	**INITIAL FIRM IDENTIFIED**	**CURRENT EFFECTIVE MAP DATE**	**REG-EMER DATE**
390170	Columbus, City of	Delaware County/Franklin County/Fairfield County	08/09/1974	07/05/1983	06/16/2011	06/16/2011

A levee is any artificial barrier together with appurtenant works that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from inundation by flood waters and are classified as follows:

- Class I: probable loss of human life, structural collapse of at least one residence or one commercial or industrial business
- Class II: disruption of a public water supply or wastewater treatment facility, or other health hazards; flooding of residential, commercial, industrial, or publicly owned structures; flooding of high-value property; damage or disruption to major roads including but not limited to interstate and state highways, and the only access to residential or other critical areas such as hospitals, nursing homes, or correctional facilities as determined by the chief; damage or disruption to railroads or public utilities
- Class III: a levee having a height of not more than three feet and a levee having a height of more than three feet when sudden failure of the levee would result in at least one of the following conditions: property losses including but not limited to rural buildings not otherwise described in this rule; damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in this rule; property losses restricted mainly to the levee and to the owner's property or to rural lands.

BUILDING DESIGN STANDARDS

The university has a set of Building Design Standards (BDS) managed by Facilities Operations and Development. The purpose of these standards is to provide guidance when preparing construction documents.

Campus buildings contribute to the accomplishment of the university's academic mission in two important ways: First, of course, they provide enclosed, comfortable, spaces that serve activities ranging from generating steam to teaching philosophy -- spaces that serve the practical, as well as the intellectual and emotional, needs of students, faculty, staff, and visitors. Second, the university's buildings create a campus that is the setting for a unique academic community--a campus that also must serve practical, intellectual, and emotional needs. In addition, all construction that occurs on campus follows all applicable federal, state and local construction codes and regulations.

The Framework 3.0 Plan (https://pare.osu.edu/framework) and its interpretation by the Planning and Real Estate (PARE), offer direction for the development of the campus as a whole and the "Building Design Standards" guide architectural details and specifications. The conceptual design, which is focused on the schematic design process, falls between master planning and architectural detailing. Responsibility for schematic design direction rests with PARE, including the University Architect (UA) and University Landscape Architect (ULA) with input from professional designers from Architect/Engineer (A/E) firms and Facilities Operations and Development, together with members of the Project Planning Team.

The architectural program of requirements for each project reflects the point of view of both the user and the university as a whole. While the user's requirements will vary significantly from units to unit, there are overall university-wide issues that must be considered in the design of all buildings and landscapes. A summary of these issues serves as a general guide for conceptual design at The Ohio State University.

There is remarkable agreement among lay persons and professional architects regarding the world's best campuses and the characteristics that contribute to this ranking. These characteristics, from which the conceptual guidelines were derived, fall generally into categories that (1) reinforce the sense of academic community; (2) support the process of learning; and (3) enhance the sense of heritage and tradition.

HAZARD EVENTS

Flood hazard events are tracked by the NOAA National Climatic Data Center. However, these events are generally catalogued on a County or Jurisdictional level. As such, only incidents impacting the city of Columbus, or neighborhoods directly bordering the campus have been included on this list. In some cases, these events were limited to street flooding and closures. Specific historical narratives relative to the university will be covered in section 4.3.4 of the plan.

Location	Date	Type	Death	Injury	Property Damage
Franklin (zone)	**1/17/1996**	**Flood**	**0**	**0**	**$ 5,000.00**
Countywide	5/8/1996	Flash Flood	0	0	$ 4,000.00
Columbus	7/18/1996	Flash Flood	0	0	$ -
Columbus	7/30/1996	Flash Flood	0	0	$ 3,000.00
Franklin (zone)	6/1/1997	Flood	0	0	$ -
Countywide	6/1/1997	Flash Flood	0	0	$ 20,000.00
Countywide	6/2/1997	Flash Flood	0	0	$ 10,000.00

Countywide	6/2/1997	Flash Flood	0	0	$ 10,000.00
Countywide	6/16/1997	Flash Flood	0	0	$ 5,000.00
Countywide	4/16/1998	Flash Flood	0	0	$ -
West Portion	6/29/1998	Flash Flood	0	0	$ 1,000,000.00
Franklin (zone)	6/29/1998	Flood	0	0	$ -
Franklin (zone)	1/24/1999	Flood	0	0	$ -
Countywide	1/3/2000	Flash Flood	0	0	$ 10,000.00
Franklin (zone)	4/9/2000	Flood	0	0	$ -
Columbus	5/28/2000	Flash Flood	0	0	$ 5,000.00
Columbus	8/18/2000	Flash Flood	0	0	$ 5,000.00
Countywide	9/23/2000	Flash Flood	0	0	$ 20,000.00
Grove City	5/16/2001	Flash Flood	0	0	$ -
Columbus	5/21/2001	Flash Flood	0	0	$ 3,000.00
Franklin (zone)	5/28/2002	Flood	0	0	$ -
Franklin (zone)	6/5/2002	Flood	0	0	$ -
Franklin (zone)	7/23/2002	Flood	0	0	$ 2,000.00
Columbus	7/23/2002	Flash Flood	0	0	$ 22,000.00
Franklin (zone)	11/10/2002	Flood	0	0	$ -
Franklin (zone)	5/9/2003	Flood	0	0	$ -
Franklin (zone)	5/15/2003	Flood	0	0	$ -

Franklin (zone)	6/13/2003	Flood	0	0	$ -
Franklin (zone)	8/4/2003	Flood	0	0	$ -
Franklin (zone)	8/7/2003	Flood	0	0	$ -
Franklin (zone)	8/12/2003	Flood	0	0	$ -
Franklin (zone)	8/12/2003	Flood	0	0	$ -
Franklin (zone)	8/15/2003	Flood	0	0	$ -
Franklin (zone)	8/15/2003	Flood	0	0	$ -
Franklin (zone)	8/27/2003	Flood	0	0	$ -
Franklin (zone)	8/27/2003	Flood	0	0	$ -
Franklin (zone)	8/30/2003	Flood	0	0	$ -
Franklin (zone)	9/1/2003	Flood	0	0	$ 5,000.00
Franklin (zone)	9/27/2003	Flood	0	0	$ -
Franklin (zone)	1/4/2004	Flood	0	0	$ -
Franklin (zone)	1/4/2004	Flood	0	0	$ -
Franklin (zone)	1/4/2004	Flood	0	0	$ -
Franklin (zone)	5/21/2004	Flood	0	0	$ -
Columbus	5/21/2004	Flash Flood	0	0	$ -
Franklin (zone)	6/11/2004	Flood	0	0	$ -
Franklin (zone)	6/15/2004	Flood	0	0	$ -
Franklin (zone)	7/11/2004	Flood	0	0	$ -

Franklin (zone)	7/22/2004	Flood	0	0	$ -
Franklin (zone)	7/31/2004	Flood	0	0	$ -
Franklin (zone)	1/5/2005	Flood	0	0	$ 30,000.00
Franklin (zone)	1/11/2005	Flood	0	0	$ 15,000.00
Franklin (zone)	1/13/2005	Flood	0	0	$ -
Franklin (zone)	6/8/2005	Flood	0	0	$ -
Franklin (zone)	6/10/2005	Flood	0	0	$ -
Franklin (zone)	6/30/2005	Flood	0	0	$ -
Franklin (zone)	8/30/2005	Flood	0	0	$ -
Columbus	10/4/2006	Flash Flood	0	0	$ 2,000.00
Columbus	3/14/2007	Flood	0	0	$ 5,000.00
Grandview Heights	6/12/2008	Flash Flood	0	0	$ 10,000.00
Columbus	7/12/2010	Flash Flood	0	0	$ 2,000.00
Columbus	7/13/2010	Flash Flood	0	0	$ 1,000.00
Ohio State University Apartments	4/4/2011	Flash Flood	0	0	$ 2,000.00
South Columbus	7/24/2011	Flash Flood	0	0	$ 30,000.00
Columbus	7/24/2011	Flash Flood	0	0	$ 20,000.00
Grandview Heights	7/22/2013	Flood	0	0	$ -
Grandview Heights	7/22/2013	Flash Flood	0	0	$ 1,000.00

NEW ALBANY	6/29/ 2013	Flood	0	0	$ -
CENTRAL COLLEGE	6/29/ 2013	Flash Flood	0	0	$ 1,000.00
GRANDVIEW HGTS	7/22/ 2013	Flood	0	0	$ -
GRANDVIEW HGTS	7/22/ 2013	Flash Flood	0	0	$ 1,000.00
(CMH)PORT COLUMBUS A	7/22/ 2013	Flood	0	0	$ -
Franklin (zone)	7/22/ 2013	Flood	0	0	$ -
Franklin (zone)	12/22 /2013	Flash Flood	0	0	$ 1,000.00
Franklin (zone)	6/24/ 2014	Flood	0	0	$ 10,000.00
Franklin (zone)	6/24/ 2014	Flood	0	0	$ -
Franklin (zone)	6/25/ 2014	Flood	0	0	$ -
Franklin (zone)	6/28/ 2014	Flood	0	0	$ -
Franklin (zone)	6/28/ 2014	Flood	0	0	$ -
Franklin (zone)	7/12/ 2015	Flood	0	0	$ -
Franklin (zone)	7/12/ 2015	Flash Flood	0	0	$ -
Franklin (zone)	7/12/ 2015	Flood	0	0	$ -
Franklin (zone)	7/12/ 2015	Flood	0	0	$ -
Franklin (zone)	7/12/ 2015	Flood	0	0	$ -
Franklin (zone)	9/3/2 015	Flood	0	0	$ -
Franklin (zone)	9/3/2 015	Flood	0	0	$ -
GRANDVIEW HGTS	5/28/ 2016	Flood	0	0	$ -

GRANDVIEW HGTS	6/23/ 2016	Flash Flood	0	0	$ -
GRANDVIEW HGTS	6/23/ 2016	Flash Flood	0	0	$ -
Franklin (zone)	6/23/ 2016	Flash Flood	0	0	$ -
Franklin (zone)	8/28/ 2016	Flash Flood	0	0	$ 2,000.00
Franklin (zone)	8/28/ 2016	Flash Flood	0	0	$ -
GRANDVIEW HGTS	7/10/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/10/ 2017	Flash Flood	0	0	$ -
UPPER ARLINGTON	7/10/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/10/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/10/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/10/ 2017	Flood	0	0	$ -
Franklin (zone)	7/13/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/13/ 2017	Flash Flood	0	0	$ -
Franklin (zone)	7/13/ 2017	Flood	0	0	$ -
(CMH)PORT COLUMBUS A	7/13/ 2017	Flood	0	0	$ -
Franklin (zone)	7/13/ 2017	Flood	0	0	$ -
Franklin (zone)	8/2/2 017	Flood	0	0	$ -
Franklin (zone)	5/21/ 2018	Flood	0	0	$ -
GROVE CITY	6/9/2 018	Flood	0	0	$ -
SOUTH COLUMBUS	6/21/ 2018	Flood	0	0	$ -

Franklin (zone)	6/21/2018	Flood	0	0	$ -
Franklin (zone)	7/23/2018	Flood	0	0	$ -
Franklin (zone)	7/23/2018	Flood	0	0	$ -
Franklin (zone)	7/23/2018	Flood	0	0	$ -
SOUTH COLUMBUS	8/11/2018	Flood	0	0	$ 2,000.00
Franklin (zone)	8/11/2018	Flood	0	0	$ -
Franklin (zone)	8/11/2018	Flood	0	0	$ -
SOUTH COLUMBUS	8/11/2018	Flood	0	0	$ -
GROVE CITY	9/1/2018	Flood	0	0	$ -
Franklin (zone)	9/1/2018	Flash Flood	0	0	$ 3,000.00
Franklin (zone)	6/19/2019	Flood	0	0	$ -
GRANDVIEW HGTS	6/19/2019	Flood	0	0	$ -
GRANDVIEW HGTS	6/19/2019	Flash Flood	0	0	$ -
GROVE CITY	6/19/2019	Flash Flood	0	0	$ -
PLEASANT CORNERS	6/19/2019	Flood	0	0	$ -
GROVE CITY	3/20/2020	Flash Flood	0	0	$ 5,000.00
Franklin (zone)	3/20/2020	Flash Flood	0	0	$ -
Franklin (zone)	3/20/2020	Flash Flood	0	0	$ -
Franklin (zone)	5/18/2020	Flood	0	0	$ -
GRANDVIEW HGTS	5/19/2020	Flash Flood	0	0	$ 5,000.00

Franklin (zone)	5/19/2020	Flash Flood	0	0	$ 20,000.00
Franklin (zone)	5/19/2020	Flash Flood	0	0	$ 50,000.00
Franklin (zone)	5/19/2020	Flood	0	0	$ -
Franklin (zone)	5/19/2020	Flood	0	0	$ 1,000.00
Franklin (zone)	5/19/2020	Flood	0	0	$ -
SOUTH COLUMBUS	5/19/2020	Flood	0	0	$ -
Franklin (zone)	5/19/2020	Flood	0	0	$ -
SOUTH COLUMBUS	5/19/2020	Flood	0	0	$ -
COLUMBUS	7/7/2020	Flood	0	0	$ -
GROVE CITY	7/27/2020	Flood	0	0	$ -
Franklin (zone)	4/29/2021	Flood	0	0	$ -
					$ 1,348,000.00

HISTORICAL OCCURRENCES

Franklin County has been a part of 10 Federal Disaster Declarations that included flooding. The Ohio State University has been able to avoid the bulk of the damages associated with flood events of this magnitude. However, the university has experienced localized riverine and urban flooding, impacting students, faculty, and staff, as well as university property.

March 1913: In March 1913, much of the west side of Columbus, and vast portions of the university's farmland were flooded. Nearly 500 people lost their lives and 100,000 lost their homes to the floods. No one on campus was hurt, and no livestock was lost, but the university was still affected.

Just before the flood, most students had gone home for Easter, returned to campus Monday, and flooding began on Tuesday. On Wednesday, classes were cancelled, and for the next few days professors took their classes all over the city to assist in relief efforts. Damages on campus were said to have been close to $10,000, plus the $3,000 cost of keeping the power plant operating.

The university attempted to fix the recurrent flooding problem by rerouting the river, which then created a spot to build the Ohio Stadium. But the problem of flooding was far from over: significant floods occurred again in 1922, prompting the creation of a levee in 1923 along the river (along where Cannon Drive now runs). The river was also widened, as part of a Works Progress Administration (WPA) project.[11]

DETAILS OF THE FLOOD Pages 3, 4 and 5

The Ohio State Lantern.

First Pictures and authentic news of University's part in great human tragedy

The Student Weekly of the Ohio State University

Vol. XXXII. No. 24. COLUMBUS, WEDNESDAY, APRIL 2, 1913. Price Five Cents

University is Practically at a Standstill While Students and Faculty Give Aid to Flood Victims; Strollers Will Add Their Profits to Relief Fund

Cadets Are Sent Out to Guard Stricken District; Vaccination Order Issued

Believed That No Undergraduates Are Drowned Although Some Are Yet Unheard From--Financial Loss to Ohio State Will Not Exceed $10,000--Men and Women Do Rescue Work Until Exhausted--Many Heroic Deeds Reported When River Was Highest--Other Institutions Offer Help

Although 192 acres of the Ohio State campus were completely covered Tuesday morning by the rise of the Olentangy river which runs through the University grounds, the damage to property is exceptionally small as compared with Columbus or the rest of the state. It will probably not exceed $10,000.

The track on the University spur was torn up and the trestle across the river was demolished. No coal or freight trains can enter the campus until this is repaired.

Heavy damage was done on the poultry farm on the west side of the river, including 1300 eggs about to hatch.

FIRST FLOOD VIEWS NEAR UNIVERSITY

The University spur, which is badly damaged, is submerged on a line near the houses in the background.

Prexy Makes Another Appeal to Assist in Labor of Restoration

Hundreds Respond to Call For Volunteers; Others Will Offer Services Later in Week; Estimated That 1000 Have Already Participated

Dramatic Society Decides on Three Benefit Performances Friday and Saturday; Committees Named to Insure Success of "The Cleanup"

More than one thousand students are estimated to have been engaged in the relief work for the flood district by noon Monday. One hundred and fifty-three students were signed up and assigned to work in less than two hours, Monday morning, by President W. O. Thompson, in the gymnasium. Most of these were sent to S. P. Bush, chairman of the Columbus Relief Committee at the City Prison.

"There is a big demand for University assistance, and every University man and woman will find plenty of work," said a member of the central relief committee. "The students are willing workers, and most of all they are intelligent workers. When they

Figure 1-3 The Lantern, April 2, 1913

Spring, 1927: Beginning in August of 1926, persistent heavy rainfall occurred and continued through the spring of 1927. Unprecedented amounts of run-off from rivers across the Midwest led to flooding on the Mississippi River. In Columbus, that flooding directly impacted The Ohio State University.

During spring break 1927, the Olentangy broke its banks, flooding the south towers and the track, but sparing the football field. In the Stadium's early years, minor floods were nearly an annual event. The Alumni Monthly remarked that "Old Man Olentangy ... feels the need of at least one workout a year on the graded playing fields and running tracks of the High Street Institution's great athletic plant.

January 1959: Rains of 3 to 6 inches fell on snow covered frozen ground, producing the most destructive flooding in Ohio since March 1913. All streams reached flood stage from January 21 to 24, killing 16 people, forcing 49,000 from their homes, and causing extensive damage to homes, businesses, roads, and bridges. Classic winter flood conditions existed across Ohio during January 1959. Soil frozen a foot deep was overlain by a snow cover. A large amount of rain fell across central Ohio on the headwaters of many of the state's largest rivers, causing the snow to melt and with frozen ground, nearly all of the water poured into streams.

On many streams, the flood levels of January 1959 were the highest since March 1913 and the second or third highest on record. The streets of Mansfield were under four feet of water and industries were closed by flood waters in Youngstown and Canton. Columbus was the most severely affected of Ohio's major cities, with many streets flooded, 100 homes badly damaged, and 3200 evacuees cared for at Red Cross shelters. One-third of Chillicothe was flooded when the Scioto River broke through a levee of sandbags. High water and ice jams on the Sandusky River flooded Upper Sandusky, Tiffin, and Fremont. Deaths and damage were much less than in the March 1913 flood because the January 1959 flood was less intense, flood-control reservoirs were built after

1913, and there was better communication of warnings, organized rescue work, and more adequate design of bridges and other structures.[13]

On The Ohio State University campus, the polo fields south of Ohio Stadium flooded, but the stadium itself was not impacted by the flood waters.

MAGNITUDE/SEVERITY

Magnitude and severity of flooding generally results from prolonged heavy rainfall and are characterized by high intensity, short duration events. Floods usually occur during the season of highest precipitations or during heavy rainfalls after long dry spells. Widespread storms over the region can occur anytime from September through April. Flooding is more severe when the ground is frozen and infiltration is minimal due to saturated ground conditions, or when rain-on- snow in the higher elevations adds snowmelt to rainfall runoff, resulting in intensified flood conditions.

Cloudburst storms, sometimes lasting as long as 3 hours, can occur over the region anytime from late spring to early fall. They also may occur as extremely severe sequences within general winter rainstorms or during unseasonable rains. The intensity of cloudburst storms is extremely high, and the storms can produce enough precipitation to result in significant runoff.

Surface flooding as well as some street flooding can occur during severe storms. Reports of minor flooding to garages and outbuildings, landscape erosion, and flooded streets have occurred in and around the university. Trash and other debris can also be found obstructing culvert and pipe openings during even moderate flows in smaller channels, which can lead to clogging, obstruction, and eventual flooding of nearby properties.

FLOOD WARNING AND NOTIFICATION

The magnitude and severity of flood damage can be reduced with longer periods of warning time and proper notification before flood waters arrive. Warning times of 12 hours or more have proven adequate for preparing communities for flooding and reducing flood damages. More than 12 hours advance warning of a flood can reduce a community's flood damage by approximately 40% in comparison with unprepared communities (Read Sturgess and Associates 2000). In addition, seasonal notification for flooding can enhance awareness for residents at risk, and when communicated effectively advance notification can reach target audiences on a large scale. The Ohio State University coordinates with the National Weather Service.

OLENTANGY RIVER CHARACTERISTICS

The Olentangy River is a tributary of the Scioto River. The total drainage area supplying surface runoff to the Olentangy River is 543 square miles.

There is a USGS river gage on the Olentangy River, at the John Herrick Bridge. This gage provides discharge information, as well as river height, in feet. This gage's data goes back to January of 2015. From January 2015, through November 2015, the highest recorded height is just over 11 feet. The discharge values have reached to just under 6000 cfs on five occasions over that 11-month period. At this time, this gage does not provide flood categories, historic crests, or recent crests.

The nearest gage that provides this data is roughly 8 miles upstream, located on the Olentangy River, near Worthington.

Considering the available records of all known floods in at this gage, it is probable that the ten

(10) largest floods along the Olentangy occurred in 1959, 1952, 1964, 1963, 1957, 1973, 2004, 1979, 1956, and 1969.   Historical Crests for the five largest floods of record for the Olentangy at Worthington are shown below.

Table 1-5 Highest Historical Crests on the Olentangy	
Date of Crest	Feet
1/21/1959	15.68
1/10/1952	15.3
5/19/2020	13.57
3/10/1964	12.66
6/23/2016	12.41
3/4/1963	11.68
5/20/1957	11.58
6/20/1973	11.55
6/14/2004	11.53
9/14/1979	11.45
5/27/1956	11.32
05/22/1969	11.23
1/24/1975	10.92
04/25/1961	10.61
5/27/1968	10.51
7/3/2019	10.37
1/12/2005	10.27
7/14/1966	10.25
12/5/2011	10.21
3/14/1967	10.19
8/8/1995	10
1/6/2005	9.67
11/19/2017	9.62
2/28/1962	9.61
06/13/1981	9.6

Table 1-5 Highest Historical Crests on the Olentangy	
12/20/1957	9.58
04/13/1972	9.53
01/14/2005	9.47
2/12/1965	9.22
6/6/2010	9.15
6/2/1980	9.1
2/28/2011	9.1
1/2/2005	8.95
4/14/2002	8.92
12/14/1959	8.81
12/22/2013	8.8
4/8/2000	8.66
2/18/1976	8.65
6/2/1997	8.55
3/21/1984	8.42
6/2/2006	8.38
6/26/2008	8.14
5/3/2011	8.1
2/22/1971	7.78
6/26/2015	7.49

Information on historical floods along the Olentangy was obtained from stream gauging stations maintained by NOAA.

Table 1-6 Flood Stage Categories for the Olentangy at Worthington	
FLOOD CATEGORIES	**FEET**
MAJOR FLOOD STAGE	15
MODERATE FLOOD STAGE	13
FLOOD STAGE	11
ACTION STAGE	8

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Reported flood events over the past 25 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the university or the surrounding area experiencing a flood event can be difficult to quantify, but based on historical record of 137 flood events since 1996, it can reasonably be assumed that this type of event has occurred once every 0.18 years from 1996 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 1996] = 25 Years on Record [(Years on Record) 25] divided by [(Number of Historical Events) 137] = 0.18

INVENTORY ASSETS EXPOSED TO FLOODING

In order to determine the inventory assets exposed to flooding, a comprehensive list of campus buildings that included replacement and investment values was used to geolocate those buildings on a campus map. This information was provided by Planning and Real Estate (PARE) and is current as of the 4th quarter of 2020. Once that base map was created, the 100 and 500-year FEMA flood hazard profiles were overlaid on that base map. This resulted in the software being able to identify the replacement and investment value of every structure that sits in the footprint of the 100 and 500-year Special Flood Hazard Area (SFHA).

In the 100-year SFHA, the university has more than $673 million in investment value in structures. The replacement value is over $900 million. These numbers represent the investment and replacement values of buildings in the SFHA. However, it is highly unlikely that a flood event would result in the total loss of these structures. These numbers are provided to offer context as to the potential threat.

In the 500-year SFHA, the university has more than $1.9 billion in investment value in structures. The replacement value of these structures is more than $2.3 billion. These numbers represent the investment and replacement values of buildings in the SFHA. However, it is highly unlikely that a flood event would result in the total loss of these structures. These numbers are provided to offer context as to the potential threat.

The Ohio State University has no repetitive loss properties nor severe repetitive loss properties within its' jurisdiction.

POTENTIAL LOSSES FROM FLOODING

All assets are considered at risk from flooding; however, losses may vary widely depending on the type and factors contributing to the flood. On campus, structures in the FEMA-designated SFHA (100 and 500-year) should be considered at an elevated risk. Not all flood events result in the total loss of structures. The expected damages to any given building on campus would be tied to the type of flooding, the depth to which it occurs, and the content exposed to the water. The most vulnerable buildings are depicted in Table ES-3.

Note: The attached SFHA Building Exposure by Replacement value maps are dated from FY2017. Due to the ongoing Cannon Drive Project, these maps have not been updated yet.

Table ES-3 Current Replacement Values of Most Vulnerable Buildings FY2022

Building Name	Replacement Cost
Postle Hall (0024)	$239,378,539
OSU Electric Substation (0079)	$5,267,060
Sisson Hall (0080)	$31,619,798
Ohio Stadium (0082)	$413,576,107
Parking Garage - Tuttle Park Pl (0088)	$49,965,718
Doan Hall (0089)	$388,219,037
Biomedical Research Tower (0112)	$255,069,553
Davis Heart and Lung Research Institute (0113)	$77,809,540
Aronoff Laboratory (0131)	$59,872,133
Wiseman Hall (0157)	$48,185,522
Tzagournis Medical Research Facility (0163)	$48,199,819
Harding Hospital (0165)	$73,711,141
Parking Garage - SafeAuto Hospitals (0170)	$47,411,983
Dodd Hall (0171)	$50,417,691
Physical Activity and Education Services - PAES (0245)	$88,193,708
Recreation and Physical Activity Center (0246)	$155,770,306
McCorkle Aquatic Pavilion (0247)	$73,802,901
Lincoln Tower (0271)	$141,353,488
Morrill Tower (0272)	$135,894,709
Parks Hall (0273)	$68,481,708
Parking Garage - Neil Ave (0287)	$40,526,257
Drake Performance and Event Center (0296)	$58,260,071
Atwell Hall (0306)	$51,142,060
Rhodes Hall (0354)	$298,303,736
Parking Garage - Twelfth Ave (0387)	$29,911,757
Chiller Plant, South Campus Central (0388)	$32,308,784
Institute for Behavioral Medicine Research (0878)	$43,742,755
Lawrence Tower (0891)	$63,301,679
Parking Garage - W Lane Ave (0892)	$12,562,192
Riverwatch Tower (0969)	$4,409,423
Parking Garage - Medical Center Tower (1028)	$88,936,442
Total:	**$3,175,605,617**

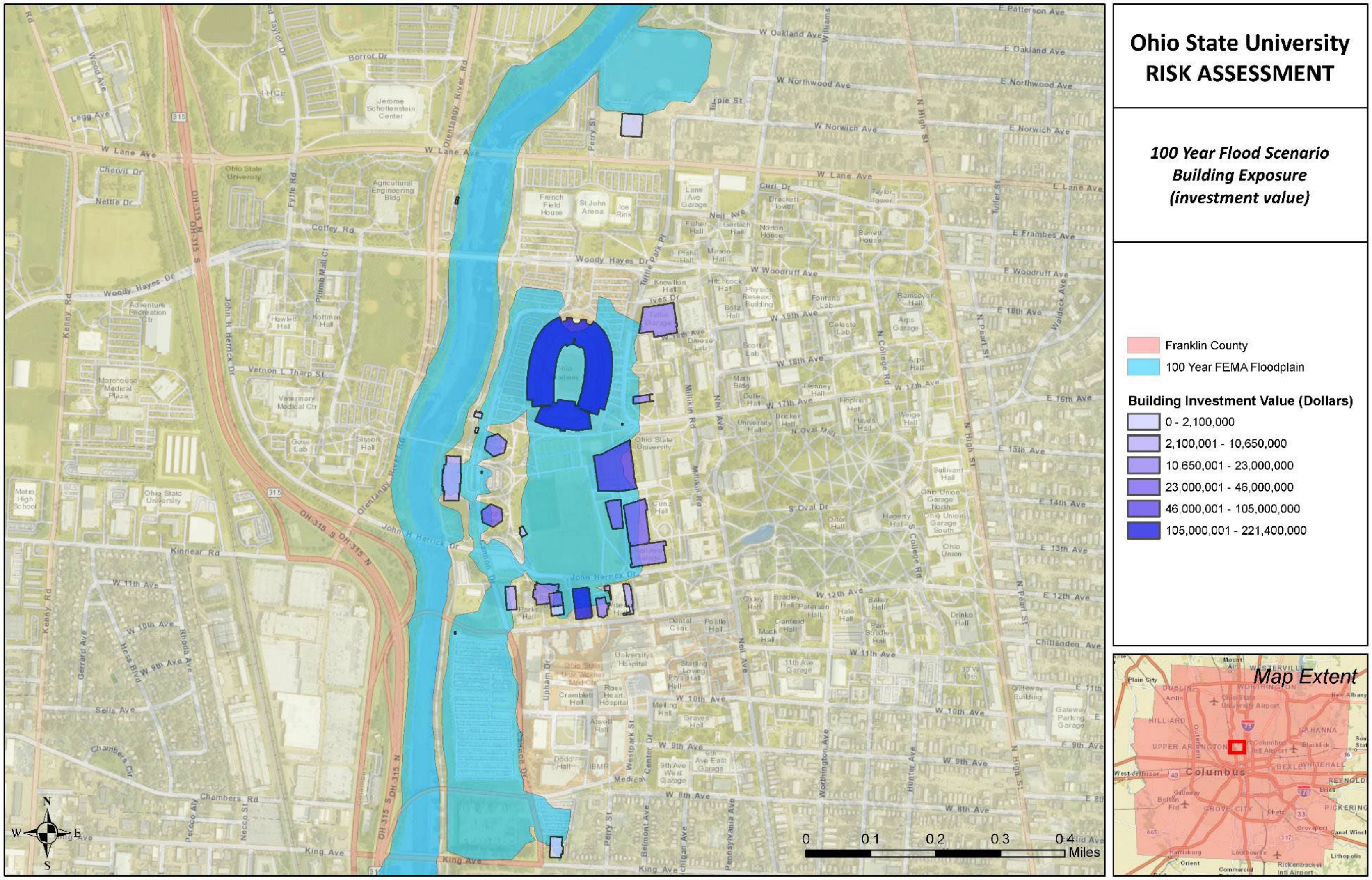


Figure 1-4 100-Year SFHA Building Exposure by Investment Value

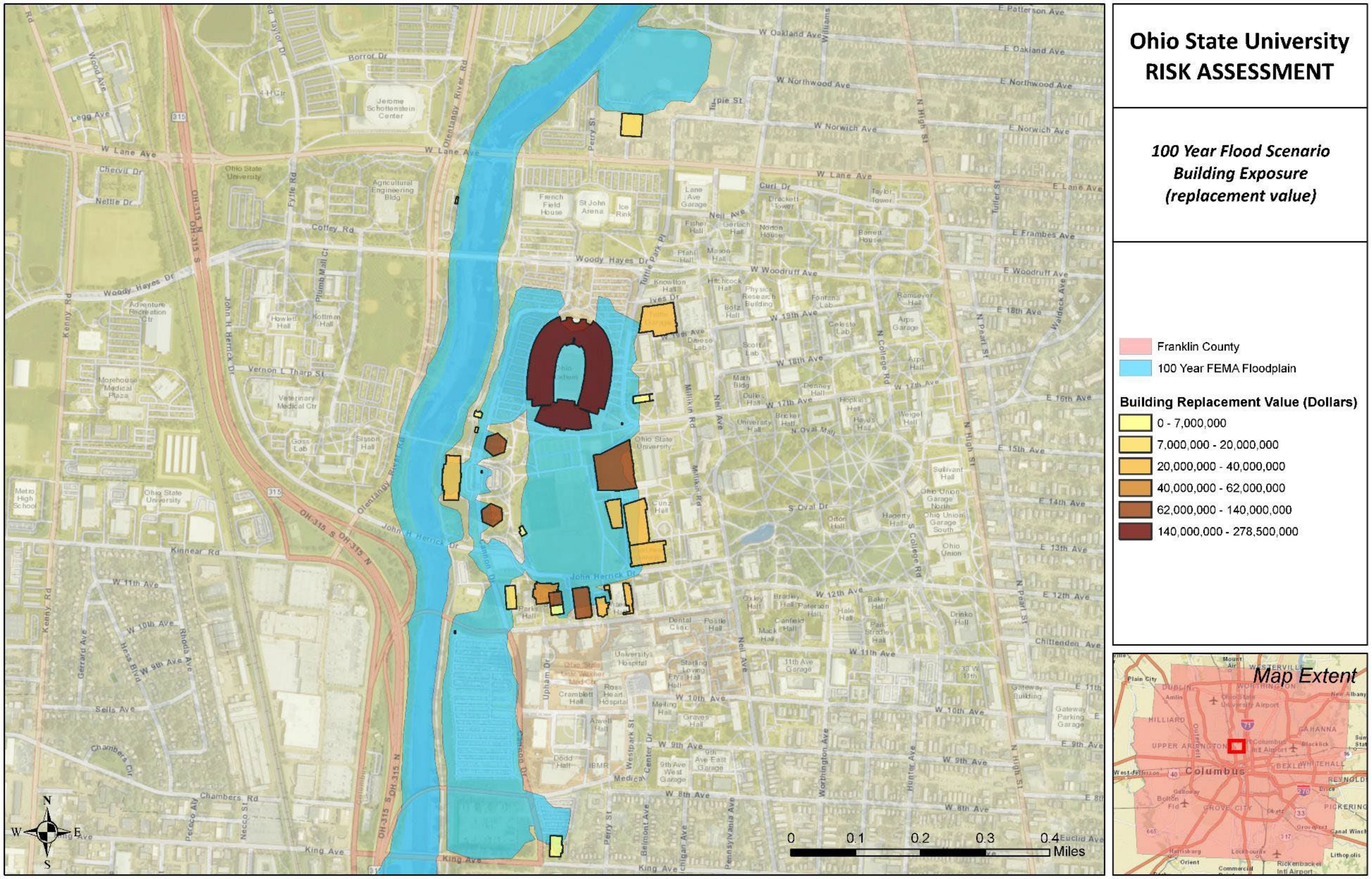


Figure 1-5 100-Year SFHA Building Exposure by Replacement Value

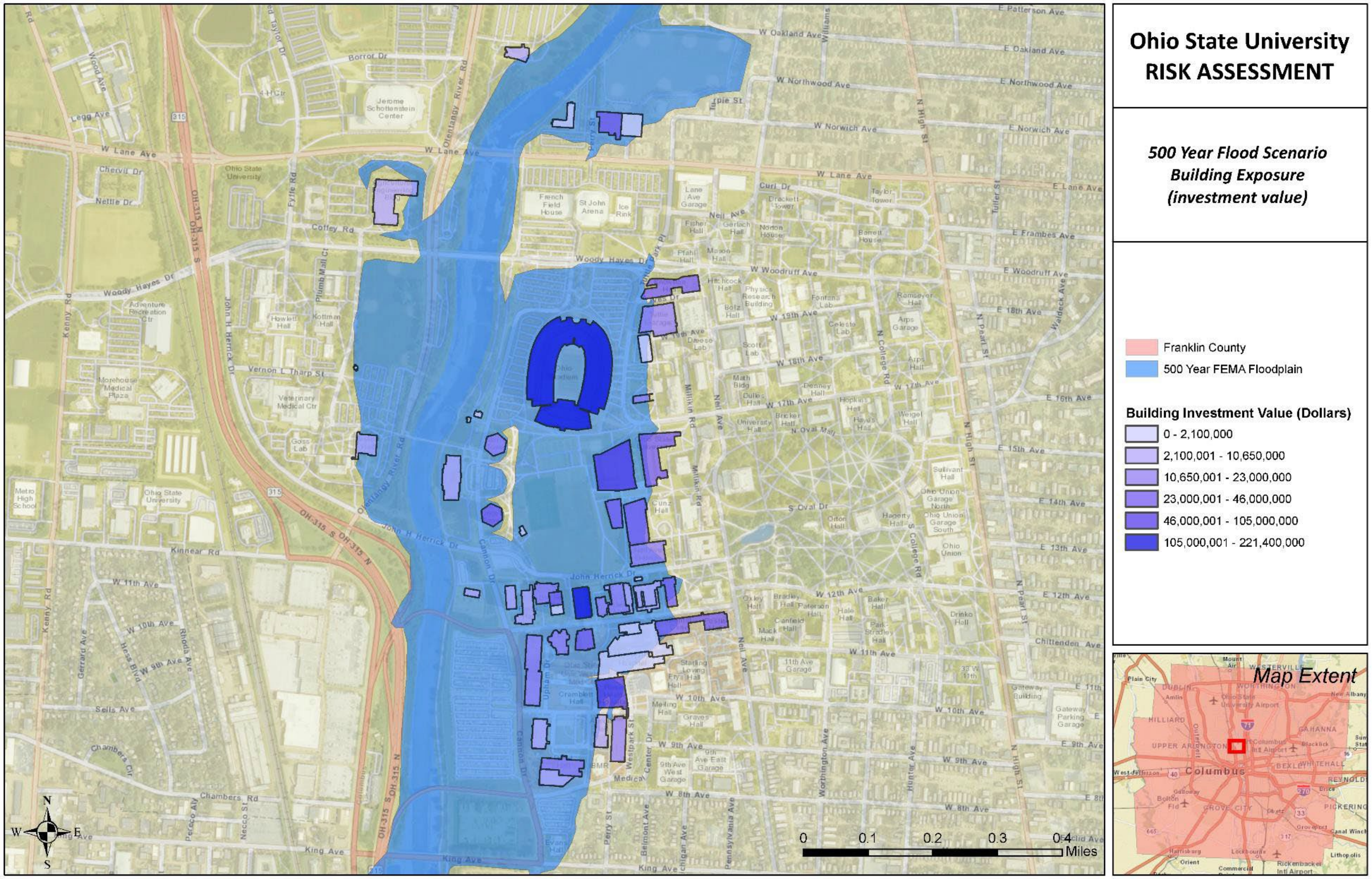


Figure 1-6 500-Year SFHA Building Exposure by Investment Value

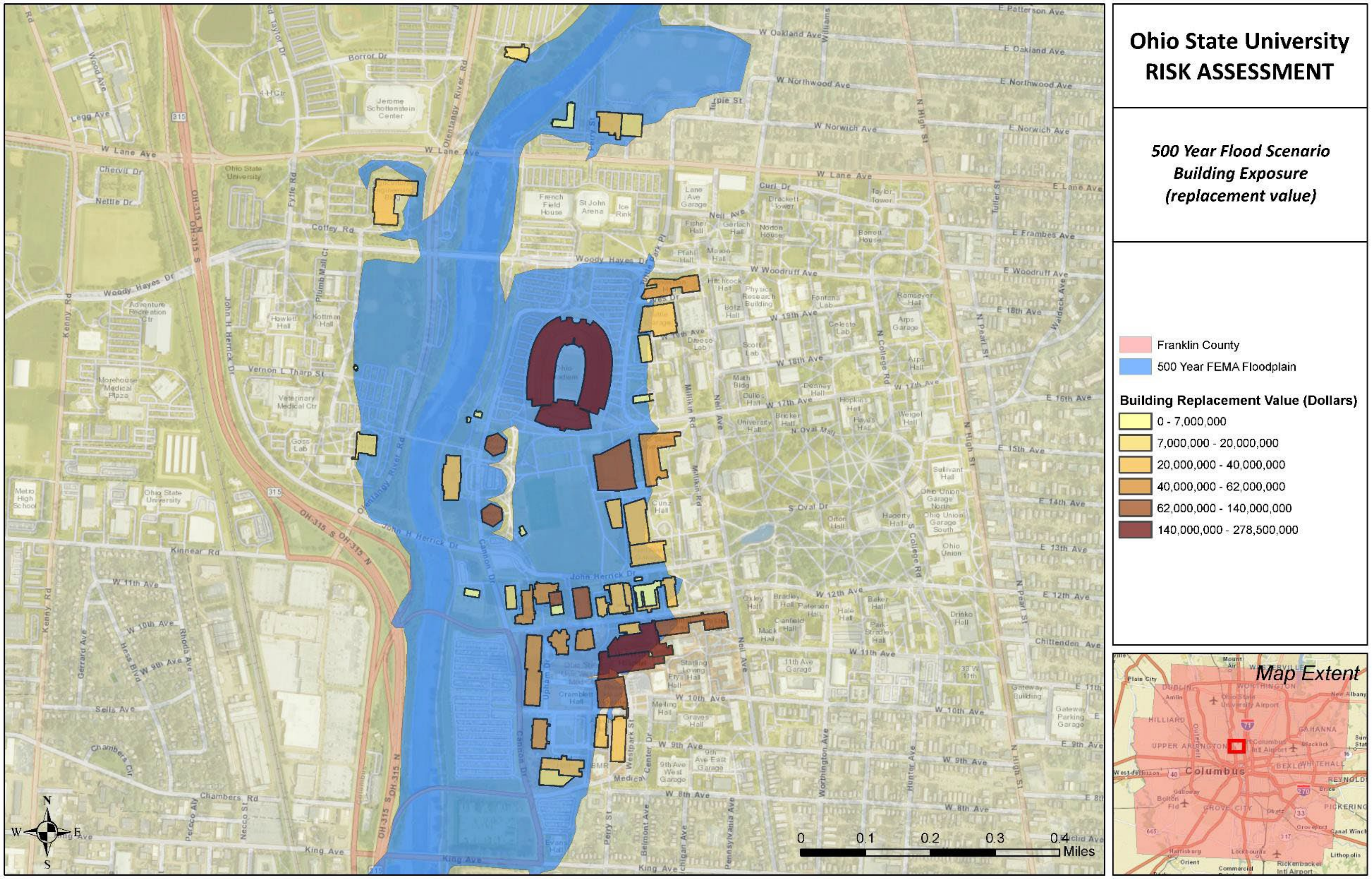


Figure 1-7 500-Year SFHA Building Exposure by Replacement Value

MITIGATION STRATEGIES

Besides the localized flooding, there is also the great amount of property, both private and public that is at risk from flooding. It is essential that land use plans take into account not only the dollar amount of damage that buildings near waterways could incur, but also the added risk of flood debris and narrowing the floodplains by building close to the rivers. The university has implemented the Framework 3.0, which includes the Cannon Drive project to address the potential for flooding along the Olentangy River.

Additional recommendations from the Ohio State University Flood Emergency Response Plan (FERP) to further protect the University from future flooding events are listed in Table ES-4 (below).

Table ES-4 Scale, Estimated Cost, and Viability of Recommended Protection

Priority	Project	Scale	Cost	Long-Term Viability / Reusability
1	**Elevation of Cannon Drive** (Phases I)	Large: Cannon Drive	$100,000,000	Long-term: permanent solution
2	**Elevation of Cannon Drive** (Phases 2)	Large: Cannon Drive	$120,000,000	Long-term: permanent solution
3	**Online Weather System**	N/A	$ 3,288 per year	Long-term: requires subscription
4	**River Gage**	Small: attaches to a bridge pylon	$ 3,322 $ 20 monthly fee	Long-term: remains on bridge pylon
5	**Check Valves** (3 backflow preventers)	Medium: Pipe infrastructure	$150,000	Long-term: permanent solution to prevent backflow
6	**Floor Drain** (895 drain covers)	Small: Building Scale	$ 11,733.45	Medium-term: semi-permanent, straightforward solution
7	**Expanded AquaFence System**	Large: Cannon Drive	None. Re-use existing panels	Long-term: panels can be rearranged throughout campus
8	**Manhole Covers** (444 covers)	Large: Cannon Drive	$ 270,840	Long-term: permanent solution that offers redundant protection against backflow
9	**Utility Vault Protection** (57 hatch covers)	Large: 100-and 500-year floodplains	$125,308.80	Long-term: permanent solution that offers protection against overhead floodwaters
10	**Flood Doors**	Small: Building Scale	$ 3,519,000	Long-term: permanent solution that offers redundant protection
11	**Sandbags** (1,000 bags)	Small: Entrances to buildings as needed	$ 3,390	Short-term: no reusability
	TOTAL		**$224,100,034.25**	**Estimated based on manufacturer/contractor quotes**

In conjunction with Framework 3.0, the relocation of Cannon Drive was a project developed by the Ohio State University that aimed to straighten and elevate Canon Drive to support future growth by creating 12 acres of developable land and serve as future flood protection for the surrounding area. Phase I occurred south of Herrick Bridge to King Avenue and increased the safety of the hospital area from 500-year elevation floods. Phase II is proposed to occur from Herrick Rd north to Lane Avenue and is scheduled to begin January 2023. The relocation of Cannon Drive Phase 2 primarily involves the reconstruction of Cannon Drive at a higher elevation and the deconstruction of the Drake Performance and Event Center. These construction activities have the potential to negatively impact the environmental integrity of the Olentangy River and its surrounding area. Completion of the Cannon Drive project will result in the creation of a Class I levee. A levee (as defined by ODNR) is any artificial barrier together with appurtenant works that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from inundation by flood waters and are classified as follows:

- Class I: probable loss of human life, structural collapse of at least one residence or one commercial or industrial business.
- Class II: disruption of a public water supply or wastewater treatment facility, or other health hazards; flooding of residential, commercial, industrial, or publicly owned structures; flooding of high-value property; damage or disruption to major roads including but not limited to interstate and state highways, and the only access to residential or other critical areas such as hospitals, nursing homes, or correctional facilities as determined by the chief; damage or disruption to railroads or public utilities
- Class III: a levee having a height of not more than three feet and a levee having a height of more than three feet when sudden failure of the levee would result in at least one of the following conditions: property losses including but not limited to rural buildings not otherwise described in this rule; damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in this rule; property losses restricted mainly to the levee and to the owner's property or to rural lands.

FLOODING MITIGATION ACTIONS

Action	Lead Agency/ Department	Implementation Schedule	Estimated Cost	Priority	Status Update
Flooding Mitigation Actions					
GOAL 1: Minimize the impact of flooding on the lives, property and infrastructure of The Ohio State University					
Objective 1.1: Further develop planning mechanisms related to flooding					
1.1.1 Evaluate current building design standards and evaluate changes to increase resilience	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$ 1,200,000.00	High	Ongoing. 06/01/2021-06/01/2026
Objective 1.2: Undertake structural and infrastructure improvements to increase resilience to flooding					
1.2.1 Develop and implement infrastructure improvements to existing storm and sanitary sewers	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2017	TBD by Scope	High	Ongoing. 06/01/2021-06/01/2026
1.2.2 Re-engineer and raise Cannon Drive to serve as both a roadway embankment and a levee to protect campus against a 500-year flood	Associate VP of Facilities, Operations and Development	01/01/2021-12/31/2024	TBD by Scope	High	Ongoing. 06/01/2021-06/01/2026
Objective 1.3: Develop and deploy public education campaigns related to flooding					
1.3.1 Develop a public education campaign to be delivered throughout the university conveying flood risk and actions	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$ 20,000.00	Medium	Ongoing. 06/01/2021-06/01/2026

FLOODING HIRA SUMMARY

Severe flooding has the potential to inflict significant damage in and around the university. Assessing flood damage requires residents throughout the university district to remain alert and notify local officials of potential flood prone areas near infrastructure such as roads, bridges, and buildings. While flooding remains a highly likely occurrence for the university, smaller floods caused by heavy rains and inadequate drainage capacity will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals. While the potential for flood is always present, the university does have policies and regulations for development that should help lessen potential damage due to floods.

TORNADO

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Tornado	**1**	**0.3**	**3**	**0.9**	**3**	**0.6**	**4**	**0.4**	**3**	**0.3**	**2.5**
MEDIUM RISK HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

Wind Can Be defined as the motion of air relative to the earth's surface. The horizontal component of the three- dimensional flow and the near-surface wind phenomenon are the most significant aspects of the hazard. Extreme windstorm events are associated with extra tropical and tropical cyclones, winter cyclones, and severe thunderstorms and accompanying mesoscale offspring such as tornadoes and downbursts. Winds vary from zero at ground level to 200-mph in the upper atmospheric jet stream at 6 to 8 miles above the earth's surface.

The damaging effects of windstorms associated with hurricanes may extend for distances in excess of 100 miles from the center of storm activity. For coastal areas from Texas to Maine, tropical cyclone winds may exceed 100 mph. Severe thunderstorms can produce wind downbursts and microbursts, as well as tornadoes. Severe windstorms result in as many as 1,000 tornadoes annually.

A **tornado** is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind- blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touchdown briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm.

Figure 1-17 Example of a Tornado Funnel 1

Structures made of light materials such as mobile homes are most susceptible to damage. Each year, an average of over 1,000 tornadoes are reported nationwide, resulting in an average of 80 deaths and 1,500 injuries.

Strong winds can also occur outside of tornadoes, severe thunderstorms, and winter storms. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems (one high pressure, one low pressure) are, the stronger the pressure gradient, and therefore, the stronger the winds are.

Downburst winds, which can cause more widespread damage than a tornado, occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, or an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A derecho, or bow echo, is a series of downbursts associated with a line of thunderstorms. This type of phenomenon can extend for hundreds of miles and contain wind speeds in excess of 100 mph.

REGULATORY ENVIRONMENT

There are negligible formal regulations that pertain to summer storm events. While there are suggested protective measures, especially for mobile/modular homes, these are generally not required in local codes.

HAZARD EVENTS

The university may experience intense winds from thunderstorms, tornadoes, and even the remnants of hurricanes and tropical storms. Tornadoes can occur any time of the year, though, peak tornado occurrences are in March through October as past county records indicate. As tornadoes are unpredictable, and no tornado has been recorded to have impacted the university directly, all tornadic events in Franklin County will be displayed in this section.

HISTORICAL OCCURRENCES

EVENT TYPES: TORNADO

34 events were reported between 01/01/1950 and 03/31/2022 (26388 days).

Column Definitions:
'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

Franklin County, Ohio Tornado History Since 1954											
Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
FRANKLIN CO.	FRANKLIN CO.	OH	06/26/1954	11:15	CST	Tornado	F0	0	0	25.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	10/11/1954	17:30	CST	Tornado	F1	0	0	2.50K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	04/28/1958	05:45	CST	Tornado	F1	0	0	25.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	07/05/1959	15:20	CST	Tornado	F1	0	0	2.50K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	07/28/1961	22:30	CST	Tornado	F0	0	0	25.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	09/12/1963	12:45	CST	Tornado	F0	0	0	2.50K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	04/02/1970	07:06	CST	Tornado	F2	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	02/22/1971	15:55	CST	Tornado	F3	0	7	2.500M	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	05/08/1973	13:10	CST	Tornado	F2	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	05/10/1973	18:00	CST	Tornado	F3	0	3	2.50K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	05/25/1973	17:30	CST	Tornado	F2	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	05/30/1973	12:55	CST	Tornado	F2	0	1	2.500M	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	07/26/1973	15:00	CST	Tornado	F1	0	0	0.25K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	04/03/1974	16:05	CST	Tornado	F2	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	06/17/1975	15:45	CST	Tornado	F1	0	0	25.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	09/11/1975	18:40	CST	Tornado	F1	0	0	25.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	06/13/1981	13:30	CST	Tornado	F0	0	0	2.50K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	08/07/1984	13:00	CST	Tornado	F1	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	06/10/1986	17:50	EST	Tornado	F1	0	0	250.00K	0.00K
FRANKLIN CO.	FRANKLIN CO.	OH	06/02/1991	16:00	EST	Tornado	F0	0	0	25.00K	0.00K

FRANKLIN CO.	FRANKLIN CO.	OH	08/27/1992	15:50	EST	Tornado	F0	0	0	25.00K	0.00K
DUBLIN	FRANKLIN CO.	OH	07/02/1997	17:30	EST	Tornado	F0	0	0	30.00K	0.00K
GROVE CITY	FRANKLIN CO.	OH	08/28/2006	18:10	EST	Tornado	F0	0	0	1.00K	0.00K
BEXLEY	FRANKLIN CO.	OH	08/28/2006	18:28	EST	Tornado	F0	0	0	1.00K	0.00K
NEW ALBANY	FRANKLIN CO.	OH	10/11/2006	17:49	EST-5	Tornado	F2	0	0	50.000M	0.00K
MUDSOCK	FRANKLIN CO.	OH	05/11/2008	12:12	EST-5	Tornado	EF0	0	0	5.00K	0.00K
TAYLOR	FRANKLIN CO.	OH	09/22/2010	15:58	EST-5	Tornado	EF0	0	0	0.00K	0.00K
GROVEPORT	FRANKLIN CO.	OH	10/26/2010	13:05	EST-5	Tornado	EF0	0	0	40.00K	0.00K
(LCK)RCKENBCKR ARPT	FRANKLIN CO.	OH	04/20/2011	01:22	EST-5	Tornado	EF1	0	0	35.00K	0.00K
GROVEPORT	FRANKLIN CO.	OH	04/20/2011	01:26	EST-5	Tornado	EF0	0	0	30.00K	0.00K
COLUMBUS SO COLUMBUS	FRANKLIN CO.	OH	10/31/2013	23:40	EST-5	Tornado	EF0	0	0	300.00K	0.00K
COLUMBUS	FRANKLIN CO.	OH	06/04/2016	17:06	EST-5	Tornado	EF0	0	0	100.00K	0.00K
GROVE CITY	FRANKLIN CO.	OH	04/03/2018	16:37	EST-5	Tornado	EF1	0	0	120.00K	0.00K
HANFORD	FRANKLIN CO.	OH	09/26/2018	04:53	EST-5	Tornado	EF1	0	0	750.00K	0.00K
Totals:								0	11	58.100M	0.00K

MAGNITUDE/SEVERITY

The Enhanced Fujita Scale, also known as the “EF-Scale,” measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita scale that was published in 1971. It classifies United States tornadoes into six intensity categories, as shown in table below, based upon the estimated maximum winds occurring within the wind vortex. The EF- Scale has become the definitive metric for estimating wind speeds within tornadoes based upon the damage done to buildings and structures since it was implemented through the National Weather Service in 2007.

Enhanced Fujita Scale and Associated Damage		
EF-SCALE NUMBER	**WIND SPEED (MPH)**	**TYPE OF DAMAGE POSSIBLE**
EFO	**65-85**	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.

Enhanced Fujita Scale and Associated Damage		
		Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	**86-110**	**Moderate damage**: Roofs severely stripped; mobile homes overturned or severely damaged; loss of exterior doors; windows and other glass broken.
EF2	**111-135**	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	**136-165**	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	**166-200**	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown, and small missiles generated.
EF5	**>200**	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure severely damaged; high-rise buildings have significant structural deformation.

The Storm Prediction Center has developed damage indicators to be used with the Enhanced Fujita Scale for different types of buildings but can also be used to classify any high wind event. Some of the indicators for different building types are shown in tables below.

Damage Indicator Table	
DAMAGE DESCRIPTION	**WIND SPEED RANGE (Expected in Parentheses)**
Threshold of visible damage	59-88 MPH (72 MPH)
Loss of roof covering (<20%)	72-109 MPH (86 MPH)
Damage to penthouse roof & walls, loss of rooftop HVAC equipment	75-111 MPH (92 MPH)
Broken glass in windows or doors	78-115 MPH (95 MPH)

Damage Indicator Table	
Uplift of lightweight roof deck & insulation, significant loss of roofing material (>20%)	95-136 MPH (114 MPH)
Façade components torn from structure	97-140 MPH (118 MPH)
Damage to curtain walls or other wall cladding	110-152 MPH (131 MPH)
Uplift of pre-cast concrete roof slabs	119-163 MPH (142 MPH)
Uplift of metal deck with concrete fill slab	118-170 MPH (146 MPH)
Collapse of some top building envelope	127-172 MPH (148 MPH)
Significant damage to building envelope	178-268 MPH (210 MPH)
DAMAGE DESCRIPTION	**WIND SPEED RANGE (Expected in Parentheses)**
Threshold of visible damage	55-83 MPH (68 MPH)
Loss of roof covering (<20%)	66-99 MPH (79 MPH)
Broken windows	71-106 MPH (87 MPH)
Exterior door failures	83-121 MPH (101 MPH)
Uplift of metal roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	85-119 MPH (101 MPH)
Damage to or loss of wall cladding	92-127 MPH (108 MPH)
Collapse of tall masonry walls at gym, cafeteria, or auditorium	94-136 MPH (114 MPH)
Uplift or collapse of light steel roof structure	108-148 MPH (125 MPH)
Collapse of exterior walls in top floor	121-153 MPH (139 MPH)
Most interior walls of top floor collapsed	133-186 MPH (158 MPH)
Total destruction of a large section of building envelope	163-224 MPH (192 MPH)
DAMAGE DESCRIPTION	**WIND SPEED RANGE (Expected in Parentheses)**
Threshold of visible damage	54-83 MPH (67 MPH)
Inward or outward collapsed of overhead doors	75-108 MPH (89 MPH)
Metal roof or wall panels pulled from the building	78-120 MPH (95 MPH)
Column anchorage failed	96-135 MPH (117 MPH)
Buckling of roof purlins	95-138 MPH (118 MPH)
Failure of X-braces in the lateral load resisting system	118-158 MPH (138 MPH)

Damage Indicator Table	
Progressive collapse of rigid frames	120-168 MPH (143 MPH)
Total destruction of building	132-178 MPH (155 MPH)

Source: Storm Prediction Center, 2009

Table 1-24 Electric Transmission Lines	
DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	70-98 MPH (83 MPH)
Broken wood cross member	80-114 MPH (99 MPH)
Wood poles leaning	85-130 MPH (108 MPH)
Broken wood poles	98-142 MPH (118 MPH)

Improved and consistent building codes have been considered as a key measure to mitigate life and property losses associated with tornadoes and wind events. All of the Columbus campus is equally at risk to tornado damage.

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Reported tornado events over the past 68 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a tornado event, although infrequent, can be difficult to quantify, but based on historical record of 34 tornado events since 1954, it can reasonably be assumed that this type of event has occurred once every 2 years from 1954 through 2022.

[(Last year of record 2022] subtracted by [(Historical Year) 1954] = 68 Years on Record

[(Years on Record) 68] divided by [(Number of Historical Events) 34] = 2

INVENTORY ASSETS EXPOSED TO TORNADOES

All university assets can be considered at risk from tornadoes and wind events. This includes 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. There is no way to predict the path that will be impacted by tornadoes. Although the university has never been directly impacted by a tornadic event, it must be considered as a potential risk. Franklin County has experienced a tornado almost once every 2 years since 1954.

POTENTIAL LOSSES FROM TORNADOES

The university's Columbus campus has never been directly impacted by a tornado, however, should one hit, the damages could be significant. The campus is fairly densely populated with buildings and infrastructure. When looking at the replacement value of all campus structures, the average value is over $47 million dollars. This average value was based on a PARE provided list of structures, along with their corresponding values. The highest value buildings tend to be the residential structures and medical center buildings.

MITIGATION STRATEGIES

Improved and consistent building codes have been considered as a key measure to mitigate life and property losses associated with tornadoes and wind events. All university property is equally at risk to tornado damage.

TORNADO/HIGH WIND MITIGATION ACTIONS

Tornado/High Wind Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 6: Understand the impact of, and increase resiliency to, tornadoes and high wind events					
Objective 6.1: Further develop planning mechanisms related to tornadoes and high wind events					
6.1.1 Achieve StormReady **Certification from NWS**	Emergency Management/Fire Prevention	06/01/2016 – 6/1/2017	Staff Time and Resources	Operating Budget	Completed July 2017; Renewed July 2020.
6.1.2 Expansion of tornado siren system on campus	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$25,000 Per Siren	Operating Budget, FEMA HMA Programs	Canceled.
6.1.3 Evaluate current building standards to ensure tornado safety for **occupants**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$300,000	Operating Budget	Ongoing. 06/01/2021-06/01/2026
6.1.4 Evaluation of installation of tornado safe rooms on campus	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	$150,000	Operating Budget, FEMA HMA Programs	Canceled.
6.1.5 Evaluate possibility of enhanced IT warning system for tornadic events (Message scroll on **university computer systems)**	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Completed - 2017.
Objective 6.2: Undertake structural and infrastructure improvements to increase resilience to tornadoes and high wind events					

6.2.1 Retrofit buildings to allow for communications from public safety dispatchers to building occupants	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	$4.50 Per Square Foot	Operating Budget, FEMA HMA Programs	Canceled.
Objective 6.3: Develop and deploy public education campaigns related to tornadoes and high wind events					
6.3.1 Develop a public education campaign to be delivered throughout the **university**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$20,000	Operating Budget	Ongoing. 06/01/2021-06/01/2026

TORNADOES HIRA SUMMARY

It's difficult to separate the various wind components that cause damage from other wind-related natural events that often occur to generate tornadoes. For example, hurricanes with intense winds often spawn numerous tornadoes or generate severe thunderstorms producing strong, localized downdrafts. Due to this difficulty, tornadoes/windstorms are difficult to predict, and the entire campus is subject to all categories of windstorms.

In addition to improved construction standards, retrofitting to enhance design standards of infrastructure can limit exposure. Examples include structural cladding, shuttering systems, and materials that are resistant to the penetration of wind-blown debris and projectiles.

SEVERE SUMMER STORMS

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Summer Storms	**4**	**1.2**	**3**	**0.9**	**1**	**0.2**	**3**	**0.3**	**2**	**0.2**	**2.8**
Moderate HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

Extreme weather conditions can exist during any season in Ohio. Thunderstorms, associated with strong winds, heavy precipitation, and lightning strikes can all be hazardous under the right conditions and locations. Strong winds and tornadoes can take down trees, damage structures, tip high profile vehicles, and create high velocity flying debris. Large hail can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people. Coastal storms, which include hurricanes, tropical storms, and nor'easters, are among the most devastating naturally occurring hazards in the United States and its territories. Past events reveal the magnitude of damage that is possible. In 2005, Hurricane Katrina resulted in the highest total damage of any natural disaster in U.S. history, an estimated $172.5 billion.

Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. Despite their small size, all thunderstorms are dangerous. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. The National Weather Service considers a thunderstorm severe if it produces hail at least 3/4 inch in diameter, winds of 58 MPH or stronger, or a tornado. Every thunderstorm needs three basic components: (1) moisture to form clouds and rain (2) unstable air which is warm air that rises rapidly and (3) lift, which is a cold or warm front capable of lifting air to help form thunderstorms.

Lightning, although not considered severe by the National Weather Service definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder.

Hail develops when a super cooled droplet collects a layer of ice and continues to grow, sustained by the updraft. Once the hail stone cannot be held up any longer by the updraft, it falls to the ground. Nationally, hailstorms cause nearly $1 billion in property and crop damage annually, as peak activity coincides with peak agricultural seasons. Severe hailstorms also cause considerable damage to buildings and automobiles, but rarely result in loss of life.

Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph), which can be destructive to roofs, buildings, automobiles, vegetation, and crops.

Table 1-7 Hail Size Comparison Table

COMMON OBJECT	SIZE IN DIAMETER
Pea	0.25 Inch
Penny or Dime	0.75 Inch
Quarter	1.00 Inch
Half Dollar	1.25 Inch
Golf Ball	1.75 Inch
Tennis Ball	2.50 Inch
Baseball	2.75 Inch
Grapefruit	4.00 Inch

Since 1956, 45 federally or state declared severe summer storm weather events have occurred in Franklin County as shown in Table 1-8. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1956 to present), these events include: severe storms, heavy rain, high winds, flooding, landslides, and mud flows.

Table 1-8 Severe Weather Federal Declarations

Disaster Number	Declaration Date	Disaster Type
4077	8/20/2012	Severe Storms and Flooding

Table 1-8 Severe Weather Federal Declarations		
1805	10/24/2008	Tornadoes, Flooding, Severe Storms, And High Winds
1507	1/26/2004	Severe Storms and Flooding
1484	8/1/2003	Severe Storms, Flooding and Tornadoes
1478	7/15/2003	Severe Storms/Flooding
1227	6/30/1998	Severe Storms, Flooding and Tornadoes
951	8/4/1992	Flooding, Severe Storm, Tornadoes
870	6/6/1990	Flooding, Severe Storm, Tornado
831	6/10/1989	Severe Storms, Flooding
243	6/5/1968	Heavy Rains, Flooding
167	3/24/1964	Severe Storms & Flooding

***Events may have occurred over multiple counties, so damage may represent only a fraction of the total event damage and may not be specific to Franklin County**

REGULATORY ENVIRONMENT

There are negligible formal regulations that pertain to summer storm events.

HAZARD EVENTS

Dangerous and damaging aspects of a severe storm are tornadoes, hail, lightning strikes, flash flooding, and winds associated with downbursts and microbursts. Reported severe weather events over the past 60 years provides an acceptable framework for determining the magnitude of such storms that can be expected and planned for accordingly. FEMA places this region in Zone IV (250 MPH) for structural wind design (Federal Emergency Management Agency, 2004b).

HAIL EVENTS

Large hail can damage structures, break windows, dent vehicles, ruin crops, and kill or injure people and livestock. Based on past occurrences, hail sizes greater than 3 inches in diameter are possible and should be accounted for in future planning activities.

There have been 90 recorded hail events associated with thunderstorms that have either directly or indirectly impacted the university and the immediately surrounding jurisdictions since 1955.

Table 1-9 Franklin County Hail Events Since 1955					
DATE RANGE	# OF EVENTS	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
1955 - 2020	120	0	0	$247,706,756	$0
	TOTALS:	**0**	**0**	$247,706,756	**$0**

Reported hail events over the past 66 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a hail event associated with damages or injury can be difficult to quantify, but based on historical record of 120 hail events since 1955, it can reasonably be assumed that this type of event has occurred once every 0.55 years from 1955 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 1955] = 66 Years on Record

[(Years on Record) 66] divided by [(Number of Historical Events) 120] = 0.55

THUNDERSTORM WIND EVENTS

Non-tornadic, thunderstorm and non-thunderstorm winds over 100 mph should also be considered in future planning initiatives. These types of winds can remove roofs, move mobile homes, topple trees, take down utility lines, and destroy poorly built or weak structures.

There have been 238 recorded severe wind events associated with thunderstorms since 1955.

Table 1-10 Thunderstorm Wind Events Since 1955						
DATE RANGE	# OF EVENTS	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
1955 - 2021	238	Thunderstorm Wind	5	52	$247,737,256.00	$540,000.00
		TOTALS:	**5**	**52**	$247,737,256.00	$540,000.00

Reported thunderstorm winds over the past 66 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing thunderstorm winds associated with damages or injury can be difficult to quantify, but based on historical record of 238 thunderstorm wind events since 1950, it can reasonably be assumed that this type of event has occurred once every 0.28 years from 1955 through 2021.

(Current Year) 2021] subtracted by [(Historical Year) 1955] = 66 Years on Record

[(Years on Record) 66] divided by [(Number of Historical Events) 238] = 0.28

LIGHTNING EVENTS

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. For the period of 1998 to 2020, NOAA had zero reported events for the university are and the jurisdictions immediately surrounding it. However, for the greater Franklin County area, there were 5 reported lightning strikes that resulted in 3 deaths and 4 injuries.

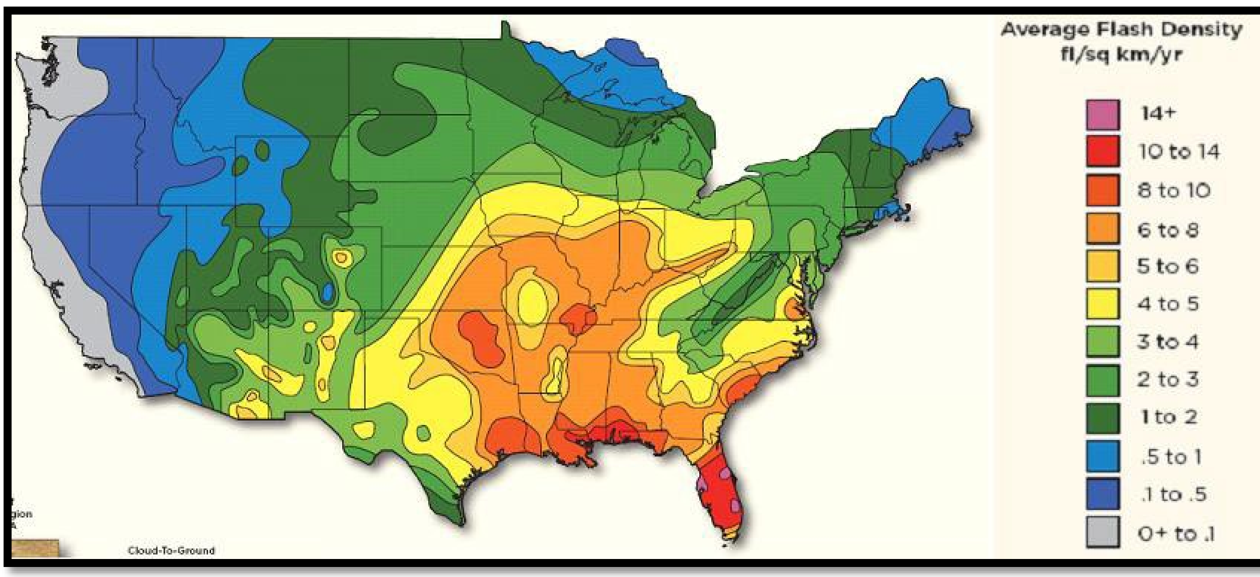


Figure 1-8 Flash Density associated with Lightning Strikes. Source: www.lightningsafety.noaa.gov

Reported lightning strikes over the past 22 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a lightning strike associated with damages or injury can be difficult to quantify, but based on historical record of 5 lightning strikes since 1999 that have either caused damages to buildings and infrastructure or resulted in an injury or death, it can reasonably be assumed that this type of event has occurred once every 4.4 years from 1999 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 1999] = 22 Years on Record

[(Years on Record) 22] divided by [(Number of Historical Events) 5] = 4.4

HISTORICAL OCCURRENCES

June 18, 1984: Powerful thunderstorms came through the greater Columbus area. This storm system resulted in 1 death, and 4 injuries. Lightning struck and injured a worker at The Ohio State University airport as he was tying down a plane during the thunderstorm. Thunderstorm winds caused structural damage at another location. A concrete wall at a construction site was blown over, falling on three workers. One worker was killed and the other two were injured.

Trees and utility lines were downed along Interstate 270.

November 9, 2000: Numerous trees were knocked down across the county, one of which fell on a car on the campus of The Ohio State University. A roof was peeled off a warehouse and several semi-trailers were overturned on the west side of Columbus. This storm resulted in $100,000 in property damage.

April 20, 2003: Hail up to the size of golf balls affected the north side of the Columbus metro area and southern Delaware County. Hail was extensive from Dublin, through Worthington and Powell, to Westerville. Trees and shrubs were stripped of their foliage and cars and homes sustained significant hail damage. The hail covered the ground in some locations up to six inches deep in Worthington in northern Franklin County and near the Polaris Mall in southern Delaware County. Damages from this storm were estimated at $80 million dollars. The storm system ranged from as far north as Hardin County down south to Montgomery County. While specific damages were not catalogued for the university, this is one of the most damaging hail events to impact the greater Columbus area.

October 4, 2006: A line of severe thunderstorms affected central Ohio during the afternoon and evening ahead of a cold front. Sixty mile per hour winds were estimated along with quarter sized hail on The Ohio State University campus. This storm caused over $200 million in damages as it passed through Central Ohio. Most of the recorded damages were incurred in Gahanna and Pataskala where egg-sized hail fell, damaging homes, commercial properties, and vehicles.

June 29, 2012: A very hot and potentially unstable air mass interacted with northwesterly flow aloft to produce a derecho across northern Illinois. This derecho then moved rapidly east southeast across the Ohio Valley producing widespread straight line wind damage. This rare derecho affected nearly every county in southeast Indiana, northern Kentucky, and southwestern Ohio with severe winds. This caused widespread power outages that lasted several days in some locations. Isolated large hail also occurred with the stronger portions of the system. This storm system resulted in $1.5 million in damages across the central Ohio area.

MAGNITUDE/SEVERITY

Thunderstorm watches and warnings are issued by the National Weather Service. There are no watches or warnings for lightning. Figure 1-9 explains the difference between watches and warnings, as used by the NWS.

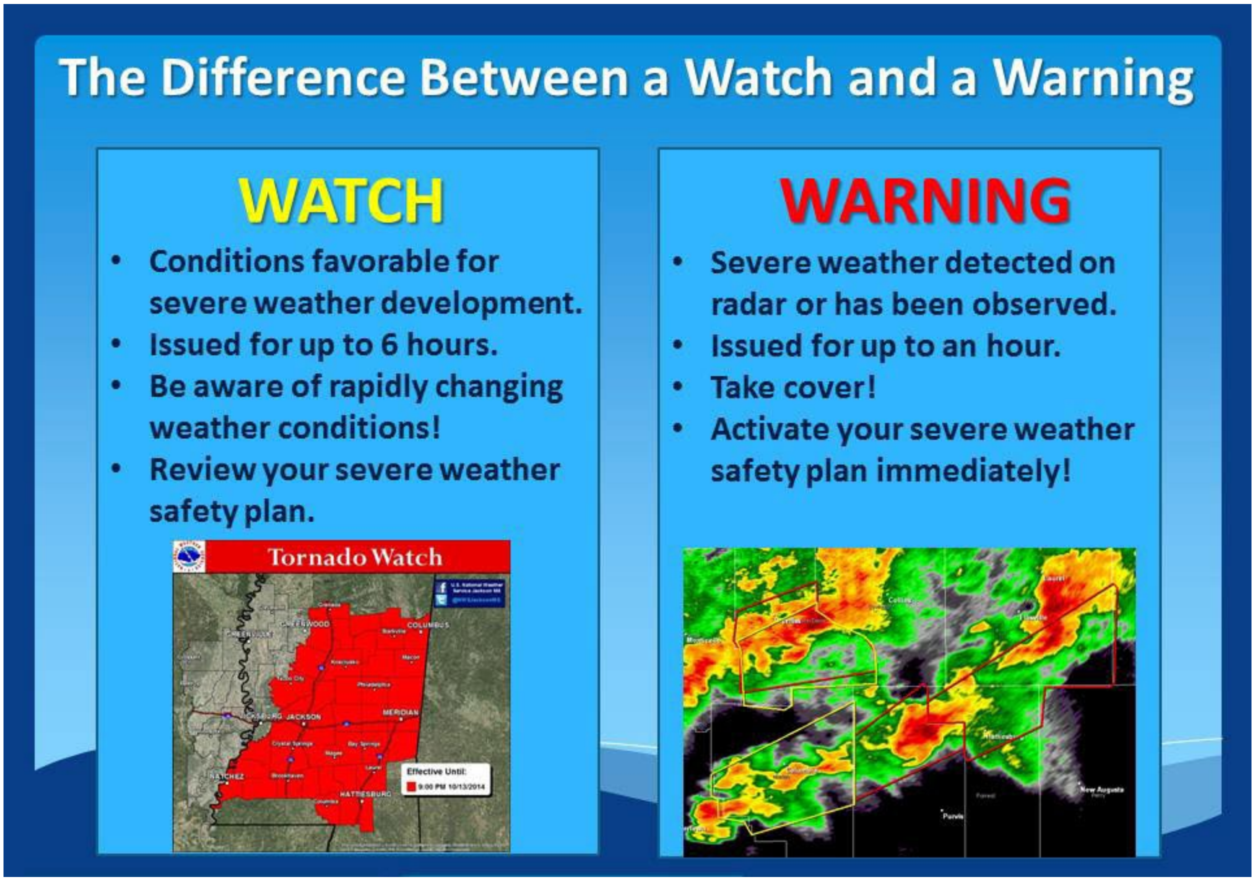


Figure 1-9 National Weather Service Watch vs Warning

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Table 1-12 Probability of Summer Storm Events

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Historic Recurrence Interval (years)	Historic Frequency (% chance/year)
Thunderstorm Wind	238	65	0.27	100%
Hail	120	65	0.54	100%
Lightning[14]	5	21	4.20	31.25%

INVENTORY ASSETS EXPOSED TO SUMMER STORMS

Damage to inventory assets exposed to severe thunderstorms is dependent on the age of the building, type, construction material used, and condition of the structure. Heavy wind loads on structures can cause poorly constructed roofs to fail, and hail is known to damage roofs and siding of structures, rendering the building more susceptible to water damage.

All university assets can be considered at risk from severe thunderstorms. This includes over 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. Damages primarily occur as a result of high winds, lightning strikes, hail, and flooding. The university also has an inventory of 50,000 trees on campus. These produce an annual benefit of $1.5 million dollars. Most structures, including critical facilities, should be able to provide adequate protection from hail but the structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

POTENTIAL LOSSES FROM SUMMER STORMS

A timely forecast may not be able to mitigate the property loss, but could reduce the casualties and associated injury. It appears possible to forecast these extreme events with some skill, but further research needs to be done to test the existing hypothesis about the interaction between the convective storm and its environment that produces the extensive swath of high winds.

Severe thunderstorms will remain a highly likely occurrence for the university. Lightning and hail may also be experienced in the area due to such storms.

Table 1-13 Damage Estimates for Summer Storms				
CATEGORY	TIME PERIOD ON RECORD	# EVENTS	DAMAGES	AVG. DAMAGE PER EVENT
Thunderstorm Winds	1955-2020	238	$247,737,256.00	$1,040,912.84
Hail	1955-2020	120	$247,706,756	$2,064,222.97
Lightning	1999-2020	5	$20,000	$4,000

There is no way to predict an area that will be impacted by thunderstorm winds, hailstorms or lightning strikes. An individual thunderstorm is unlikely to damage large numbers of structures on its own. However, the side effects of a thunderstorm (hail, winds and lightning), have the ability to cause damage to structures and property on campus. Nationwide, insurance claims resulting from hailstorm damage increased 84% (467,602 to 861,579) from 2010 to 2012 according to the National Insurance Claim Bureau. Hail can damage homes and vehicles, as well as crops. Hail is the third leading cause of crop failure in the United States. While drought was by far the leading cause of crop failures in 2012, at 79%, thunderstorms and their hazards accounted for over $1 Billion in losses nationwide in 2012. These losses, resulting from thunderstorms, can be difficult to overcome. Insurance policies offer some relief from the losses, both for homeowners and farmers.

MITIGATION STRATEGIES

All future structures built by the university will likely be exposed to severe thunderstorm damage. The university needs to adhere to building codes, and therefore, new development can be built to current standards to best protect from future storm damage.

SUMMER STORM MITIGATION ACTIONS

Summer Storm Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 2: Minimize the impact of summer storms on the lives, property and infrastructure of The Ohio State University					
Objective 2.1: Further develop planning mechanisms related to summer storms					
2.1.1 Achieve StormReady Certification from NWS	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2017	Staff Time and Resources	Operating Budget	Completed July 2017; Renewed July 2020.

Summer Storm Mitigation Actions					
2.1.2 Develop site preparation plans for known storm events	Assistant Vice President and Director of Public Safety; Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
2.1.3 Evaluate current building standards and evaluate changes to increase resilience	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$ 300,000.00	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
Objective 2.2: Undertake structural and infrastructure improvements to increase resilience to summer storms					
2.2.1 Conduct a tree-trimming program on campus	Facilities Operations and Development /Grounds	06/01/2016 – 6/1/2021	$1,000,000/$300,000	Operating Budget	Ongoing. 06/01/2021-06/01/2026
2.2.2 Upgrade and improve lightning systems on buildings	Various (Operations (incl. Med Center), Student Life, Athletics, Business Advancement)	06/01/2016 – 6/1/2017	TBD by Scope	Operating Budget	Ongoing. 06/01/2021-06/01/2026
2.2.3 Purchase and install an outdoor lightning warning system	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$ 750,000.00	Operating Budget, FEMA HMA Programs	Canceled
2.2.4 Undertake structural projects to increase resilience of buildings to the effects of summer storms	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	3-5% of Current Replacement Value of Buildings	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026

Summer Storm Mitigation Actions					
2.2.5 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already equipped with backup power	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$500,000 per generator	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026
Objective 2.3: Develop and deploy public education campaigns related to summer storms					
2.3.1 Develop a public education campaign to be delivered throughout the university conveying summer storm risk	Assistant Vice President and Director of Public Safety	06/01/2016 – 06/01/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026

SUMMER STORM HIRA SUMMARY

The Ohio State University is subject to severe storms ranging from thunderstorms to tropical storms which have the potential to cause flash flooding, tornadoes, downbursts, and debris. The severe summer storms profile is primarily concerned with past and future damages from high winds, lightning, and hail. Flooding is covered as a separate hazard, including flooding that occurs from a heavy precipitation event.

Mitigation of building damage has been most successful where strict building codes for high- wind influence areas and designated special flood hazard areas have been adopted and enforced by local governments, and the builders have complied. Proven techniques are available to reduce lightning damage by grounding techniques for buildings. Post-disaster mitigation efforts include buyout programs, relocations, structural elevations, improved open-space preservation, and land use planning within high-risk areas. Due to the significant risk from severe storms, the university will remain proactive in its mitigation efforts to help build sustainability.

SEVERE WINTER STORMS

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Winter Storms	**4**	**1.2**	**3**	**0.9**	**1**	**0.2**	**3**	**0.9**	**2**	**0.2**	**2.8**
MODERATE HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

Franklin County has been impacted by varying degrees of winter weather over the last century; however, the occurrence of severe winter weather in the county is relatively infrequent, even during winter months. Severe winter weather can cause hazardous driving conditions, communications and electrical power failure, community isolation and can adversely affect business continuity. This type of severe weather may include one or more of the following winter factors:

Blizzards, as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.

Heavy snow, in large quantities, may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events.

Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow before the leaves fall from the trees in the fall or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages.

Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth's surface. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines.

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Franklin County. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it "feels" and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects. (National Weather Service)

The science of meteorology and records of severe weather are not quite sophisticated enough to identify what areas of the county are at greater risk for damages. Therefore, all areas of the county are assumed to have the same winter weather risk.

Severe winter weather can result in the closing of primary and secondary roads, particularly in rural locations, loss of utility services, and depletion of oil heating supplies. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and/or high winds which can break limbs or even bring down large trees. Gradual melting of snow and ice provides excellent groundwater recharge; however, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flash flooding.

The State of Ohio does have an extensive history of severe winter weather. In the winter of 2005, the state was hit by a series of winter storms. These storms included ice storms, followed by unseasonably high temperatures and high rainfall totals, all of which resulted in extensive flooding and mudslides. This series of storms resulted in Presidential Declaration FEMA-DR- 1580-OH. This declaration provided over one-hundred and forty million dollars in recovery funds. These funds included Individual assistance, public assistance, Hazard Mitigation Grant Funds, and a state match to the federal hazard mitigation funds.

More specifically, winter weather is a common occurrence in Ohio throughout the winter, and early spring months. According to the National Climatic Data Center, there have been 120 winter events in Franklin County since 1996.

Due to the nature of winter storms, it is extremely difficult to predict, but through identifying various indicators of weather systems, and tracking these indicators, it provides us with a crucial means of monitoring winter weather. Understanding the historical frequency, duration, and spatial extent of winter weather assists in determining the likelihood and potential severity of future occurrences. The characteristics of past severe winter events provide benchmarks for projecting similar conditions into the future.

Heavy Snowstorms can immobilize a region and paralyze the university. These events can strand commuters, close airports, stop supplies from reaching their destinations and disrupt emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Homes and farms may be isolated and unprotected livestock may be lost. The cost of snow removal, repairing damages, and the loss of business can have economic impacts on cities and towns.

REGULATORY ENVIRONMENT

There are negligible formal regulations that pertain to generalized severe winter weather events.

HAZARD EVENTS

Table 1-14 Winter Storm Events

Date	Type	Property Damage	Crop Damage	Injuries	Deaths
1/2/1996	Winter Storm	$ 25,000.00	$ -	0	0
1/6/1996	Winter Storm	$ 500,000.00	$ -	0	0
3/6/1996	Ice Storm	$ -	$ -	0	0
3/19/1996	Winter Storm	$ -	$ -	0	0
1/24/1997	Ice Storm	$ -	$ -	0	0
1/1/1999	Winter Storm	$ -	$ -	0	0
1/7/1999	Winter Storm	$ -	$ -	0	0
1/13/1999	Winter Storm	$ -	$ -	0	0
3/9/1999	Heavy Snow	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
1/19/2000	Heavy Snow	$ -	$ -	0	0
12/13/2000	Ice Storm	$ -	$ -	0	0
1/26/2003	Winter Storm	$ -	$ -	0	0
2/15/2003	Winter Storm	$ -	$ -	0	0
1/25/2004	Winter Storm	$ -	$ -	0	0
3/16/2004	Winter Storm	$ -	$ -	0	0
12/22/2004	Winter Storm	$ 55,000.00	$ -	0	0
12/8/2005	Winter Storm	$ -	$ -	0	0
2/6/2007	Heavy Snow	$ -	$ -	0	0
2/13/2007	Heavy Snow	$ -	$ -	0	0
4/6/2007	Frost/Freeze	$ -	$ 540,000.00	0	0
12/5/2007	Heavy Snow	$ -	$ -	0	0
12/7/2007	Winter Weather	$ -	$ -	0	0
12/15/2007	Heavy Snow	$ -	$ -	0	0
1/1/2008	Winter Weather	$ -	$ -	0	0
2/21/2008	Winter Storm	$ -	$ -	0	0
3/7/2008	Winter Storm	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
1/10/2009	Ice Storm	$ -	$ -	0	0
1/14/2009	Heavy Snow	$ -	$ -	0	0
1/27/2009	Heavy Snow	$ -	$ -	0	0
12/19/2009	Winter Weather	$ -	$ -	0	0
1/7/2010	Winter Weather	$ -	$ -	0	0
2/5/2010	Heavy Snow	$ -	$ -	0	0
2/9/2010	Winter Weather	$ -	$ -	0	0
2/15/2010	Heavy Snow	$ -	$ -	0	0
2/26/2010	Winter Weather	$ -	$ -	0	0
3/25/2010	Winter Weather	$ -	$ -	0	0
12/12/2010	Winter Weather	$ -	$ -	0	0
12/16/2010	Winter Weather	$ -	$ -	0	0
1/11/2011	Winter Weather	$ -	$ -	0	0
1/20/2011	Winter Weather	$ -	$ -	0	0
2/1/2011	Ice Storm	$ -	$ -	0	0
1/13/2012	Winter Weather	$ -	$ -	0	0
1/19/2012	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
1/20/2012	Winter Weather	$ -	$ -	0	0
2/8/2012	Winter Weather	$ -	$ -	0	0
2/10/2012	Winter Weather	$ -	$ -	0	0
2/14/2012	Winter Weather	$ -	$ -	0	0
12/26/2012	Winter Storm	$ -	$ -	0	0
12/28/2012	Winter Weather	$ -	$ -	0	0
12/28/2012	Winter Weather	$ -	$ -	0	0
1/21/2013	Winter Weather	$ 700,000.00	$ -	0	0
1/25/2013	Winter Weather	$ -	$ -	0	0
1/31/2013	Winter Weather	$ -	$ -	0	0
2/21/2013	Winter Weather	$ -	$ -	0	0
3/5/2013	Winter Storm	$ -	$ -	0	0
3/24/2013	Winter Weather	$ -	$ -	0	0
11/11/2013	Winter Weather	$ -	$ -	0	0
11/26/2013	Winter Weather	$ -	$ -	0	0
12/6/2013	Winter Weather	$ -	$ -	0	0
12/10/2013	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
12/14/2013	Winter Weather	$ -	$ -	0	0
12/16/2013	Winter Weather	$ -	$ -	0	0
1/2/2014	Winter Weather	$ -	$ -	0	0
1/17/2014	Winter Weather	$ -	$ -	0	0
1/18/2014	Winter Weather	$ -	$ -	0	0
1/20/2014	Winter Weather	$ -	$ -	0	0
2/4/2014	Winter Storm	$ -	$ -	0	0
2/14/2014	Winter Weather	$ -	$ -	0	0
2/17/2014	Winter Weather	$ -	$ -	0	0
3/2/2014	Winter Weather	$ -	$ -	0	0
11/16/2014	Winter Weather	$ -	$ -	0	0
11/22/2014	Winter Weather	$ -	$ -	0	0
1/5/2015	Winter Weather	$ -	$ -	0	0
1/25/2015	Winter Weather	$ -	$ -	0	0
2/4/2015	Winter Weather	$ -	$ -	0	0
2/14/2015	Winter Weather	$ -	$ -	0	0
2/15/2015	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
2/20/2015	Winter Weather	$ -	$ -	0	0
2/21/2015	Winter Storm	$ -	$ -	0	0
3/1/2015	Winter Weather	$ -	$ -	0	0
3/23/2015	Winter Weather	$ -	$ -	0	0
1/10/2016	Winter Weather	$ -	$ -	0	0
1/12/2016	Winter Weather	$ -	$ -	0	0
1/20/2016	Winter Weather	$ -	$ -	0	0
2/8/2016	Winter Weather	$ -	$ -	0	0
2/14/2016	Winter Weather	$ -	$ -	0	0
2/15/2016	Winter Weather	$ -	$ -	0	0
4/8/2016	Winter Weather	$ -	$ -	0	0
12/11/2016	Winter Weather	$ -	$ -	0	0
12/13/2016	Winter Weather	$ -	$ -	0	0
12/16/2016	Winter Weather	$ -	$ -	0	0
1/5/2017	Winter Weather	$ -	$ -	0	0
2/8/2017	Winter Weather	$ -	$ -	0	0
3/1/2017	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
3/13/2017	Winter Weather	$ -	$ -	0	0
12/9/2017	Winter Weather	$ -	$ -	0	0
12/12/2017	Winter Weather	$ -	$ -	0	0
12/24/2017	Winter Weather	$ -	$ -	0	0
12/29/2017	Winter Weather	$ -	$ -	0	0
1/8/2018	Winter Weather	$ -	$ -	0	0
1/12/2018	Winter Weather	$ -	$ -	0	0
1/15/2018	Winter Weather	$ -	$ -	0	0
2/6/2018	Winter Weather	$ -	$ -	0	0
3/7/2018	Winter Weather	$ -	$ -	0	0
3/20/2018	Winter Weather	$ -	$ -	0	0
4/1/2018	Winter Weather	$ -	$ -	0	0
11/14/2018	Ice Storm	$ -	$ -	0	0
1/12/2019	Winter Weather	$ -	$ -	0	0
1/19/2019	Winter Storm	$ -	$ -	0	0
2/1/2019	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
2/10/2019	Winter Weather	$ -	$ -	0	0
2/20/2019	Winter Weather	$ -	$ -	0	0
3/3/2019	Winter Weather	$ -	$ -	0	0
11/11/2019	Winter Weather	$ -	$ -	0	0
12/15/2019	Winter Weather	$ -	$ -	0	0
12/16/2019	Winter Weather	$ -	$ -	0	0
1/17/2020	Winter Weather	$ -	$ -	0	0
2/6/2020	Winter Weather	$ -	$ -	0	0
2/8/2020	Winter Weather	$ -	$ -	0	0
2/8/2020	Winter Weather	$ -	$ -	0	0
2/12/2020	Winter Weather	$ -	$ -	0	0
2/26/2020	Winter Weather	$ -	$ -	0	0
2/27/2020	Winter Weather	$ -	$ -	0	0
11/30/2020	Winter Weather	$ -	$ -	0	0
12/1/2020	Winter Weather	$ -	$ -	0	0
12/16/2020	Winter Weather	$ -	$ -	0	0
12/24/2020	Winter Weather	$ -	$ -	0	0

Table 1-14 Winter Storm Events					
1/1/2021	Winter Weather	$ -	$ -	0	0
1/30/2021	Winter Weather	$ -	$ -	0	0
2/8/2021	Winter Weather	$ -	$ -	0	0
2/10/2021	Winter Weather	$ -	$ -	0	0
4/20/2021	Winter Weather	$ -	$ -	0	0
	Totals:	$ 1,280,000.00	$ 540,000.00	0	0

Since 1978, six federally or state declared severe winter weather events have occurred in Franklin County as shown in Table 1-15. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1956 to present), these events include: severe winter storms, winter storms, flooding, landslides, and mud flows.

Table 1-15 Severe Winter Weather Federal Declarations

Disaster Number	Declaration Date	Disaster Type
EM-3286	4/4/2008	Snow
DR-1580	2/15/2005	Severe Winter Storms, Flooding and Mudslides
EM-3198	1/11/2005	Ohio Snow
DR-1507	1/26/2004	Severe Storms, Flooding, Mudslides, and Landslides
DR-1453	3/14/2003	Severe Winter Storm
EM-3055	1/26/1978	Ohio Blizzards & Snowstorms

Since 1996, 132 severe winter events occurred, of which only four have caused any significant damage or injury.

Table 1-16 Significant Winter Events Since 1996						
Location	Date	Event Type	Death	Injury	Property Damage	Agricultural Damage
Franklin (ZONE)	1/2/1996	Winter Storm	0	0	$ 25,000.00	$ -
Franklin (ZONE)	1/6/1996	Winter Storm	0	0	$ 500,000.00	$ -
Franklin (ZONE)	12/22/2004	Winter Storm	0	0	$ 55,000.00	$ -
Franklin (ZONE)	1/21/2013	Winter Storm	0	0	$ 700,000.00	$ -
		Totals:	0	0	$ 1,280,000.00	$ -

HISTORICAL OCCURRENCES

February 8, 1971: President Fawcett cancelled classes at 3 p.m. due to the 10 inches of snow that had fallen by then. He was quoted in The Lantern as doing so to “allow streets and sidewalks to be cleared so classes and offices can operate normally Tuesday.”

January 26-27, 1978: The famed Blizzard of ’78 stopped all but essential services on campus with 65 mph wind gusts and almost five inches of snow. Payroll operations, Medical Center personnel, telephone center operators, physical facilities workers, and student-life employees all braved the elements to keep necessary functions going.

February 28, 1984: It wasn’t quite the Blizzard of ’78, but the snowstorm that hit town in late February of ’84 did manage to bring most of Columbus screeching to a halt. In addition to the county offices, courts, highways, and garbage pickups that were shut down for the day, some campus parking garages were closed, and classes were cancelled starting at 4 p.m.

January 6, 1996: The Blizzard of '96 developed near the Gulf Coast and moved up the East Coast. This massive system produced the greatest total and 24-hour snowfall at Greater Cincinnati\Northern Kentucky airport. This one storm brought 14.3 inches of snowfall to the airport which normally receives 23 inches for an entire season. The heaviest snow fell near the Ohio River in the extreme south.

The worst blizzard conditions occurred over West Central areas as dry and powdery snow was blown around by high winds causing whiteouts. Some areas had more than 30 continuous hours of snowfall, and many people in Southern Ohio felt this was the worst winter storm since the Blizzard of '78. In Fayette County, the airport reported a wind gust to 56 mph during the height of the storm. By the end of the storm many homes and businesses had their roof collapse or partially collapse from the weight of the new snow, and snow from a storm earlier in the week.

By late in the day on the 7th arctic air was pouring into the region. A 47-year-old man died of exposure under an overpass in Miami County. A 76-year-old man died of exposure on his front porch in Montgomery County.

January 21, 2013: A highly unstable air mass produced deep convective snow showers that produced snow squalls during the late morning into the afternoon. These isolated squalls caused whiteout conditions on area roadways. Three major pileups and one minor pileup resulted in over 175 vehicle crashes on the interstate system, causing numerous injuries and one fatality. Snow squalls in the region caused whiteout conditions, resulting in a 29-car pileup in the southbound lanes of I-270 on the northeast side of Columbus. Four people were hospitalized as a result. Later in the afternoon, I-71 at the intersection of I-670 saw an accident involving two semi-trailers and other vehicles.

December 22, 2014: A surface and upper-level low pressure center tracked northeast across the Ohio Valley on Wednesday, December 22nd and exited the region on the 23rd. A swath of heavy snow cut through southeast Indiana and into the Miami Valley of Ohio. 24-hour storm totals in this narrow band exceeded 2 feet in Preble and Darke counties. Snowfall totals of 20 inches or more were found along a line generally running from Eaton to Greenville, Piqua, Sidney, and Bellefontaine. Along and west of the I-71 corridor between Cincinnati and Columbus, over 8 inches of snow fell. East of this line, warm air infiltrated the lower layers of the atmosphere and brought periods of freezing rain and sleet during the evening and overnight hours. A quarter inch or more of ice occurred along a line from Batavia to Hillsboro, to Circleville and Newark. Several communities in south central and central Ohio were crippled by power outages. Up to 236,000 electric customers were without power for several hours, some lasting up to a week before it was restored. At one point in time, 90% of Highland County was without power, and parts of Adams County were without water for a week. The Ohio Insurance Agency estimated the damage to all of Ohio from this storm to be on the order of 85 million dollars, including over 25 million dollars in property damage.

MAGNITUDE/SEVERITY

The National Weather Service uses different terminology for winter weather events, depending on the situation.

National Weather Service Watch Definitions	
Watch Type	**Description**
Blizzard Watch	Conditions are favorable for a blizzard event in the next 24 to 72 hours. Sustained wind or frequent gusts greater than or equal to 35 mph will accompany falling and/or blowing snow to frequently reduce visibility to less than 1/4 mile for three or more hours.
Lake Effect Snow Watch	Conditions are favorable for a lake effect snow event to meet or exceed local lake effect snow warning criteria in the next 24 to 72 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulation to 7 or more inches in 12 hours or less. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger a watch (i.e., 5 to 8 inches of snow = watch).
Wind Chill Watch	Conditions are favorable for wind chill temperatures to meet or exceed local wind chill warning criteria in the next 24 to 72 hours. Wind chill temperatures may reach or exceed -25°F.
Winter Storm Watch	Conditions are favorable for a winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow or a combination of events) to meet or exceed local winter storm warning criteria in the next 24 to 72 hours. Criteria for snow is 7 inches or more in 12 hours or less; or 9 inches or more in 24 hours covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger a watch (i.e., 5 to 8 inches of snow = watch). Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.

Outlook - Winter weather that may cause significant impact in the day 3 to 7 forecast time period and eventually lead to the issuance of a watch or warning is contained in the Hazardous Weather Outlook. More scientific discussion on the event can also be found in the Area Forecast Discussion. Forecasts in the day 3 to 7 time period typically have a lot of forecast uncertainty. Uncertainty is generally in the 30 to 50% range that the event will occur and reach warning criteria. It is intended to provide information to those who need considerable lead time to prepare for the event.

Watch - A watch is generally issued in the 24 to 72 hour forecast time frame when the risk of a hazardous winter weather event has increased (50 to 80% certainty that warning thresholds will be met). It is intended to provide enough lead time so those who need to set their plans in motion can do so. A watch is issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of watch has been issued.

Warning - Warnings are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). A warning is used for conditions posing a threat to life or property. Warnings are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of warning/advisory has been issued.

National Weather Service Warning Definitions	
Warning Type	**Description**
Blizzard Warning	Blizzard event is imminent or expected in the next 12 to 36 hours. Sustained wind or frequent gusts greater than or equal to 35 mph will accompany falling and/or blowing snow to frequently reduce visibility to less than 1/4 mile for three or more hours.
Ice Storm Warning	An ice storm event is expected to meet or exceed local ice storm warning criteria in the next 12 to 36 hours. Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.
Lake Effect Snow Warning	A lake effect snow event is expected to meet or exceed local lake effect snow warning criteria in the next 12 to 36 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulation to 7 or more inches in 12 hours or less. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger warning (i.e., 5 to 8 inches of snow = warning).
Wind Chill Warning	Wind chill temperatures are expected to meet or exceed local wind chill warning criteria in the next 12 to 36 hours. Wind chill temperatures may reach or exceed -25°F.
Winter Storm Warning	A winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow or a combination of events) is expected to meet or exceed local winter storm warning criteria in the next 12 to 36 hours. Criteria for snow is 7 inches or more in 12 hours or less; or 9 inches or more in 24 hours covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger warning (i.e., 5 to 8 inches of snow = warning). Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.

Advisory - Advisories are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). An advisory is for less serious conditions that cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life and/or property. Advisories are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of advisory has been issued.

National Weather Service Advisory Definitions	
Advisory Type	**Description**
Winter Weather Advisory	A winter storm event (sleet, snow, freezing rain, snow and blowing snow, or a combination of events) is expected to meet or exceed local winter weather advisory criteria in the next 12 to 36 hours but stay below warning criteria. Criteria for snow is 4 inches or more in 12 hours or less covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger advisory (i.e., 2 to 5 inches of snow = advisory). Criteria for ice is any ice accumulation less than 1/2 inch over at least 50 percent of the zone or encompassing most of the population. Winter Weather Advisory can also be issued for black ice. This is optional.
Freezing Rain Advisory	Any accumulation of freezing rain is expected in the next 12 to 36 hours (but will remain below 1/2 inch) for at least 50 percent of the zone or encompassing most of the population.
Lake Effect Snow Advisory	A lake effect snow event is expected to meet or exceed local lake effect snow advisory criteria in the next 12 to 36 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulating to 4 or more inches in 12 hours or less, but remain less than 7 inches. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger advisory (i.e., 2 to 5 inches of snow = advisory).
Wind Chill Advisory	Wind chill temperatures are expected to meet or exceed local wind chill advisory criteria in the next 12 to 36 hours. Wind chill temperatures may reach or exceed -15°F.

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Reported winter events over the past 25 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the university experiencing a winter storm event can be difficult to quantify, but based on historical record of 131 winter storm events since

1996, it can reasonably be assumed that this type of event has occurred more than three times every year from 1996 through 2014.

[(Current Year) 2021] subtracted by [(Historical Year) 1996] = 25 Years on Record [(Years on Record) 25] divided by [(Number of Historical Events) 132] = 0.19

INVENTORY ASSETS EXPOSED TO WINTER STORMS

A timely forecast may not be able to mitigate the property loss, but could reduce the casualties and associated injury. In severe winter storm events, buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. The university is also subject to outages resulting from damages to the electrical grid in other parts of the state.

Winter storms affect the entire planning area of The Ohio State University's Columbus campus, including all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be impacts with lost time, maintenance costs, and contents within structures.

POTENTIAL LOSSES FROM WINTER STORMS

All assets located on campus can be considered at risk from severe winter storms. This includes over 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. Damages primarily occur as a result of cold temperatures, heavy snow or ice and sometimes strong winds. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies. Most structures, including the county's critical facilities, should be able to provide adequate protection the structures could suffer damage from snow load on rooftops and large deposits of ice. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out, even if only certain systems are powered by that generator.

Winter weather and related storms do not generally have a negative impact on structures. While cold temperatures and power losses can render a structure uninhabitable for a time, they are unlikely to cause structural damages. However, snow and ice accumulation can impact structures and infrastructure. Older structures, in particular are more susceptible to the impacts from winter weather due to older construction and insulation methods.

In addition to the infrastructure of the university, the population needs to be taken into consideration. The students, faculty and staff often commute to campus and generally park at a distance from their final destinations, requiring some degree of walking. Due to the nature of the amount of the population having to transit by foot in severe weather, there are increased personal injury accidents and lost productivity.

MITIGATION STRATEGIES

As stated above, in severe winter storm events, buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. Environmental impacts often include damage shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. This is particularly a concern in urban areas. Another important secondary impact for winter storms is building or structure collapses; if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse.

Winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

WINTER STORM MITIGATION ACTIONS

Winter Storm Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 3: Minimize the impact of winter storms on the lives, property and infrastructure of The Ohio State University					
Objective 3.1: Further develop planning mechanisms related to winter storms					
3.1.1 Use GIS to determine priority areas to clear snow/deposit snow	Director, Facilities Information Technologies Services (FITS)	06/01/2016 – 6/1/2021	$ 250,000.00	Operating Budgets, FEMA HMA Programs	Completed. 2018.
3.1.2 Develop site preparation plans for known storm events	Assistant Vice President and Director of Public Safety; Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
3.1.3 Evaluate current building standards and evaluate changes to increase resilience	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	$ 300,000.00	Operating Budgets	Ongoing. 06/01/2021-06/01/2026

Winter Storm Mitigation Actions					
3.1.4 Integrate existing ground sensors into **building automation systems**	Director, Landscape Services	06/01/2016 – 6/1/2021	$ 200,000.00	Operating Budgets, FEMA HMA Programs	Canceled.
3.1.5 Develop a live monitoring system of snow removal equipment (similar to the City of **Columbus Snow Warrior tracker)**	Director, Landscape Services	06/01/2016 – 6/1/2021	$ 250,000.00	Operating Budgets, FEMA HMA Programs	Canceled.
Objective 3.2: Undertake structural and infrastructure improvements to increase resilience to winter **storms**					
3.2.1 Conduct a tree-trimming program on campus	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$1,000,000/$300,000	Operating Budget	Ongoing. 06/01/2021-06/01/2026
3.2.2 Undertake infrastructure improvements to install roadway heating/roof heating elements	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	TBS Based on Scope	Operating Budgets, FEMA HMA Programs	Canceled.
3.2.3 Increase salt **storage capacity to 2,000 tons**	Director, Landscape Services	06/01/2016 – 6/1/2019	300000	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026
3.2.4 Undertake structural projects to increase resilience of buildings to the effects of winter storms	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	3-5% of Current Replacement Value of Buildings	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026

Winter Storm Mitigation Actions					
3.2.5 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already **equipped with backup power**	Various – Depending on ownership of building	06/01/2016 – 6/1/2021	$500,000 per generator	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026
Objective 3.3: Develop and deploy public education campaigns related to winter storms					
3.3.1 Develop a public education campaign to be delivered throughout the university **conveying winter storm risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026

WINTER STORM HIRA SUMMARY

The Ohio State University is subject to severe winter storms which have the potential to be hazard as a result of cold temperatures, heavy snow or ice and sometimes strong winds. Severe winter storm hazards can cause a range of damage to structures that will depend on the magnitude and duration of storm events. Losses may be as small as lost productivity and wages when workers are unable to travel or as large as sustained roof damage or building collapse.

The severe winter storms profile is primarily concerned with past and future damages from cold temperatures, heavy snow or ice and sometimes strong winds.

DROUGHT

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Drought	**2**	**0.6**	**1**	**0.3**	**4**	**0.8**	**1**	**0.1**	**4**	**0.4**	**2.2**
MEDIUM RISK HAZARD (2.0 – 3.9)											

HAZARD IDENTIFICATION

Drought is a normal, recurrent, feature of climate and originates from a deficiency of precipitation over an extended period, usually one or more seasons. Drought can result in a water shortage for some activity, group, or environmental sector. Drought is a complex natural hazard, which is reflected in the following four definitions commonly used to describe it:

- Agricultural – drought is defined principally in terms of naturally occurring soil moisture deficiencies relative to water demands of plant life, usually arid crops.
- Hydrological – drought is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- Meteorological – drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- Socio-economic – drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. It may also be called a water management drought.

Although climate is a primary contributor to hydrological drought, other factors such as changes in land use (e.g., deforestation), land degradation, and the construction of dams all affect the hydrological characteristics of a particular region. Since regions are interconnected by natural systems, the impact of meteorological drought may extend well beyond the borders of the precipitation-deficient area. Changes in land use upstream may alter hydrologic characteristics such as infiltration and runoff rates, resulting in more variable stream flow and a higher incidence of hydrologic drought downstream. Land use change is one-way human actions alter the frequency of water shortage even when no change in the in precipitation has been observed has been observed (National Drought Mitigation Center 2014).

There is no commonly accepted approach for assessing risk associated with droughts given the varying types and indices. Drought risk is based on a combination of the frequency, severity, and spatial extent (the physical nature of drought) and the degree to which a population or activity is vulnerable to the effects of drought. The degree of the university's vulnerability to drought depends on the environmental and social characteristics of the region and is measured by its ability to anticipate, cope with, resist, and recover from drought.

Because drought is usually considered a regional hazard, it is not enhanced or analyzed by County-level mapping. All jurisdictions are assumed to have the same risk level within Franklin County. Mapping of the current drought status is published by the National Integrated Drought Information System (NIDIS): U.S. Drought Portal which can be found online at: www.drought.gov

According to the NCDC, the only recorded drought for Franklin County, Ohio was in July and August of 1999. However, in 2012, extremely dry conditions pushed into the month of September. These same dry conditions had persisted for most of the month resulting in crop losses throughout Ohio.

The 2012-2013 North American droughts began in the spring of 2012, when the lack of snow in the continental United States resulted in very little melt water being absorbed into the soil.

Drought conditions were experienced almost nationwide. Multiple Ohio counties were designated as being in a moderate drought condition by June. The Governor of Ohio sent a memorandum to the USDA State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought. The USDA reviewed this memorandum and determined that there were sufficient production losses in 85 counties to warrant a Secretarial disaster designation.

The following image shows the USDA Secretarial Disaster Designations for Crop Year (CY) 2012. As can be seen on the map, Franklin County was included in this disaster designation.

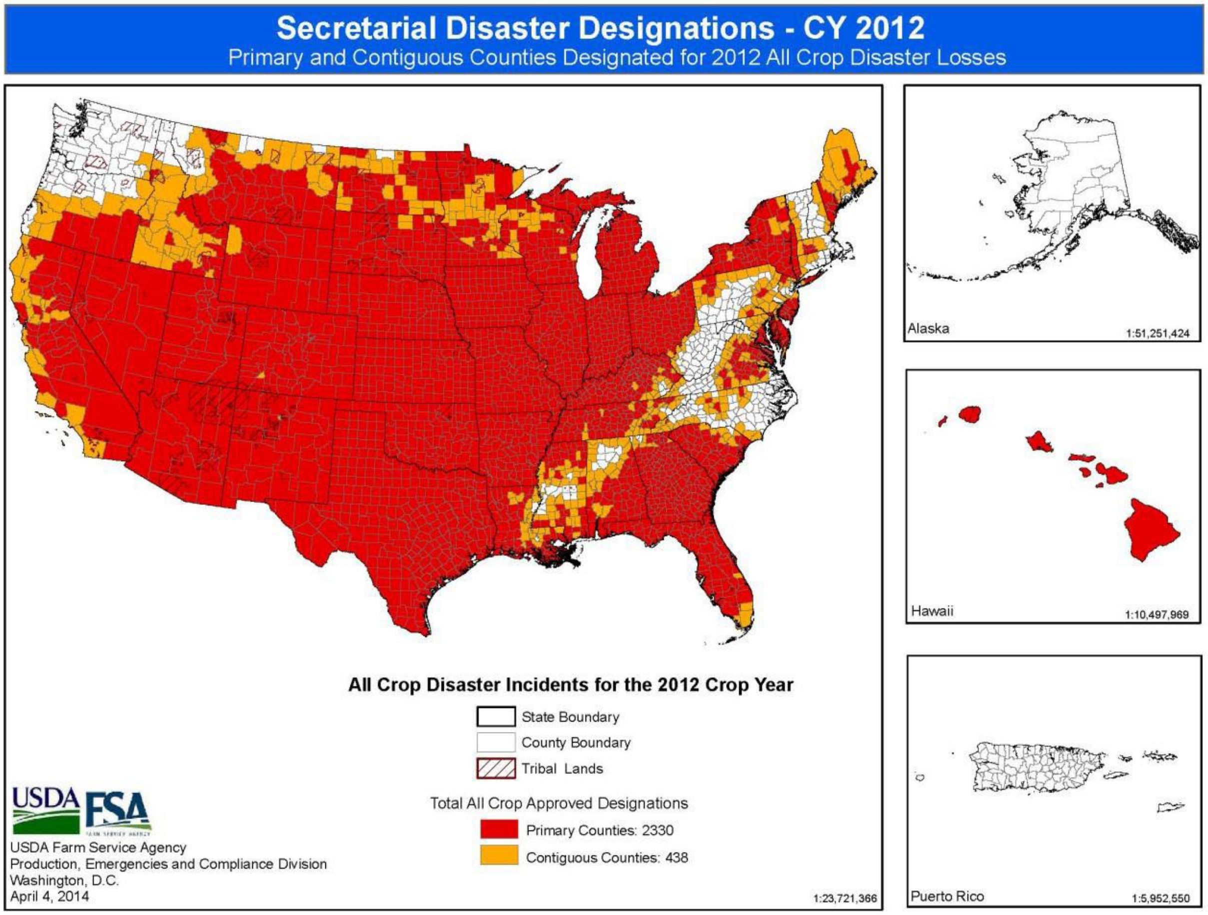


Figure 1-24 Crop Year 2012 USDA Disaster Declarations

DROUGHT IMPACT CATEGORIES

- ***Agriculture:*** Impacts associated with agriculture, farming, and ranching. Examples of drought-induced agricultural impacts include: damage to crop quality; income loss for farmers due to reduced crop yields; reduced productivity of cropland (due to wind erosion, long-term loss of organic matter, etc.); insect infestation; plant disease; increased irrigation costs; costs of new or supplemental water resource development (wells, dams, pipelines); reduced productivity of rangeland; forced reduction of foundation stock; closure/limitation of public lands to grazing; high cost/unavailability of water for livestock; and range fires.
- ***Water/Energy:*** Impacts associated with surface or subsurface water supplies (i.e., reservoirs or aquifers), stream levels or stream flow, hydropower generation, or navigation. Examples of drought-induced water/energy impacts include: lower water levels in reservoirs, lakes, and ponds; reduced flow from springs; reduced stream flow; loss of wetlands; estuarine impacts (e.g., changes in salinity levels); increased groundwater depletion, land subsidence, reduced recharge; water quality effects (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity); revenue shortfalls and/or windfall profits; cost of water transport or transfer; cost of new or supplemental water resource development; loss from impaired navigability of streams, rivers, and canals.

- ***Environment:*** *Impacts associated with wildlife, fisheries, forests, and other fauna. Examples of drought-induced environment impacts include: loss of biodiversity of plants or wildlife; loss of trees from urban landscapes, shelterbelts, wooded conservation areas; reduction and degradation of fish and wildlife habitat; lack of feed and drinking water; greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion; disease; increased vulnerability to predation (from species concentrated near water); migration and concentration (loss of wildlife in some areas and too many wildlife in other areas); and increased stress to endangered species.*
- ***Fire:*** Impacts associated with forest and range fires that occur during drought events. The relationship between fires and droughts is very complex. Not all fires are caused by droughts and serious fires can result when droughts are not taking place.
- ***Social:*** Impacts associated with the public, or the recreation/tourism sector. Examples of drought-induced social impacts include: health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced firefighting capability, etc.); loss of human life (e.g., from heat stress, suicides); public safety from forest and range fires; increased respiratory ailments; increased disease caused by wildlife concentrations; population migrations (rural to urban areas, migrants into the United States); loss of aesthetic values; reduction or modification of recreational activities; losses to manufacturers and sellers of recreational equipment; losses related to curtailed activities (hunting and fishing, bird watching, boating, etc.).
- ***Other:*** Drought impacts that do not easily fit into any of the above categories.

REGULATORY ENVIRONMENT

There are negligible formal regulations that pertain to drought events.

HAZARD EVENTS

Franklin County has had only two occurrences of drought stage conditions (as recognized by NOAA). Neither of which caused any property damage or crop loss.

Table 1-27 Drought Events Since 1999

LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
Franklin Co.	7/1/1999	Drought	0	0	0.00K	0.00K
Franklin Co.	8/1/1999	Drought	0	0	0.00K	0.00K
TOTALS:			**0**	**0**	**$0**	**$0**

HISTORICAL OCCURRENCES

While NOAA and its National Climactic Database do not list a drought in 2012, there were nationwide drought conditions observed that year. The 2012-2013 North American droughts began in the spring of 2012, when the lack of snow in the continental United States resulted in very little melt water being absorbed into the soil. Drought conditions were experienced almost nationwide. Multiple Ohio counties were designated as being in a moderate drought condition by June. The Governor of Ohio sent a memorandum to the USDA State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought. The USDA reviewed this memorandum and determined that there were sufficient production losses in eighty-five counties to warrant a Secretarial disaster designation.

MAGNITUDE/SEVERITY

The Palmer Drought Severity Index (PDSI) was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index. The Palmer Index is most effective in determining long term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

Table 1-28 Palmer Drought Severity Index					
DROUGHT SEVERITY	RETURN PERIOD (YEARS)	DESCRIPTION OF POSSIBLE IMPACTS	DROUGHT MONITORING INDICES		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44 +	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies	Less than -2	D4	-5.0 or less

Source: National Drought Mitigation Center

Drought severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. The magnitude of drought is usually measured in time and the severity of the hydrologic deficit.

Several resources are available to evaluate drought status and estimate future expected conditions. The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning. The NIDIS maintains the U.S. Drought Portal (www.drought.gov), a web-based access point to several drought related resources. Resources include the U.S. Drought Monitor (USDM) and the U.S. Seasonal Drought Outlook (USSDO).

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Drought conditions are likely to become more frequent and persistent over the 21st century due to climate change. Drought related to climate change will increase pressure on Ohio water resources. Decreasing snowmelt and spring stream flows coupled with increasing populations, anticipated hotter climate, and demand for water in southern portions of Ohio may lead to water shortages for residents.

Due to the nature of drought, it is extremely difficult to predict, but through identifying various indicators of drought, and tracking these indicators, it provides us with a crucial means of monitoring drought. Understanding the historical frequency, duration, and spatial extent of drought assists in determining the likelihood and potential severity of future droughts. The characteristics of past droughts provide benchmarks for projecting similar conditions into the future. The probability of the university experiencing a drought event can be difficult to quantify, but based on historical record of 3 recorded droughts since 1999, it can be stated that this type of event has occurred once every 7.33 years from 1999 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 1999] = 22 Years on Record [(Years on Record) 22] divided by [(Number of Historical Events) 3] = 7.33

The National Oceanic and Atmospheric Administration Paleoclimatology Program studies drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the United States. According to their research, "…paleoclimatic data suggest that droughts as severe as the 1950's drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North America as recently as 500 years ago." Based on this research, the 1950's drought situation could be expected approximately once every 50 years or 20% chance every ten years. An extreme drought, worse than the 1930's "Dust Bowl," has an approximate probability of occurring once every 500 years or a 2% chance of occurring each decade. (NOAA, 2003) A 500-year drought with a magnitude similar to that of the 1930's that destroys the agricultural economy and leads to wildfires is an example of a high magnitude event.

Impacts to vegetation and wildlife can include death from dehydration and spread of invasive species or disease because of stressed conditions. However, drought is a natural part of the environment in Ohio and native species are likely to be adapted to surviving periodic drought conditions. It is unlikely that drought would jeopardize the existence of rare species or vegetative communities.

Environmental impacts are more likely at the interface of the human and natural world. The loss of crops or livestock due to drought can have far-reaching economic effects. Wind and water erosion can alter the visual landscape and dust can damage property. Water-based recreational resources are affected by drought conditions. Indirect impacts from drought arise from wildfire, which may have additional effects on the landscape and sensitive resources such as historic or archeological sites.

INVENTORY ASSETS AND POTENTIAL LOSSES DUE TO DROUGHT

Drought typically does not have a direct impact on critical facilities or structures. However, possible losses/impacts to critical facilities include the loss of critical function due to low water supplies. Severe droughts can negatively affect drinking water supplies. Should a public water system be affected, the losses could total into the millions of dollars if outside water is shipped in. Private springs/wells could also dry up. Possible losses to infrastructure include the loss of potable water.

Droughts slowly evolve over time and the population typically has ample time to prepare for its effects. Should a drought affect the water available for public water systems or individual wells, the availability of clean drinking water could be compromised. This situation would require emergency actions and could possibly overwhelm the local government and financial resources.

Droughts are not likely to impact structures or infrastructure. The prolonged absence of precipitation is more likely to have an impact on agricultural operations than on more urban settings. While the university's infrastructure may not be susceptible to the effects of a drought, the agricultural program's various project areas may be impacted.

POTENTIAL LOSSES FROM DROUGHT

Due to the nature of drought, all university property is expected to be impacted equally due to drought conditions.

MITIGATION STRATEGIES

Society's vulnerability to drought is affected by (among other things) population growth and shifts, urbanization, demographic characteristics, technology, water use trends, government policy, social behavior, and environmental awareness. These factors are continually changing, and society's vulnerability to drought may rise or fall in response to these changes. For example, increasing and shifting populations put increasing pressure on water and other natural resources—more people need more water.

Future development's greatest impact on the drought hazard would possibly be to ground water resources. New water and sewer systems or significant well and septic sites could use up more of the water available, particularly during periods of drought. Public water systems are monitored, but individual wells and septic systems are not as strictly regulated. Therefore, future development could have an impact on the drought vulnerabilities.

DROUGHT MITIGATION ACTIONS

Drought Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 8: Understand the impact of, and increase resiliency to, drought events					
Objective 8.1: Undertake structural and infrastructure improvements to increase resilience to drought events					
8.1.1 Evaluate infrastructure for the use of gray water	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	TBS by Scope	Operating Budget	Canceled
8.1.2 Evaluate building plumbing **systems to reduce water flow/usage**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$5,000 per building	Operating Budget	Canceled

Drought Mitigation Actions					
8.1.3 Evaluate the use of secondary sources of natural **water sources**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Canceled
Objective 8.2: Develop and deploy public education campaigns related to drought events					
8.2.1 Develop a public education campaign to be delivered throughout the university **conveying drought risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026

DROUGHT HIRA SUMMARY

As stated, due to the nature of drought, it is extremely difficult to predict, but through identifying various indicators of drought, and tracking these indicators, it provides us with a crucial means of monitoring drought. Several mitigation measures will be reviewed and considered by the university for incorporation into future Plan updates.

- Assessment programs
- Water supply augmentation and development of new supplies
- Public awareness and education programs
- Technical assistance on water conservation
- Reduction and water conservation programs
- Emergency response programs
- Drought contingency plans

Some of these actions can have long-term impacts, such as contingency plan development, and the development of water conservation and public awareness programs. As the university gains more experience assessing and responding to drought, future actions will undoubtedly become more timely, effective, and less reactive.

EXTREME TEMPERATURES

Hazard Assessment Chart											
Natural Hazards	**Probability**		**Impact**		**Resilience**		**Warning Time**		**Duration**		**RF Rating**
Extremes Temperature	**4**	**1.2**	**2**	**0.6**	**4**	**0.8**	**2**	**0.2**	**3**	**0.3**	**3.1**
HIGH RISK HAZARD (3.0 – 3.9)											

In the 2019 State of Ohio Hazard Mitigation Plan (SOHMP), climate change is treated as a condition that will occur and potentially exacerbate the impact of hazardous extreme temperatures. According to the SOHMP, extreme heat and heat waves are existing hazards that will be exacerbated by climate change. Heat is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year. Extreme Cold can cause hazardous driving conditions, communications and electrical power failure, community isolation and can adversely affect business continuity. This section provides definitions and profiles for the hazard of extreme heat and extreme cold.

HAZARD IDENTIFICATION

EXTREME HEAT

Temperatures that remain at 10 degrees or more above the average high temperature for the area are defined as extreme heat. The National Weather Service (NWS) issues an Excessive Heat Warning/Advisory when an extreme heat event (a "heat wave") is expected within 36 hours. The NWS issues these warnings based on a "Heat Index" - a combination of heat and humidity - that is predicted to be 105 degrees or greater for two or more consecutive days. Local weather forecast offices may use different criteria for Excessive Heat Warning/Advisories based on maximum temperatures, nighttime temperatures, and other methods.

Extreme Heat is the number one weather-related killer in the United States. It causes more fatalities each year than floods, lightning, tornadoes, and hurricanes combined. In the Midwest, summers tend to combine both high temperature and high humidity. Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When the body heats too quickly, to cool itself safely, or when too much fluid is lost through dehydration or sweating, the body temperature rises, and heat-related illnesses may develop.

Extreme temperatures can result in elevated utility costs to consumers and also can cause human risks. Extremely high temperatures cause heat stress which can be divided into four categories. Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death.

EXTREME COLD

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Franklin County. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it “feels” and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects. (National Weather Service)

Extreme Cold is also responsible for a number of fatalities each year. Threats, such as hypothermia and frostbite, can lead to loss of fingers and toes or cause permanent kidney, pancreas, and liver injury and even death. Major winter storms can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall and cold temperatures. Fifty percent of cold-related injuries happen to people over 60 years of age. More than 75 percent of injuries happen to males, and almost 20 percent occur within the home.

The dangers associated with extreme cold include frostbite and hypothermia. Frostbite is damage to body tissue caused by that tissue being frozen. Frostbite causes a loss of feeling in extremities, such as fingers, toes, ear lobes, or the tip of the nose. Hypothermia, or low body temperature can lead to uncontrollable shivering, memory loss, disorientation, slurred speech, drowsiness, and apparent exhaustion.

REGULATORY ENVIRONMENT

There are negligible formal regulations that pertain to generalized extreme temperature events.

HAZARD EVENTS

Extreme temperatures are city/county/zone-wide hazards. As such, all Franklin County, Ohio instances of these events were looked at as previous hazard events.

The National Oceanic and Atmospheric Administration (NOAA) Climatic Data Center (NCDC) does not list any occurrences of either excessive heat, or extreme cold/wind chill for Franklin County, Ohio.

HISTORICAL OCCURRENCES

January 18, 1977: Classes were cancelled due to cold weather in an attempt to conserve gas and electric resources at the request of Columbia Gas and Southern Ohio Electric. But students didn’t get too much of a break: Cancelled classes were rescheduled for President’s Day.

January 6-7, 2014: An anomalous Arctic air mass descended on much of the eastern two- thirds of the United States on January 6 and 7, 2014. Despite the very cold air throughout the depth of the atmosphere, even colder readings were not realized at the ground because of persistent winds and a lack of deep snowpack in much of the area. To maximize cooling at night, typically clear skies, calm winds, and deep snowpack are most efficient. Nevertheless, the air mass was cold enough to produce record low temperatures. Depending on location, the temperatures were the lowest since other cold outbreaks in 2011, 2009, or 1994.[15]

Columbus set a new record low for January 7, at -7 degrees Fahrenheit. The previous record was -5 degrees, set in 1884.

This event was categorized as a polar vortex. The polar vortex is a whirling and persistent large area of low pressure, found typically over both North and South poles. The northern polar vortex was pushing southward over western Wisconsin and eastern Minnesota on Monday, Jan. 6, 2014, and was bringing frigid temperatures to half of the continental United States.

This polar vortex resulted in the university being closed on January 6 and 7. The decision to close was based, partly on the hazards to students, faculty and staff transiting to, from and around campus during this event. University closures result in a loss of academic instruction time and staff productivity at a great cost to the university.

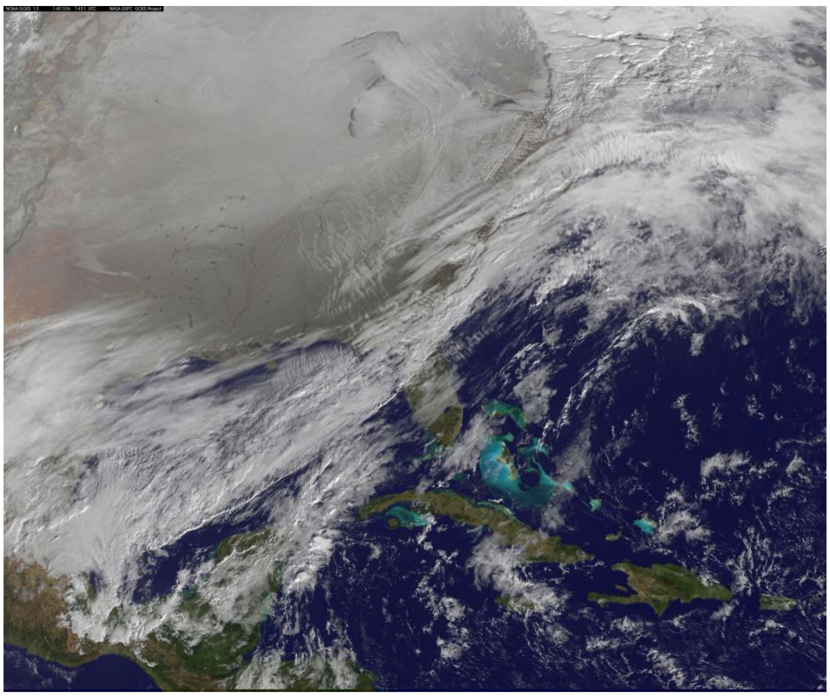


Figure 1-13 January 2014 Polar Vortex 1

February 2015: Winter made a sudden comeback as the calendar flipped to 2015, however, with January bringing significantly colder temperatures along with several inches of snow to the greater Dayton and Columbus metro areas. February brought a few blasts of bitter cold and a handful of winter storms to the region with the month finishing much colder and snowier than normal. A Valentine's Day snow squall day brought very little snow, but the combination only about 1 inch of snow with wind and reduced visibility resulted in multiple pileups on three Ohio interstates and several highway fatalities. President's Day week followed with very cold temperatures – with overnight lows hitting the -10 to even -20 degrees across the region.

MAGNITUDE/SEVERITY

While cold temperatures and power losses can render a structure uninhabitable for a time, they are unlikely to cause structural damages. Those people living in these older homes are more likely to need services offered in response to extreme cold.

Extremely high temperatures cause heat stress which can be divided into four categories. Each category is defined by apparent temperature. Apparent temperature is the general term for the perceived outdoor temperature, caused by the combined effects of air temperature, relative humidity, and wind speed. Apparent temperature is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, fainting, heat exhaustion, heatstroke, and death. Note that while the temperatures in Table 1-17 serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

Temperature advisories, watches, and warnings are issued by the National Weather Service relating the above impacts to the range of temperatures typically experienced in Ohio. Exact thresholds vary across the State, but in general *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warning*s are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches* are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010).

Table 1-17 Four Categories of Heat Stress (FEMA, 1997)

DANGER CATEGORY	HEAT DISORDERS	APPARENT TEMPERATURE (°F)
I (Caution)	Fatigue possible with prolonged exposure and physical activity.	80 to 90
II (Extreme Caution)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90 to 105
III (Danger)	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105 to 130
IV (Extreme Danger)	Heatstroke or sunstroke imminent.	>130

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Figure 1-14 NOAA's National Weather Service Heat Index

Excessive Cold Threat Level Description Table	
Excessive Cold Threat Level	**Threat Level Descriptions**
Extreme	**"An Extreme Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -35° F or below for 3 hours or more. Or lowest air temperature less than or equal to -20° F.
High	**"A High Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -28° F to -35 ° F for 3 hours or more. Or lowest air temperature -15° to -20° F.
Moderate	**"A Moderate Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -20° F to -28 ° F or below for 3 hours or more. Or, lowest air temperature -10° to -15° F.
Low	**"A Low Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -15° F to -20 ° F or below for 3 hours or more. Or lowest air temperature -5° to -10° F.
Very Low	**"A Very Low Threat to Life and Property from Excessive Cold."** It is likely that that wind chill values will drop to -10° F to -15 ° F or below for 3 hours or more. Or lowest air temperature zero to -5° F.
Non-Threatening	**"No Discernable Threat to Life and Property from Excessive Cold."** Cold season weather conditions are non-threatening.

Figure 1-15 Extreme Cold Temperature and Associated Threat Level

NWS Windchill Chart

Wind (mph) \ Temperature (°F)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Figure 1-16 National Weather Service Wind Chill Chart

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

The probability of the university experiencing an extreme temperature can be difficult to quantify. Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. The length of days above 100 degrees may also extend significantly.

There are no recorded (by NOAA) extreme temperature events for Franklin County. However, the NWS has recorded extreme cold events in 1994, 2009, 2014 and 2015. These reported events over the past 27 years provide a framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its municipalities experiencing an extreme cold event can be difficult to quantify, but based on historical record of 4 extreme cold events since 1994, it can be assumed that this type of event has occurred once every 6.75 years from 1994 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 1994] = 27 Years on Record [(Years on Record) 27] divided by [(Number of Historical Events) 4] = 6.75

INVENTORY ASSETS EXPOSED TO EXTREME TEMPERATURES

Vulnerability for extreme heat was classified as areas having a maximum average temperature over 85 degrees, according to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) study. This range falls within the upper limits of FEMA's heat stress index, Caution Category 1. Extreme heat does not generally impact buildings; instead, they primarily impact people. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

Additionally, vulnerability for extreme cold was classified as areas having a minimum average temperature less than 14 degrees, according to the USDA NRCS study. Extreme cold does not generally impact buildings; instead, they primarily impact people. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

POTENTIAL LOSSES FROM TEMPERATURE EXTREMES

As stated above, since 1994, the NWS reported four extreme cold events in Franklin County. It's evident that extreme temperatures are dangerous and can cause death. Therefore, it's important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Additionally, extreme cold can cause damage to structures; for example, burst pipes will damage buildings and will necessitate repairs. It is unlikely that an entire building would be impacted in an extreme cold event.

There is no way to predict an area that will be impacted by extreme temperatures. As a result, all university property located must be viewed as susceptible to the effects of extreme temperatures. While temperature extremes are not usually thought of as damaging to structures, they can make structures unusable. However, extreme temperatures can cause other issues, like pipes that burst causing flooding and damage. These secondary impacts can render a building unusable if there is an interruption to the utilities provided to it, whether it be water, gas or electricity.

MITIGATION STRATEGIES

Buildings of significant age may be more susceptible to temperature extremes. It is important to identify older building stock and be prepared for potential issues in those locations.

EXTREME TEMPERATURE MITIGATION ACTIONS

Extreme Temperature Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 4: Increase the university's resilience to extreme temperatures					
Objective 4.1: Undertake structural and infrastructure improvements to increase resilience to extreme temperatures					

<table>
<tr><th colspan="6">Extreme Temperature Mitigation Actions</th></tr>
<tr><td>4.1.1 Evaluate mechanical system and building envelope improvements in buildings to increase resilience to extreme cold temperatures</td><td>Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management</td><td>06/01/2016 – 6/1/2021</td><td>$25,000 per building</td><td>Operating Budgets, FEMA HMA Programs</td><td>Ongoing. 06/01/2021-06/01/2026</td></tr>
<tr><td>4.1.2 Develop and asset management system to track infrastructure integrity</td><td>Associate VP of Facilities, Operations and Development</td><td>06/01/2016 – 6/1/2021</td><td>$200,000 to develop - $1,000,000 to implement</td><td>Operating Budgets, FEMA HMA Programs</td><td>Canceled</td></tr>
<tr><td>4.1.3 Ensure infrastructure system redundancy</td><td>Associate VP of Facilities, Operations and Development</td><td>06/01/2016 – 6/1/2021</td><td>TBD by Scope</td><td>Operating Budgets, FEMA HMA Programs</td><td>Canceled</td></tr>
<tr><td>4.1.4 Evaluate building design standards for extreme temperatures</td><td>Associate VP of Facilities, Operations and Development</td><td>06/01/2016 – 6/1/2021</td><td>$ 300,000.00</td><td>Operating Budget</td><td>Canceled</td></tr>
<tr><td colspan="6">Objective 5.2: Develop and deploy public education campaigns related to extreme temperatures</td></tr>
<tr><td>4.2.1 Develop a public education campaign to be delivered throughout the university conveying extreme temperature risk</td><td>Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center</td><td>06/01/2016 – 6/1/2021</td><td>Staff Time and Resources</td><td>Operating Budget</td><td>Ongoing. 06/01/2021-06/01/2026</td></tr>
</table>

TEMPERATURE EXTREME HIRA SUMMARY

Temporary periods of extreme hot or cold temperatures typically do not have significant environmental impact. However, prolonged periods of hot temperatures may be associated with drought conditions and can damage or destroy vegetation, dry up rivers and streams, and reduce water quality. Prolonged exposure to extremely cold temperatures can kill wildlife and vegetation.

HAZARDOUS MATERIALS INCIDENT

Hazard Assessment Chart											
Non-Natural Hazard	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
HazMat Incident	**4**	**1.2**	**1**	**0.3**	**1**	**0.2**	**4**	**0.4**	**1**	**0.1**	**2.2**
MEDIUM RISK HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

TRADITIONAL HAZARDOUS MATERIALS

A hazardous material release is the contamination of the environment (i.e., air, water, soil) by any material that because of its quantity, concentration, physical characteristics, or chemical characteristics threatens human, animal, or plant health, the environment, or property.

Hazardous material spills are usually accidental events that arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. The consequences of such spills are usually unintended. An accidental or intentional release of hazardous materials could produce a health hazard to those in the area, downwind, and/or downstream with immediate, prolonged, and/or delayed effects. The spread of the material may additionally be defined by weather conditions and topography of the area. A hazardous material release can come from a fixed facility, transportation, or an intentional release such terrorism.

A hazardous material release may also occur due to a transportation accident. The most likely locations for a transportation-related hazardous material release are along the roads and highways running along the perimeters of the campus. Gas, propane, and other hazardous materials are delivered throughout the area year-round. The need for gas, propane, fertilizers, and other toxic materials in daily life creates a larger risk for a hazardous materials release.

A hazardous materials release on or near the university grounds may not only contaminate dirt or surface material but potentially contaminate flowing water in ditches, rivers, or small streams. Other potential concerns for spills/leaks are icy road conditions during winter months, sabotage, and terrorism.

The university has two railroad lines that border it. One east of campus, and one that goes through a part of the western part of campus. Major transportation routes include State Route 315 (which runs through campus, to the west), Olentangy River Road, and High Street.

The university has an Office of Environmental Health and Safety (EHS), whose mission is: *to assist the university community in providing and maintaining a safe, healthful work environment for students, faculty, staff, contractors, and visitors. The EHS mission also encompasses responsibilities of protecting the local community and environment from potential hazards generated by university activities*

Fixed facilities housing hazardous substances at the university include swimming pools, gas stations, and supply stores containing substances such as fuel, farm chemicals, propane, fuel oil, paint, and small amounts of chlorine.

RADIOACTIVE MATERIALS

In addition to being susceptible to the more traditional hazardous materials incidents, the university houses a variety of radioactive materials. There are numerous laboratories that either work with or store radioactive material. In addition, the hospital uses radioisotopes for diagnostic and therapeutic applications. These materials all need to be stored, used and disposed of in a safe and responsible manner. EHS is equipped to handle not only chemical and environmental issues, but radiation safety as well. The office is responsible for approving requisitions, permitting, laboratory inspections and radioactive waste disposal.

HOSPITAL RADIOACTIVE ISOTOPES

Hospitals are increasingly using radioactive isotopes for diagnostic and therapeutic applications. The bulk of the hospital radioactive waste is commonly generated in the department of Nuclear Medicine. Generally, most of the radioactive waste is liquid. Some lesser amounts of the waste are solid and gaseous. The solid waste containing traces of radioactivity can be in the form of syringes, needles, cotton swabs, vials, contaminated gloves, and absorbent materials.

UNIVERSITY NUCLEAR REACTOR

The Ohio State University Nuclear Reactor Lab (Ohio State -NRL) is used for a wide range of nuclear-related research endeavors, including evaluation of material elemental constituents using neutron activation analysis (NAA) and neutron depth profiling (NDP); evaluation of radiation damage to electronic components and other materials, such as optical fibers and optical fiber-based sensors; evaluation of neutron and gamma-ray radiation sensitive detector performance; isotope production; and biomedical experiments. The Ohio State-NRL staff provides a variety of instructional services ranging from general tours to group laboratory sessions, and facilitates research projects structured to student and faculty interests.

The Ohio State-NRL features The Ohio State University Research Reactor (OSURR), as well as a professional gamma-ray spectroscopy system and two gamma-ray irradiators. The OSURR is a pool‐type reactor, with multiple beam ports and dry tubes as irradiation facilities, that is

utilized for a variety of instructional, research, and service activities. It is licensed to operate at thermal powers up to a maximum of 500 kilowatts, and at this maximum steady‐state power, the maximum thermal neutron flux in the central irradiation facility is approximately 1.4x1013 n/cm2/s.

OHIO EMERGENCY MANAGEMENT AGENCY RADIOLOGICAL BRANCH OFFICE

Housed in close proximity to the Ohio State-NRL, is the space where the Ohio EMA's Radiological Instrumentation, Maintenance and Calibration Section operates. This office is responsible for maintaining the field monitoring teams that respond to nuclear power plant incidents and others as needed in support of the Ohio Department of Health. It also repairs, calibrates and exchanges radiological response instruments and dosimeters used by emergency services personnel in state agencies, Ohio's 88 counties and other states, as contracted.

REGULATORY ENVIRONMENT

The US EPA's Toxic Release Inventory (TRI) program tracks hazardous materials release and disposal data for US counties and states. Disposals in the Columbus area include ammonia, styrene (a carcinogenic chemical), 1,2,4 trimethylbenzene, toluene, and xylene. The TRI data does not provide data regarding the effect on the public of releases or disposals of hazardous materials.

HAZARD EVENTS/HISTORICAL OCCURRENCES

The university has been subjected to various small-scale spills on campus. Some of these have included fuel spills at pump locations. The EHS office has been able to address these local spills. Any spills that have occurred on state routes bordering campus are handled by the appropriate responding agency. This may be the City of Columbus hazardous materials team, or a Franklin County entity.

MAGNITUDE/SEVERITY

With a hazardous material release, whether accidental or intentional, there are several potentially exacerbating or mitigating circumstances that will affect its severity or impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place protects people and property from the harmful effects of a hazardous material release. Exacerbating conditions, or characteristics that can enhance or magnify the effects of a hazardous material release, include:

- **Weather conditions:** affects how the hazard occurs and develops
- **Micro-meteorological effects of buildings and terrain** alters dispersion of hazardous materials
- **Non-compliance with applicable codes (e.g., building or fire codes) and maintenance failures (e.g., fire protection and containment features):** can substantially increase the damage to the facility itself and to surrounding buildings.

Whether or not a hazardous materials site is contained in the SFHA is also a concern, as there could be larger-scale water contamination during a flood event should the flood compromise the production or storage of hazardous chemicals. Such a situation could swiftly move toxic chemicals throughout a water supply and across great distances.

The severity of a given incident is dependent not only on the circumstances described above, but also with the type of material released and the distance and related response time for emergency response teams. The areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g., centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

A hazardous materials or nuclear release has the possibility of having a significant impact on the campus.

Most hazardous material releases do not usually have an effect on infrastructure, particularly underground infrastructure. Some critical facilities use hazardous materials to operate such as chlorine for water treatment and PCB's for electric transformers. Similarly, the contamination of the water supply may be treated like a hazardous material release. Propane, oil, and natural gas, necessary fuels for heating, can also be hazardous if released during their delivery due to their explosive potential. Transportation may be limited if a key roadway or railway is blocked by an incident.

- Possible losses to critical facilities include:
  - Critical functional losses
  - Contamination
  - Structural and contents losses, if an explosion is present
- Possible losses to structures include:
  - Inaccessibility
  - Contamination
  - Structural and contents losses, if an explosion is present
- Possible economic losses include:
  - Business closures and associated business disruption losses
- Possible ecologic losses include:
  - Loss of wildlife
  - Habitat damage
  - Reduced air and water quality
- Possible social losses include:
  - Canceled activities
  - Emotional impacts of significant population losses and illnesses

FREQUENCY/POSSIBILITY OF FUTURE OCCURRENCES

There is not enough historical precedence to determine frequency or future probability of a hazardous materials release.

INVENTORY ASSETS EXPOSED TO HAZARDOUS MATERIALS/RADIOLOGICAL RELEASE

All university assets can be considered at risk from hazardous materials releases. This includes 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. The presence of the railroad tracks, as well as state routes, which pass through or on the perimeter of campus make the entire university vulnerable to the effects of a possible release.

POTENTIAL LOSSES

A hazardous materials or nuclear release has the possibility of having a significant impact on the campus.

Most hazardous material releases do not usually have an effect on infrastructure, particularly underground infrastructure. Some critical facilities use hazardous materials to operate such as chlorine for water treatment and PCB's for electric transformers. Similarly, the contamination of the water supply may be treated like a hazardous material release. Propane, oil, and natural gas, necessary fuels for heating, can also be hazardous if released during their delivery due to their explosive potential. Transportation may be limited if a key roadway or railway is blocked by an incident.

- Possible losses to critical facilities include:
  - Critical functional losses
  - Contamination
  - Structural and contents losses if an explosion is present
- Possible losses to structures include:
  - Inaccessibility
  - Contamination

- Structural and contents losses if an explosion is present
- Possible economic losses include:
  - Business closures and associated business disruption losses
- Possible ecologic losses include:
  - Loss of wildlife
  - Habitat damage
  - Reduced air and water quality
- Possible social losses include:
  - Canceled activities
  - Emotional impacts of significant population losses and illnesses

MITIGATION STRATEGIES

The population impacts are often greater than the structural impacts during a hazardous material a release. Depending on the material, the health impacts to humans can be long and short term. A release on or near campus could threaten the population. Generally, an incident will affect only a subset of the total population at risk. In a hazardous material release, those in the immediate isolation area would have little to no warning, whereas the population further away in the dispersion path may have some time to evacuate, depending on the weather conditions, material released, and public notification.

There are often no land use regulations that restrict building around industrial facilities or along transportation routes. As the population increases, development will also continue to increase in these areas thereby exposing a greater number of individuals to the risk of a hazardous materials release. Increase development will lead to increased vulnerability and increased potential losses.

HAZARDOUS MATERIALS MITIGATION ACTIONS

Hazardous Materials Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 13: Increase the university's ability to respond to and recover from a HazMat release					
Objective 13.1: Further develop planning mechanisms related to hazardous materials releases					
13.1.1 Conduct a commodity study to understand what is being transported past or near campus on trains, **or trucks.**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2017	$15,000 per unit	Operating Budget	Canceled
Objective 13.2: Develop and deploy public education campaigns related to hazardous materials releases					

Hazardous Materials Mitigation Actions					
13.2.1 Conduct public education and outreach regarding **hazardous materials releases**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	(Ongoing: 06/01/2021-06/01/2026)

HAZARDOUS MATERIALS HIRA SUMMARY

Hazardous materials incidents can pose a series of threats to human safety and welfare, as well as the environment. Incidents occur regularly, but are not often of a size to cause a significant threat. However, it seems likely that incidents will continue and the potential for a significant release is present. Incidents often occur in conjunction with, or as a result of, natural hazards impacting facilities that house hazardous materials. Depending upon the materials released, as well as atmospheric conditions, an incident has the potential to cause significant disruption to the university.

TRANSPORTATION INCIDENT

Hazard Assessment Chart											
Non-Natural Hazards	Likelihood		Consequence		Resilience		Warning Time		Duration		Risk Factor
Transportation Incident	**2**	**0.6**	**2**	**0.6**	**2**	**0.4**	**4**	**0.4**	**2**	**0.2**	**2.2**
MEDIUM RISK HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

Transportation accidents can result from any form of air, rail, water, or road travel. Certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present.[27] Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density.[28]

ROAD TRAFFIC

There are several transportation routes near the university that are highly vulnerable to accidents. These vulnerable routes include State Route 315, Olentangy River Road, and High Street.

Table 1-32 Average Annual Daily Traffic Counts Near Campus

Roadway	Traffic Section	Average Annual Daily Traffic
State Route 315	Lane Avenue	121,380 (117,430 passenger + 3,950 commercial)
	Olentangy River Road	125,060 (120,760 passenger + 4,300 commercial)
	Ramps for Ohio State Hospital	102,290 (98,300 passenger + 3,990 commercial)
N. High Street	At W. Woodruff Ave.	19,274
Olentangy River Road	At Lane Avenue	13,448

According to the university's Office of Transportation & Traffic Management, more than 84,000 vehicles per day travel through campus. It should be noted that this figure is for an average day on campus and does not reflect special events, athletic events, or concerts that occur regularly on campus. All of this vehicular traffic has the ability to impact the university. Whether as a vehicle versus vehicle accident, or vehicle versus pedestrian. Although crosswalks are well marked across campus, incidents involving vehicles are a constant threat to the university.

RAIL TRAFFIC

Bordering the campus to the east and west, are CSX rail lines. The western line runs through the very western edge of campus. The eastern CSX line does not immediately border campus; however, it is close enough that if there were an accident, the campus could be significantly impacted. These trains could be carrying:

- Automobiles
- Coal
- Metals
- Chemicals (Sulfur, Petroleum, Chlorine and Bleaching Products, Plastics, Chemical Waste, Plastics, Other Non-Hazardous Waste)
- Electronics
- Machinery

REGULATORY ENVIRONMENT

AUTOMOTIVE

Auto accidents generally fall under the authority of the appropriate law enforcement agency. On or near the campus, this generally means The Ohio State University police, or the City of Columbus Division of Police.

RAIL TRAFFIC

The Federal Railroad Administration is tasked with the safe, reliable, and efficient movement of people and goods.

AIR TRAFFIC

The Federal Aviation Administration is tasked with regulating air travel within the United States.

HAZARD EVENTS/HISTORICAL OCCURRENCES

AUTOMOTIVE

Auto accidents are a common enough occurrence that they are not catalogued as completely as other types of transportation incidents.

RAIL TRAFFIC

On July 11, 2012, a train derailed less than a mile from the eastern edge of the campus. The derailment began to be reported at 2 a.m. Several 911 calls reported large fire with flames reaching 60- to 70 feet high. The incident led to the evacuation of roughly 100 people within a one-mile radius of the accident. The train was carrying (among other things) ethanol. The accident was determined to be caused by a damaged rail. This accident also caused roughly $1.2 million in damages.

MAGNITUDE/SEVERITY

Significant transportation accidents can result in death or serious injury or extensive property loss or damage. Road and railway accidents in particular have the potential to result in hazardous materials release. Air traffic accidents have the capability to cause extensive damage.

FREQUENCY/PROBABILITY OF OCCURRENCES

There is not enough historical precedence to determine frequency or future probability of transportation incidents on or around the Ohio State campus.

INVENTORY ASSETS EXPOSED TO TRANSPORTATION INCIDENTS

All university assets can be considered at risk from a transportation incident. This includes over 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. The number of roads passing through and around campus, the presence of railroad tracks on the east and west perimeters of campus, and the flight paths that pass overhead all place the university at some level of risk.

POTENTIAL LOSSES

A transportation incident can have a significant impact on campus. While most accidents do not result in damage to infrastructure or buildings, they have the ability to render them uninhabitable. Hazardous materials are a possible side effect from transportation incidents. An air crash occurring on or near campus could be catastrophic.

MITIGATION STRATEGIES

Most of the existing transportation routes on, near, or through campus are already well established. Steps can be taken to improve safety for pedestrians, and to control traffic patterns to make the roads as safe as possible. Rail lines are inspected regularly, and all policies are in place to mitigate potential losses along the lines. The FAA develops policies, and air operators follow recommended maintenance protocols to ensure that air travel is as safe as possible.

TRANSPORTATION INCIDENT MITIGATION ACTIONS

Transportation Incident Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 14: Increase the resiliency of the university to transportation incidents					
Objective 14.1: Further develop planning mechanisms related to transportation incidents					

Transportation Incident Mitigation Actions					
14.1.1 Conduct safety studies of **intersections as needed**	Director, Transportation & Traffic Management	06/01/2016 – 6/1/2019	$25,000 per study	Operating Budget	Canceled.
14.1.2 Map student movement on campus as needed	Director, Transportation & Traffic Management; Director, Planning and Real Estate	06/01/2016 – 6/1/2019	Staff Time and Resources	Operating Budget	Canceled.
Objective 14.2: Develop and deploy public education campaigns related to hazardous materials releases					
14.2.1 Continue to conduct public education and outreach regarding **transportation incidents**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	(Ongoing: 06/01/2021-06/01/2026)

TRANSPORTATION INCIDENT HIRA SUMMARY

Transportation incidents occur commonly, but often with little impact to operations or the safety of campus. However, the possibility does exist for a large-scale rail or air traffic incident to impact the campus. In those cases, not only would people be at risk, but potentially infrastructure as well. These incidents can often have a secondary effect of causing a hazardous materials spill.

UTILITY FAILURE

Hazard Assessment Chart											
Non-Natural Hazard	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Utility Failure	**4**	**1.2**	**2**	**0.6**	**3**	**0.6**	**4**	**0.4**	**2**	**0.2**	**3.0**
HIGH RISK HAZARD (3.0 – 3.9)											

HAZARD IDENTIFICATION

Utility interruption includes any impairment of the functioning of telecommunication, gas, electric, water, or waste networks. These interruptions or outages occur because of geomagnetic storms, fuel or resources shortage, electromagnetic pulses, information technology failures, transmission facility or linear utility accident, and major energy, power, or utility failure. The focus of utility interruptions as a hazard lies in fuel, energy, or utility failure; this hazard is often secondary to other natural hazard event, particularly transportation accidents, lightning strikes, extreme heat or cold events, and coastal and winter storms.

University utility interruptions that occur are usually small-scale, localized incidents. Utility interruptions are possible anywhere there is utility service. On the campus of The Ohio State University, there are a variety of utilities to service buildings. An example of the utility infrastructure that services the university includes:

- Chilled water
- Datacom
- Domestic cold water
- Domestic hot water
- High voltage
- Fuel oil
- Fire protection
- Natural gas
- Heating hot water
- Irrigation
- Lighting
- Sanitary (which also includes combined sewer)
- Steam (includes CON, condensate return lines)
- Storm Sewer
- Tunnels

Utility services are produced and delivered to customers by an extensive utility infrastructure system that is undergoing significant renewal, upgrade, and expansion as part of the Infrastructure Master Plan. Utilities' activities focus on maintaining reliable utilities, ensuring appropriate project designs and installations, minimizing construction impacts, and maximizing efforts to facilitate university business throughout construction, renewal, and expansion activities.

STEAM, HOT WATER, CHILLED WATER

The McCracken Power Plant provides steam, hot water, and chilled water for campus consumption. It is responsible for a providing much of the heating requirements of the main campus. Steam produced at the plant supplies: space and water heating, turbine-driven chilling, absorption air conditioning, autoclaves, distillation units, food service, soil sterilization at some of the greenhouses, humidification, and laboratories. The plant has a storage capacity that allows it to operate for multiple days without being resupplied.

Chilled Water: When the capacity is fully utilized, over 100 buildings on campus will be served by centralized chilled water.

ELECTRICAL POWER SYSTEMS

There are three feeders from American Electric Power that supply the main campus through both The Ohio State University Columbus and West Campus Substations. Approximately 25% of campus power is sourced from wind under a power purchase agreement. From the two main substations, electrical power is distributed to Smith Substation (adjacent to McCracken) and to campus. Most campus buildings have two power feeders to increase reliability. This redundant radial distribution system supports construction and maintenance outages without impact to building service.

Generators: There are three diesel generators that provide standby power to McCracken Power Plant.

UTILITY SUPPORT SERVICES

The following services support the university's Utilities system

UTILITIES ENGINEERING

- Technical support to maintain 99.9% utility service reliability.
- Utility system planning for the Infrastructure Master Plan.
- System modeling for capacity evaluation and growth studies.
- Campus distribution and energy conversion system optimization.
- Critical review of utilities aspects of new construction.
- Campus power plant and central chiller plant controls.
- Specialized technical consulting on utility system equipment, steam piping, electrical systems safety, energy conservation, process communication, and controls.

UTILITIES SUPPORT SERVICES

- Maintains an extensive system of underground utility tunnels, trench boxes, and direct buried piping.
- Operates and maintains the campus domestic water distribution system and fire hydrants.
- Operates and maintains primary meter gas distribution systems for campus.
- Construction and maintenance outage coordination and planning support to plant operations.

ELECTRICAL SERVICES

- Ohio State, West Campus, and Smith Substation operation and circuit switching.
- Electrical energy services to campus buildings.
- Electrical fault studies and system planning.
- Medium and high voltage system maintenance and repair, including building transformers.
- Utility Plant electrical system repair and maintenance.
- Provides 99.9% electrical reliability utilizing redundant circuits to most campus buildings.

INFORMATION TECHNOLOGY SYSTEMS

The Ohio State University Office of Chief Information Office (OCIO) maintains the university's core network infrastructure, also known as the “wired network” or OSUNet.

OSUNet enables connectivity to both commercial Internet and Internet2, a high-speed educational research network.

OSUNet provides inter-building connectivity. College and department local IT organizational units provide networking inside buildings.

Remote VPN client software is available on the Site License Software website to allow students, faculty, and staff to gain “local access” to university resources from a remote, off-campus site using an Internet service provider.

The standard OSUNet service available to departments and colleges provides:

- 1000Mb (10/100/1000 BasT Ethernet port connection to dedicated port on the university supported network (OSUNet)
- IP address space on university owned IP space
- Domain Name Service (DNS) support; one zone per university entity
- Network Time Protocol (NTP) services for network clock synchronization

REGULATORY ENVIRONMENT

The university continued compliance activities for the natural gas pipelines to comply with CFR 192 and Public Utility Commission requirements.

In addition, the university developed an asset numbering template for the Natural Gas Pipeline system in collaboration with the mapping group. A handheld GPS system was purchased, and a template developed to facilitate location and data input to an improved electronic Gas Asset information system. Utilities Support Service staff began use of the GPS for mapping updates in June.

HAZARD EVENTS

Minor, short-term utility interruptions may occur several times a year for any given area on campus, while major, long-term events may take place once every few years. Utility interruptions are difficult to predict, but they are likely to have a relatively short duration of 24 hours or less. Since utility interruptions are sometimes by-products of severe weather events, citizens should prepare for them during severe storms.

Windstorms and winter storms have caused power outages on occasion to outlying campus buildings supplied from overhead lines. Extreme cold can increase regional demand gas demand to the limit of the gas distribution systems' capacity. Minor utility interruptions occur annually on campus, caused by these and other circumstances. There is no complete list of utility interruption events available for the university.

IT RELIABILITY REPORTING

The OCIO provides an on-demand, real time system status for the university's IT systems. The web page can be found at: https://osuitsm.service-now.com/selfservice/system_status

The page tracks all available university-related IT services. It provides a running, 5-day log of the systems' operations. Systems are identified as being in one of five conditions:

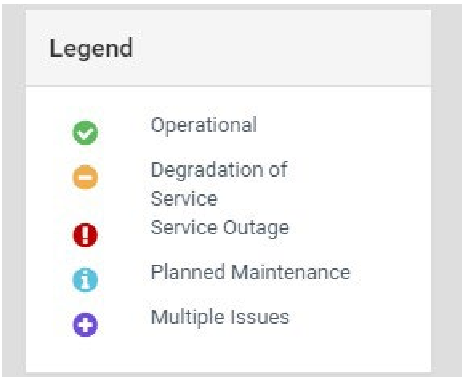


Figure 1-25 OCIO System Status Conditions

HISTORICAL OCCURRENCES/PROBABILITY OF FUTURE OCCURRENCES

Utility interruptions occur frequently, and are dealt with on an as-needed basis.

MAGNITUDE/SEVERITY

The most severe utility interruptions will be regional or widespread power outages. With the loss of power, electrically powered equipment and systems will not be operational. Examples may include lighting; HVAC and ancillary support equipment; communication (i.e., public address systems, telephone, computer servers, and peripherals); ventilation systems; fire and security systems; refrigerators, sterilizers, trash compactors, office equipment; and medical equipment. This can cause food spoilage, loss of heat or air conditioning, basement flooding (sump pump failure), lack of light, loss of water (well pump failure), lack of phone service, or lack of internet service. However, this is most often a short-term nuisance rather than a catastrophic hazard. The severity of a utility interruption can be compounded with extreme weather events, especially winter weather events. Interruptions can also be more severe for special needs populations that are dependent on electronic medical equipment. Utility interruptions can significantly hamper first responders in their efforts to provide aid in a compound disaster situation, especially with losses of telecommunications and wireless capabilities.

The university has a great number of research projects going on at any given time. A utility interruption affecting these projects, or the buildings that they are housed in could prove disastrous for the projects, and set the research back an unknown amount of time.

In a possible worst-case scenario, a winter storm event causes widespread power outages, leaving students, faculty, and staff without heat in the midst of subzero temperatures. Power lines are unable to be repaired because of the magnitude of the storm, and the power outage lasts for several days.

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

Reported utility interruptions over the past six years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the university experiencing a utility outage can be difficult to quantify, but based on historical record of 431 outages since 2010, it can reasonably be assumed that this type of event has occurred once every 0.13 years from 2010 through 2021.

[(Current Year) 2021] subtracted by [(Historical Year) 2010] = 6 Years on Record [(Years on Record) 6] divided by [(Number of Historical Events) 431] = 0.13

INVENTORY ASSETS EXPOSED TO UTILITY FAILURE

All university assets can be considered at risk to utility failure. With the variety of services to keep the university and its individual buildings, they must all be considered at risk. This includes over 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. There is no way to predict potential utility failure. The long-term loss of utilities to any of the 49 residence halls that house approximately 16,000 residents will particularly be detrimental and may require contracting other housing for the residents at considerable cost.

POTENTIAL LOSSES FROM UTILITY FAILURE

Utility failure in and of itself would be unlikely to cause any sort of physical losses. However, losses from utility failure can be measured in lost productivity (due to IT issues) and loss of use in structures (due to loss of water/electric/heat).

MITIGATION STRATEGIES

Utility services are produced and delivered to customers by an extensive utility infrastructure system that is undergoing significant renewal, upgrade, and expansion as part of the Infrastructure Master Plan. Utilities' activities focus on maintaining reliable utilities, ensuring appropriate project designs and installations, minimizing construction impacts and maximizing efforts to facilitate university business throughout construction, renewal, and expansion activities.

Utility Failure Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 9: Increase the resiliency of the university to utility failures					
Objective 9.1: Further develop planning mechanisms related to utilities					
9.1.1 Install leak detection systems on utility infrastructure	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	TBD by Scope, $300,000 for Initial Study	Operating Budget	Canceled
9.1.2 Develop a load-shedding plan	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Canceled
9.1.3 Develop a water prioritization plan (loss of pressure/services from the city of **Columbus)**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Ongoing. 06/01/2021-06/01/2026
Objective 9.2: Undertake structural and infrastructure improvements to increase resilience to utility failure					
9.2.1 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already **equipped with backup power**	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$500,000 per generator	Operating Budgets, FEMA HMA Programs	Ongoing. 06/01/2021-06/01/2026

UTILITY FAILURE HIRA SUMMARY

The probability of a catastrophic utility failure is low, but there is a vulnerability to interruptions. These interruptions are generally short-lived, as seen in the utility uptime figures.

CYBER-THREAT

Hazard Assessment Chart											
Human-Caused Hazard	Likelihood		Consequence		Resilience		Warning Time		Duration		Risk Factor
Cyber-Threat	**4**	**1.2**	**4**	**0.3**	**4**	**0.8**	**4**	**0.4**	**3**	**0.3**	**3.9**
HIGH RISK HAZARD (3.0 – 3.9)											

HAZARD IDENTIFICATION

This plan defines cyber-attacks as "deliberate exploitation of computer systems, technology-dependent enterprises, and networks." Cyber-attacks use malicious code to alter computer operations or data. The vulnerability of computer systems to attacks is a growing concern as people and institutions become more dependent upon networked technologies. The Federal Bureau of Investigation (FBI) reports that, "cyber intrusions are becoming more commonplace, more dangerous, and more sophisticated," with implications for private- and public-sector networks. Cyber threats can take many forms, including:

Phishing attacks: Phishing attacks are fraudulent communications that appear to come from legitimate sources. Phishing attacks typically come through email but may come through text messages as well. Phishing may also be considered a type of social engineering meant to exploit employees into paying fake invoices, providing passwords, or sending sensitive information.

Malware attacks: Malware is malicious code that may infect a computer system. Malware typically gains a foothold when a user visits an unsafe site, downloads untrusted software, or may be downloaded in conjunction with a phishing attack. Malware can remain undetected for years and spread across an entire network.

Ransomware: Ransomware typically blocks access to a jurisdiction's/agency's/ business' data by encrypting it. Perpetrators will ask for a ransom to provide the security key and decrypt the data, although many ransomware victims never get their data back even after paying the ransom.

Distributed Denial of Service (DDoS) attack: Perhaps the most common type of cyber-attack, a DDoS attack seeks to overwhelm a network and causes it to either be inaccessible or shut down. A DDoS typically uses other infected systems and internet connected devices to "request" information from a specific network or server that is not configured or powerful enough to handle the traffic.

Data breach: Hackers gaining access to large amounts of personal, sensitive, or confidential information has become increasingly common in recent years. In addition to networked systems, data breaches can occur due to the mishandling of external drives.

Critical Infrastructure/SCADA System attack: There have been recent critical infrastructure Supervisory Control and Data Acquisition (SCADA) system attacks aimed at taking down lifelines such as power plants and wastewater facilities. These attacks typically combine a form of phishing, malware, or other social engineering mechanisms to gain access to the system.

This is a continually developing threat, so as more resources are devoted to countering the hazard, the risk of a disruption will decrease. Mitigation opportunities for this hazard include continued diligence of the OCIO, as well as for other government and private sector entities to continue to monitor, block, and report cyber-attacks, and continually assess the vulnerability of systems.

REGULATORY ENVIRONMENT

STATE LAWS

The following state of Ohio laws impact Ohio State:

STATE LAWS REGULATORY ENVIRONMENT		
LAW	**SUMMARY**	**ACTION REQUIRED?**
OH H 368 Enact Ohio Computer Crimes Act (link is external) (PENDING, PROPOSED ON 2/16/21)	The bill aims to lessen the frequency of cyber-crimes by updating and the modernizing Ohio's computer crimes laws. It makes electronic data theft and electronic data tampering felonies of the third degree. House Bill 368 also allows those negatively impacted by a breach to bring a civil action against a person convicted of violating the law. Those impacted may receive compensatory damages, attorney fees, or other equitable relief. In addition, Ohio prosecutors will now be able to prosecute cybercriminals efficiently without trying to prove and calculate damages using limited and outdated sources.	Informational
Ohio Legislature Senate Bill 220(link is external)	Senate Bill 220 was introduced to provide businesses with an incentive to achieve a "higher level of cybersecurity" by maintaining a cybersecurity program that substantially complies with one of eight industry-recommended frameworks. The Ohio State University's Information Security Control Requirements (ISCR) are based on NIST SP 800-53. To see how the	Adhere to the ISCR.

STATE LAWS REGULATORY ENVIRONMENT		
	ISCR maps to NIST SP 800-53, please see the Information Risk Management Framework (IRMF), appendix "A".	
Ohio Revised Code §1347(link is external)	Establishes requirements for notifying Ohio residents in the event that certain personal information is disclosed or reasonably believed to be disclosed to unauthorized persons through a system security breach. Personal information as defined in this law includes an individual's name coupled with his or her Social Security number, driver's license number and/or credit card information. Specific requirements vary depending on the size and certainty of the disclosure.	Informational
State of Ohio Personal Privacy Act (CURRENTLY IN DRAFT)	The Ohio Privacy Protection Act (OPPA) would establish statutory protections for Ohioans' personal information when used by companies doing business in Ohio. OPPA seeks to balance reasonable privacy standards to protect Ohioans with less bureaucracy and regulation on businesses.	TBD

FEDERAL LAWS

The following federal laws apply to Ohio State:

FEDERAL LAWS REGULATORY ENVIRONMENT		
LAW	**SUMMARY**	**ACTION REQUIRED?**
California Consumer Privacy Act (link is external) (CCPA)	CCPA gives consumers more control over the personal information that businesses collect about them.	Informational
Children's Online Privacy Protection Rule (link is external) (COPPA)	COPPA imposes certain requirements on operators of websites or online services directed to children under 13 years of age. It also governs operators of other websites or online services that have actual knowledge that they are collecting personal information online from a child under 13 years of age. Office of Institutional Equity Youth Activities and Programs(link is external)	TBA
Communications Assistance for Law Enforcement Act (link is external) (CALEA)	CALEA preserves the ability of law enforcement agencies to conduct electronic surveillance while protecting the privacy of information outside the scope of the investigation.	Informational
Controlling the Assault of Non-Solicited Pornography and Marketing Act of 2003(link is	CAN-SPAM sets a national standard for the regulation of email.	Informational

FEDERAL LAWS REGULATORY ENVIRONMENT		
external) (CAN-SPAM)		
Cybersecurity Enhancement Act (link is external)	Provides an ongoing, voluntary public-private partnership to improve cybersecurity and strengthen cybersecurity research and development, workforce development and education and public awareness and preparedness.	Informational
Cybersecurity Information Sharing Act (link is external) (CISA)	Its objective is to improve cybersecurity in the United States through enhanced sharing of information about cybersecurity threats, and for other purposes. The law allows the sharing of Internet traffic information between the U.S. government and technology and manufacturing companies.	Informational
Electronic Communications Privacy Act (link is external) (ECPA)	ECPA expands and revises federal wiretapping and electronic eavesdropping provisions. Office of Technology and Digital Innovation Responsible Use of University Computing and Network Resources(link is external)	Informational
Fair and Accurate Credit Transactions Act (link is external) (FACTA)	FACTA adds provisions designed to improve the accuracy of consumers' credit-related records. Office of Academic Affairs Privacy and Release of Student Education Records(link is external)	Informational

FEDERAL LAWS REGULATORY ENVIRONMENT		
Fair Credit Reporting Act (link is external) (FCRA)	FCRA protects information collected by consumer reporting agencies such as credit bureaus, medical information companies, and tenant screening services. Office of Academic Affairs Privacy and Release of Student Education Records(link is external)	Informational
Family Educational Rights and Privacy Act (link is external) (FERPA)	FERPA protects the privacy of student education records. The law applies to all schools that receive funds under an applicable program of the U.S. Department of Education. Office of Academic Affairs Privacy and Release of Student Education Records(link is external)	Adhere to the ISCR.
Federal Exchange Data Breach Notification Act (link is external)	In the event of a security breach, this bill requires a health insurance exchange to notify everyone whose personal information is known to have been acquired or accessed. It applies to any system maintained by the exchange. Those affected must be notified as soon as possible but not later than 60 days after discovery of the breach.	Informational
Federal Information Security Modernization Act (link is external) (FISMA)	FISMA is United States legislation that defines a comprehensive framework to protect government information, operations, and assets against natural or man-made threats.	Organizations who work with federal agencies must follow FISMA in order to get contracts from federal agencies. Depending on the language in the contract, follow the "LOW", "MOD", or "HIGH" tags in the ISCR.

FEDERAL LAWS REGULATORY ENVIRONMENT		
Federal Policy for the Protection of Human Subjects (link is external) ('Common Rule')	Known as the "Common Rule," this rule of ethics in the United States governs biomedical and behavioral research involving human subjects.	If your organization has human subject research questions or concerns, contact the Office of Responsible Research Practices(link is external) to ensure compliance.
Federal Trade Commission Act (link is external)(FTC)	Gives the U.S. government a full complement of legal tools to use against anticompetitive, unfair, and deceptive practices in the marketplace.	Informational
Gramm-Leach-Bliley Act (link is external) (GLBA)	GLBA requires financial institutions – companies that offer consumers financial products or services like loans, financial or investment advice, or insurance – to explain their information-sharing practices to their customers and to safeguard sensitive data. The Ohio State University's Information Security Standards are based on the National Institute of Standards and Technology's Special Publication 800-53 (NIST SP 800-53). The university created the Information Security Control Requirements (ISCR) document, which maps non-technical and technical risk areas to NIST SP 800-53 as an industry-standard basis to meet the security requirements of regulations such as GLBA. The university mandates organizations across the university adhere to the ISCR. We verify that we are meeting this mandate by requiring the completion of Ohio	Adhere to the ISCR.

FEDERAL LAWS REGULATORY ENVIRONMENT		
	State's Information Security Control Requirements Assessment (ISCR.a) annually and performing ongoing technical testing to demonstrate effectiveness. Ohio State's Internal Audit team, as well as the Office of Technology and Digital Innovation/Digital Security and Trust's Security Governance team, reviews the results. Any discrepancies are addressed and remediated. Ohio State's Chief Information Security Officer provides ongoing security posture updates to university security committees as well as to Ohio State's Board of Trustees. To stay ahead of emerging threats and changes to state or federal regulation, Ohio State publishes updates to the ISCR (and other supporting security documentation as needed) periodically throughout the year.	
Health Information Technology for Economic and Clinical Health (link is external) (HITECH)	HITECH promotes and expands the adoption of health information technology, specifically, the use of electronic health records (EHRs) by healthcare providers.	Informational
Health Insurance Portability and Accountability Act (link is external) (HIPAA)	HIPAA modernizes the flow of healthcare information, stipulates how personally identifiable information maintained by the healthcare and healthcare insurance industries should be protected from fraud and theft, and addresses limitations on healthcare insurance coverage. To understand how the ISCR maps to HIPAA, please see the Information Risk	Adhere to the ISCR control requirements with the "HIPAA" tag.

FEDERAL LAWS REGULATORY ENVIRONMENT		
	Management Framework (IRMF), appendix "B". Wexner Medical Center Compliance and Integrity Protected Health Information and HIPAA Policy(link is external)	
Homeland Security Act (link is external)	The Homeland Security Act includes the Federal Information Security Management Act (FISMA), which requires the development and implementation of mandatory policies, principles, standards, and guidelines on information security. The Ohio State University's Information Security Control Requirements (ISCR) are based on NIST SP 800-53 "Low".	Informational
International Traffic in Arms Regulations (link is external) (ITAR)	ITAR restricts and controls the export of defense and military-related technologies to safeguard U.S. national security and further U.S. foreign policy objectives.	If your organization has export control/ITAR questions or concerns, contact the Office of Secure Research(link is external) to ensure compliance.
Telephone Consumer Protection Act (link is external) (TCPA)	TCPA restricts telemarketing calls and the use of automatic telephone dialing systems and artificial or prerecorded voice messages. Prior express consent is a requirement. Ohio State Privacy Office SMS Texting Information (link is external)	Informational

INDUSTRY STANDARDS

The following industry standard(s) impact Ohio State:

INDUSTRY STANDARDS REGULATORY ENVIRONMENT		
INDUSTRY STANDARD	**SUMMARY**	**ACTION REQUIRED?**
Control of Unclassified Information (link is external) (CUI)	DFARS 252.204-7012, NIST SP 800-171 Controlled Unclassified Information (CUI) is information that requires safeguarding or dissemination controls pursuant to and consistent with applicable law, regulations, and government-wide policies but is not classified under Executive Order 13526 or the Atomic Energy Act, as amended. It is a data classification below Classified, but still pertinent to data sensitive to national security. Executive Order 13556 "Controlled Unclassified Information" (the Order), establishes a program for managing CUI across the Executive branch and designates the National Archives and Records Administration (NARA) as Executive Agent to implement the Order and oversee agency actions to ensure compliance. The Archivist of the United States delegated these responsibilities to the Information Security Oversight Office (ISOO). 32 CFR Part 2002 "Controlled Unclassified Information" was issued by ISOO to establish policy for agencies on designating, safeguarding, disseminating, marking, decontrolling, and disposing of CUI, self-inspection and oversight requirements, and other facets of the Program. The rule affects Federal executive branch agencies that handle CUI and all organizations (sources) that handle, possess, use, share, or receive	Adhere to the ISCR control requirements with the "CUI" tag. If your organization has CUI questions or concerns, contact the Office of Secure Research(link is external) to ensure compliance.

INDUSTRY STANDARDS REGULATORY ENVIRONMENT		
	CUI—or which operate, use, or have access to Federal information and information systems on behalf of an agency.	
Cybersecurity Maturity Model Certification (link is external) (CMMC)	The CMMC will review and combine various cybersecurity standards, best practices, and map these controls and processes across several maturity levels that range from basic cyber hygiene to more advanced protections. It governs the security of Controlled Unclassified Information.	The Security and Privacy Governance team (SPG) is working with the Office of Secure Research to ensure the university is fully adhering to NIST SP 800-171 (where applicable) and to the newly released Cybersecurity Maturity Model Certification (CMMC). In doing so, specific areas within the university must self-assess and report complete adherence against NIST SP 800-171 and achieve a level 2 certification performed by a CMMC Third Party Assessment Organization (C3APO). A level 2 certification is the minimum level a specific area within an organization must achieve when dealing with Controlled Unclassified Information (CUI). If your organization has CUI questions or concerns, contact the Office of Secure Research(link is external) to ensure compliance.
Payment Card Industry (link is external) (PCI)	PCI enhances global payment account data security by developing standards and supporting services that drive education,	Organizations with merchant IDs must comply with the PCI's

INDUSTRY STANDARDS REGULATORY ENVIRONMENT		
	awareness, and effective implementation by stakeholders. To understand how the ISCR maps to PCI, please see the Information Risk Management Framework (IRMF), appendices "E-K".	Data Security Standards. Contact the Office of the Treasurer for more information (link is external).

INTERNATIONAL LAWS

The following international law(s), to a degree, impact Ohio State:

INTERNATIONAL LAW REGULATORY ENVIRONMENT		
LAW	**SUMMARY**	**ACTION REQUIRED?**
General Data Protection Regulation (link is external) (GDPR)	This European Union (EU) regulation covers data protection and privacy for European residents in the European Union (EU) and the European Economic Area (EEA). It also addresses the transfer of personal data outside the EU and EEA areas. The GDPR's primary aim is to give individuals control over their personal data and to simplify the regulatory environment for international business by unifying the regulation within the EU.	For additional information regarding Ohio State's GDPR statement, please visit the following link: https://it.osu.edu/privacy/gdpr-statement(link is external).
Lei Geral de Proteção de Dados(link is external) (LGPD, translated: General Personal Data Protection Law)	The LGPD is applicable to businesses of all sizes. It provides exceptions only in a few enumerated instances, such as where data are collected exclusively for journalistic, artistic and academic purposes, or public safety and national defense. The LGPD also provides for extraterritorial jurisdiction. Under Article 3, a personal data processor is subject to	Informational

INTERNATIONAL LAW REGULATORY ENVIRONMENT		
	the law when the data is either collected or processed within Brazil or the data is processed for the purpose of offering goods or services to individuals in Brazil. Accordingly, as long as one of these conditions is met, regardless of the nation in which the company is headquartered, the LGPD is fully applicable.	
Personal Data Protection Bill (link is external) (India) (PENDING FINAL APPROVAL BY PARLIAMENT)	India's Personal Data Protection Bill sets out to align India's data protection regime with the EU's General Data Protection Regulation. It protects citizens' data as well as the cross-border flow of data. It also creates a Data Protection Authority (DPA), which is entrusted with regulating the interests of individuals pertaining to data protection.	Informational
Personal Information Protection Law (link is external) (China)	China's Personal Information Protection Law creates the country's first comprehensive set of data protection rules. More information to follow.	Informational

HAZARD EVENTS/HISTORICAL OCCURRENCES

In 2010, hacker's breached a university server, accessing roughly 760,000 people's personal information, including but not limited to names, Social Security numbers, dates of birth and addresses. As a result of this breach, the university hired computer forensic consultants to investigate.

Ohio State University's (OSU) Veterans Neuromodulation Operation Wellness (NOW) pilot program was compromised in 2021 prior to the program shutting down permanently. It is unclear how many patients were impacted by the breach, but the letter stated that addresses, Social Security numbers, and medical history information was accessed without authorization.

MAGNITUDE/SEVERITY

There is no universally accepted scale to explain the severity of cyber-attacks. The strength of a DDoS attack is often explained in terms of a data transmission rate. One of the largest DDoS disruptions ever, the attack on a Microsoft Azure customer in November 2021, peaked at 3.45 terabytes per second and a packet rate of 340 million PPS. This attack is believed to be the largest DDoS attack ever recorded.

Data breaches are often described in terms of the number of records or identities exposed. The largest data breach ever reported occurred in August 2013, when hackers gained access to all three billion Yahoo accounts. The hacking incidents associated with Colorado in the Privacy Rights Clearinghouse database are of a smaller scale, ranging from just 32 records to approximately 60,000, along with several cases in which an indeterminate number of records may have been stolen.

Ransomware attacks are often described in terms of the amount of ransom requested, or by the amount of time and money spent to recover from the attack. Increasingly, they can also be escribed in terms of services impacted, such as phone, email, websites, or even 911 services.

FREQUENCY/PROBABILITY OF OCCURRENCES

Small-scale cyber-attacks such as DDoS attacks occur daily, but most have negligible impacts at the local or regional level. Data breaches are also extremely common, but again most have only minor impacts on government services.

Perhaps of greatest concern are ransomware attacks, which are becoming increasingly common. It is difficult to predict the odds of being hit with a successful ransomware attack in any given year, but it is safe to say it is likely to be attacked in the coming years.

The possibility of a larger disruption affecting systems within the county is a constant threat, but it is difficult to quantify the exact probability due to such highly variable factors as the type of attack and intent of the attacker. Major attacks specifically targeting systems or infrastructure in the county cannot be ruled out.

POTENTIAL LOSSES

Overall, the potential magnitude of a cyber-attack can be seen as limited due to the lack of deaths and injuries, but the economic costs can be significant.

MITIGATION STRATEGIES

Cyber-attacks can and have occurred in every location regardless of geography, demographics, and security posture. Incidents may involve a single location or multiple geographic areas. A disruption can have far-reaching effects beyond the location of the targeted system; disruptions that occur far outside the state can still impact people, businesses, and institutions within the county. All the populated areas of the university are potentially susceptible to cyber-attacks, making the geographic extent **significant**.

CYBER-THREAT EVENT MITIGATION ACTIONS

Cyber-Threat Event Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 16:					
Objective 16.1: Develop additional planning mechanisms related to cyber-threat events					
16.1.1 Continue to enhance and refine protocols for anticipated cyber-threat events	Office of the Chief Information Officer	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	(Ongoing: 06/01/2021- 06/01/2026)
16.1.2 Continue to enhance protocols to help prevent potential IT intrusions that are malicious	Office of the Chief Information Officer	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	(Ongoing: 06/01/2021- 06/01/2026)

HIRA SUMMARY

While the vast majority of cyber-attacks affect only data and computer systems, sophisticated attacks against utilities and infrastructure sites have occurred. Such attacks typically target the Supervisory Control and Data Acquisition (SCADA) systems of critical infrastructure, which can potentially result in system failures on a scale equal with natural disasters. Facilities and infrastructure, such as the electrical grid, could become unusable as a result of a cyber-attack. A cyber-attack took down the power grid in Ukraine in 2015, leaving over 230,000 people without power. Agencies/Organizations that rely on electronic backup of critical files are vulnerable.

The delivery of services can be impacted since the university relies to a great extent upon electronic delivery of services. Most departments at the university rely on server backups, electronic backups, and remote options for Continuity of Operations. Some departments have the option to move to a paper method, however, access to documents on the network, OneDrive access, and other operations that require collaboration across the university will be significantly impacted.

Loss of servers due to a cyber-attack could affect the ability of faculty and staff to do their jobs. Cyber-attacks can interfere with emergency response communications, access to mobile data terminals, and access to critical preplans and response documents.

The geographic extent of the hazard is considered significant. The probability of future occurrences is considered likely and the magnitude/severity for the event of record is limited.

TERRORISM

Hazard Assessment Chart											
Non-Natural Hazard	Likelihood		Consequence		Resilience		Warning Time		Duration		Risk Factor
Terrorism	2	0.6	3	0.9	3	0.6	4	0.4	3	0.3	2.8
MEDIUM RISK HAZARD (2.0 – 2.9)											

HAZARD IDENTIFICATION

The term "terrorism" refers to intentional, criminal, malicious acts, but the functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as "…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR §0.85). Terrorists use threats to create fear, to try to convince citizens of the powerlessness of their government, and/or to get publicity for their cause.

Terrorist attacks can take many forms, including agriterrorism, arson/incendiary attack, armed attack, assassination, biological agent, chemical agent, cyberterrorism, conventional bomb, hijackings, intentional hazardous material release, kidnapping, nuclear bomb and radiological agent (FEMA April 2009). Explosives have been the traditional method of conducting terrorism, but intelligence suggests that the possibility of biological or chemical terrorism is increasing.

The severity of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

Biological agents are organisms or toxins that have illness-producing effects on people, livestock and crops. Some biological agents cannot be easily detected and may take time to develop. Therefore, it can be difficult to know that a biological attack has occurred until victims display symptoms. In other cases, the effects are immediate. Those affected by a biological agent require the immediate attention of professional medical personnel. Some agents are contagious which may result in the need for victims to be quarantined.

Terrorism using **explosive** and incendiary devices includes bombs and any other technique that creates an explosive, destructive effect. Bombs can take many forms from a car bomb to a mail bomb. They can be remotely detonated using a variety of devices or directly detonated in the case of a suicide bomb.

Radiological terrorism involves the use of radiological dispersal devices or nuclear facilities to attack the population. Exposure to radiation can cause radiation sickness, long-term illness, and even death. Terrorism experts fear the use of explosive and radiological devices in the form of a "dirty bomb" to attack the population. A “dirty bomb” is a low-tech, easily assembled, and transported device made up of simple explosives combined with a suitable radioactive agent

In recent years**, cyber terrorism** has become a larger threat than in years past. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure appear to be the main goals at this point in time. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. They have been known to overtake websites, and alter the content that is presented to the public. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed, and any possible measures taken to harden those resources to attack.

In recent years, as **drones** have become more available to the public and prevalent in society, they pose a growing risk. These small, remote-controlled objects are becoming a tool for criminals and terrorists. Of specific worry to law enforcement is that these small aircraft are difficult to detect and stop. Recently, drones have been used to smuggle drugs and contraband. Another concern is that these drones could be modified to mount attacks with explosives or chemical weapons. Most small drones remain limited by short battery life and small payload capacity. The most popular consumer drones can carry just a few pounds. But some of the features that have made the devices increasingly attractive for businesses and photographers— that they are small, easy to fly and can capture high-definition images—also make them a potentially powerful tool for criminals and terrorists.

BUCKEYE ALERT

Ohio State's Department of Public Safety uses a variety of methods to communicate with the campus community. These include, but are not limited to, the Buckeye Alert System and Public Safety Notices. Public Safety Notices are distributed when a Clery reportable crime occurs on Clery reportable property and presents and ongoing threat to the safety of the campus community. These are often sent via email, when information becomes known, and are evaluated on a case-by-case basis by the OSU Police Division. These are informational and are not used during an emergency situation.

The Buckeye Alert System is a multi-modal, emergency notification system that includes nearly two dozen different communication methods. A Buckeye Alert, often sent via text message, is issued when it is determined that the campus community needs to take immediate action to remain safe. An example would be a severe weather situation. Based upon a variety of factors, including when information becomes known, Ohio State Public Safety officials will determine which method, or combination of methods, may be utilized to communicate during an emergency.

These methods are supported by the Department of Public Safety website, social media, traditional media, and other communication channels.

The current communications methods utilized by university Public Safety include:

- emergency.osu.edu webpage
- dps.osu.edu website
- osu.edu (emergency banner)
- osu.edu news page
- OSU Mobile App (emergency banner)

- Buckeye Alert System (text messages, emails, phone calls, etc.)
- Automated severe weather text alerts
- Emergency Management Twitter
- Emergency management Facebook
- Police Twitter
- Police Facebook
- Public Safety Notices (email)
- Campus-wide email messages
- Media outreach (Television, radio, print and online)
- Wexner Medical Center One Source
- Ohio State Cable Television Crawl (Columbus campus only)
- Ohio State Cable Television voiceover (Columbus campus only)
- Ohio State Traffic Info Radio (Columbus campus only)
- Outdoor Warning Sirens/Speakers
- Vehicle Public Address Speakers
- Two-Way Radios
- Building Alarm / Speaker Systems
- NOAA Weather Radio
- Emergency Info Telephone Line 614-247-7777

NOAA ALERTS

In addition, when notified by a government official, the NWS has the ability to send alert messages through the Emergency Alert System and over NOAA Weather Radio. Examples include the following:

- Local Area Emergency Message: This message defines an event that by itself does not pose a significant threat to public safety and/or property, but the event could escalate, contribute to other more serious events, or disrupt critical public safety services. Instructions, other than public protective actions, may be provided by authorized officials. Examples of when this message may be used include utility disruptions, road closures, or a potential terrorist threat where the public is asked to remain alert.
- Civil Emergency Message: This message outlines a significant threat or threats to public safety and/or property that is imminent or in progress. The hazard is usually less specific or severe than those requiring a Civil Danger Warning.
- Law Enforcement Warning: This warning is issued for a bomb explosion, riot, or other criminal event. An authorized law enforcement agency may block roads, waterways, or facilities, evacuate, or deny access to affected areas, and arrest violators or suspicious persons.
- Radiological Hazard Warning: This warning warns of the loss, discovery, or release of a radiological hazard such as the theft of a radiological isotope used for medical, seismic, or other purposes, discovery of radioactive materials, or a transportation accident involving nuclear weapons, nuclear fuel, or radioactive wastes. Authorized officials may recommend protective actions be taken if a radioactive hazard is discovered.
- Civil Danger Warning: This warning is issued when an event presents a danger to a significant civilian population. The message usually warns of a specific hazard and outlines specific protective actions such as evacuation or shelter in place.
- Shelter In Place Warning: This warning is issued when the public is recommended to shelter in place (go inside, close doors and windows, turn off air conditioning or heating

systems, and turn on the radio or TV for more information). Examples include hazardous material releases or radioactive fallout.

REGULATORY ENVIRONMENT

Terrorism, by definition, is an act that is against the law. The regulatory environment tied to terrorism falls under law enforcement jurisdiction.

The university developed a video called "Surviving an Active Shooter." The university's Department of Public Safety and the Office of Student Life partnered with university police in order to spread the practice of "Run. Hide. Fight." This video is meant to teach students, faculty, and staff how to respond to a potential active shooter situation on campus.

HAZARD EVENTS/HISTORICAL OCCURRENCES

November 16, 2010: Four Ohio State buildings were evacuated after the FBI's Columbus bureau notified the university it received an anonymous message that explosives were placed in the buildings.

October 27, 2015: An anonymous online threat of violence was made to an Ohio State University campus. The Department of Public Safety and its law enforcement partners actively investigated the threat and notified the campus community.

November 28, 2016: A terrorist vehicle-ramming and stabbing attack occurred at 9:52 a.m. EST at Ohio State University's Watts Hall in Columbus, Ohio. The attacker, Somali refugee Abdul Razak Ali Artan, was shot and killed by the first responding OSU police officer, and 13 people were hospitalized for injuries.

Authorities began investigating the possibility of the attack being an act of terrorism. On the next day, law enforcement officials stated that Artan was inspired by terrorist propaganda from the Islamic State of Iraq and the Levant (ISIL) and the late radical Muslim cleric Anwar al-Awlaki. Amaq News Agency released a statement claiming the attacker responded to an ISIL call to attack coalition citizens, though there is no evidence of direct contact between the group and Artan.

MAGNITUDE/SEVERITY

Events classified as terrorism have been shown to impact as few as one person to thousands. One of the inherent risks of terrorism is the unpredictability. Of particular concern is the Ohio Stadium that holds over 108,000 persons during home football games and is iconic in nature making it an attractive target for terrorists. In addition to the attendees at football games, the Ohio State University Police Department estimates that an additional 25,000 – 50,000 individuals are outside the stadium on game days. There are multiple other high-profile events that occur on campus in any given year. In the past, President Barack Obama has spoken on the Oval as well as at commencement. Concerts are held in the stadium that attract up to 55,000 attendees, and the Value City Arena at the Jerome Schottenstein Center hosts a variety of sporting events during the year, to include men's and women's sporting events as well as concerts.

FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

There is not enough historical precedence to determine frequency or future probability of terrorism or threatened terroristic events.

Since the probability of terrorism occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets, planning efforts can be put in place to reduce the risk of attack. FEMA's *Integrating Manmade Hazards into Mitigation Planning* (2003) encourages site- specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

INHERENT VULNERABILITY:

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
- Accessibility – How accessible is the place to the public?
- Asset mobility – is the asset's location fixed or mobile?
- Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
- Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

TACTICAL VULNERABILITY:

Site Perimeter

- Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
- Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

Building Envelope

- Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological and radiological contaminants?

Facility Interior

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and Heating, Ventilating and Air Conditioning (HVAC) systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

INVENTORY ASSETS EXPOSED TO/POTENTIAL LOSSES TO TERRORISM

Terrorism is a real concern for all public universities. At Ohio State, the safety of the nearly 117,000 students, faculty, staff, and visitors which utilize campus each day is the university's top priority.

MITIGATION STRATEGIES

Land use and development are not directly tied to the prevention or discouragement of terrorism. However, structures can be designed with safety devices meant to protect the populations inside. Things like two-way fire alarm panels, security cameras and alarm boxes are currently in use on campuses nationwide.

TERRORISM MITIGATION ACTIONS

Terrorism Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 10: Increase the resiliency of the university to terrorism					
Objective 10.1: Develop additional planning mechanisms related to terrorism					
10.1.1 Continue to refine site preparation plans **for large-scale events**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	TBD by Event	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
10.1.2 Provide additional training for first responders related to terrorism and active shooters	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$25,000 per Year	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
10.1.3 Development of a campus CERT Team	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$100,000 per Year	Operating Budgets	Canceled.
10.1.4 Continue to enhance protocols for high-profile public events on campus	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	TBD by Event	Operating Budgets	Ongoing. 06/01/2021-06/01/2026
10.1.5 Continue to enhance protocols to help prevent potential IT intrusions that are malicious	Office of the Chief Information Officer	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	**Moved to Cyber-Threat**
Objective 10.2: Develop and deploy public education campaigns related to terrorism					

Terrorism Mitigation Actions					
10.2.1 Continue to educate the campus about the way to react to the dangers of a potential terrorism threat	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$30,000	Operating Budgets	Ongoing. 06/01/2021-06/01/2026

TERRORISM HIRA SUMMARY

One of the primary attributes of terrorism is its unexpected nature. This makes planning for potential attacks virtually impossible. The key to terrorism mitigation lies in the planning phase, and understanding the potential vulnerability of a specific area.

ACTIVE AGGRESSOR INCIDENT

Hazard Assessment Chart											
Human-Caused Hazards	Likelihood		Consequence		Resilience		Warning Time		Duration		Risk Factor
Active Aggressor Incident	**4**	**1.2**	**3**	**0.9**	**3**	**0.6**	**4**	**0.4**	**3**	**0.3**	**3.4**
HIGH RISK HAZARD (3.0 – 3.9)											

HAZARD IDENTIFICATION

An Active Aggressor is a situation where one or more suspects participate in a random or systematic shooting spree and demonstrate intent to continuously harm others. The overriding objective appears to be that of inflicting serious bodily injury/death rather than other criminal conduct. These situations are dynamic and evolve rapidly, demanding immediate deployment of law enforcement resources to stop the shooting and mitigate harm to innocent victims. The term active aggressor is used in place of the prior term "active shooter" as there have since been incident's involving aggressors attacking multiple victims withs weapons other than firearms, such as vehicles, knifes, etc., with the same intent to continuously harm others.

Active aggressors, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active aggressors use firearm[s] and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active aggressors include the Robb Elementary School shooting in Uvalde, Texas (May 24, 2022), the 2017 Las Vegas Shooting at the Route 91 Harvest music festival in Las Vegas, Nevada (October 1, 2017), the Sandy Hook Elementary school shootings in Newtown, Connecticut (December 14, 2012), the shooting in the Aurora, Colorado movie theater (July 20, 2012), and the shooting in Tucson, Arizona involving U.S. Representative Gabrielle Giffords (January 8, 2011). Historical active aggressor events include the Virginia Tech shootings, the Columbine High School shootings and the University of Texas, Austin shootings. No substantive research has yet been compiled to address the potential vulnerability to an active aggressor incident. As a very open, public society, these incidents are easier to accomplish for those bent on doing harm. Some of these incidents have occurred in public places, and some in places that are considered more restricted (like elementary schools and high schools). There is no discernible pattern to the location chosen by the aggressor.

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- OSU Mobile App (emergency banner)
- Buckeye Alert System (text messages, emails, phone calls, etc.)
- Automated severe weather text alerts
- Emergency Management Twitter
- Emergency management Facebook
- Police Twitter
- Police Facebook
- Public Safety Notices (email)
- Campus-wide email messages
- Media outreach (Television, radio, print and online)
- Wexner Medical Center One Source
- Ohio State Cable Television Crawl (Columbus campus only)
- Ohio State Cable Television voiceover (Columbus campus only)
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- Civil Emergency Message: This message outlines a significant threat or threats to public safety and/or property that is imminent or in progress. The hazard is usually less specific or severe than those requiring a Civil Danger Warning.
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- Radiological Hazard Warning: This warning warns of the loss, discovery, or release of a radiological hazard such as the theft of a radiological isotope used for medical, seismic, or other purposes, discovery of radioactive materials, or a transportation accident involving nuclear weapons, nuclear fuel, or radioactive wastes. Authorized officials may recommend protective actions be taken if a radioactive hazard is discovered.
- Civil Danger Warning: This warning is issued when an event presents a danger to a significant civilian population. The message usually warns of a specific hazard and outlines specific protective actions such as evacuation or shelter in place.
- Shelter In Place Warning: This warning is issued when the public is recommended to shelter in place (go inside, close doors and windows, turn off air conditioning or heating systems, and turn on the radio or TV for more information). Examples include hazardous material releases or radioactive fallout.

REGULATORY ENVIRONMENT

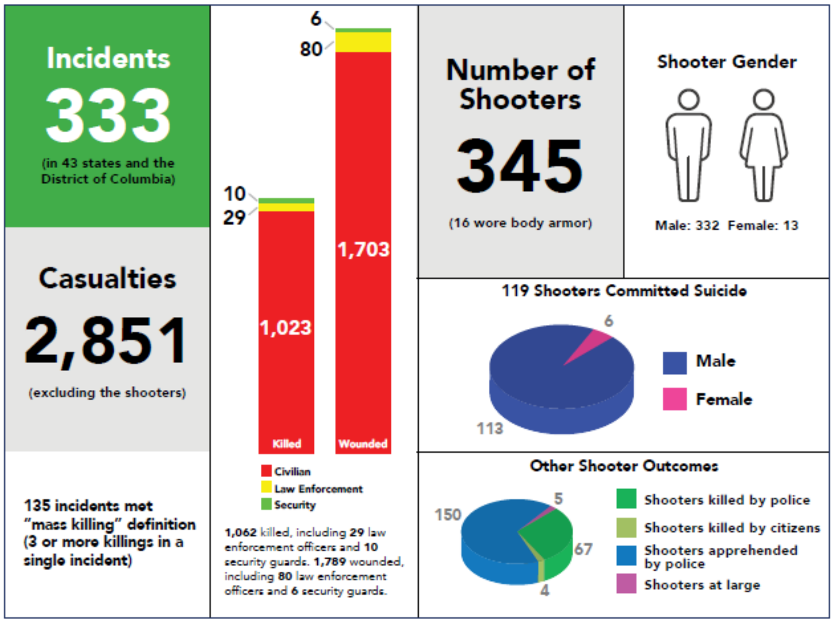
Active aggressor incidents are by definition, is a situation where one or more suspects participate in a random or systematic shooting spree and demonstrate intent to continuously harm others. The overriding objective appears to be that of inflicting serious bodily injury/death rather than other criminal conduct. These situations are dynamic and evolve rapidly, demanding immediate deployment of law enforcement resources to stop the shooting and mitigate harm to innocent victims. The regulatory environment tied to active aggressor incidents falls under law enforcement jurisdiction.

The university developed a video called “Surviving an Active Shooter.” The university’s Department of Public Safety and the Office of Student Life partnered with university police in order to spread the practice of “Run. Hide. Fight.” This video is meant to teach students, faculty, and staff how to respond to a potential active aggressor situation on campus.

HAZARD EVENTS/HISTORICAL OCCURRENCES

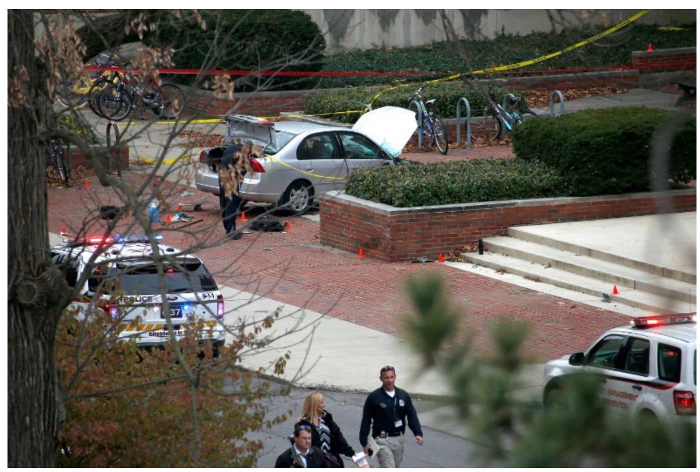
According to the Federal Bureau of Investigation’s report “Active Shooter Incidents, 20-Year Review 200-2019”, there was a total of 333 recorded incidents with 135 of those incidents meeting the definition of “mass killing” (3 or more killings in a single incident).

20-Year Active Shooter Summary



Incidents: 333 (in 43 states and the District of Columbia). Total casualties: 2,851 (excluding the shooters). 135 incidents met "mass killing" definition (3 or more killings in a single incident). Killed: 1,062 (including 1,023 civilians, 29 law enforcement officers and 10 security guards). Wounded: 1,789 (including 1,703 civilians, 80 law enforcement officers, and 6 security guards). Number of shooters: 345 (16 wore body armor). Shooter gender: 332 male, 13 female. 119 shooters committed suicide (113 male, 6 female). Other shooter outcomes: 67 killed by police, 4 killed by citizens, 150 apprehended by police, 4 at large.

March 9, 2010: An Ohio State University janitor walked into the university's Maintenance Building at 2000 Tuttle Park Place and shot and killed a university employee. The shooter ended up taking his own life in the building before police could apprehend him.



November 28, 2016: An attacker drove a car over a curb and struck pedestrians before attacking the people with a butcher knife. Within minutes of the attack, a campus police officer shot and killed the suspect. Eleven people were injured in the attack.

MAGNITUDE/SEVERITY

Events classified as terrorism have been shown to impact as few as one person to thousands. One of the inherent risks of terrorism is the unpredictability. Of particular concern is the Ohio Stadium that holds over 108,000 persons during home football games and is iconic in nature making it an attractive target for terrorists. In addition to the attendees at football games, the Ohio State University Police Department estimates that an additional 25,000 – 50,000 individuals are outside the stadium on game days. There are multiple other high-profile events that occur on campus in any given year. In the past, President Barack Obama has spoken on the Oval as well as at commencement. Concerts are held in the stadium that attract up to 55,000 attendees, and the Value City Arena at the Jerome Schottenstein

Center hosts a variety of sporting events during the year, to include men's and women's sporting events as well as concerts.

FREQUENCY/PROBABILITY OF OCCURRENCES

There is not enough historical precedence to determine frequency or future probability of active aggressor incidents. Since the probability of active aggressor incidents occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk targets, planning efforts can be put in place to reduce the risk of attack. FEMA's *Integrating Manmade Hazards into Mitigation Planning* (2003) encourages site- specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

INHERENT VULNERABILITY:

- Visibility – How aware is the public of the existence of the facility?
- Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
- Accessibility – How accessible is the place to the public?
- Asset mobility – is the asset's location fixed or mobile?
- Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
- Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?

TACTICAL VULNERABILITY:

Site Perimeter

- Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
- Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

Building Envelope

- Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological and radiological contaminants?

Facility Interior

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and Heating, Ventilating and Air Conditioning (HVAC) systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?

- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

POTENTIAL LOSSES

Active aggressors are a real concern for all public universities. At Ohio State, the safety of the nearly 117,000 students, faculty, staff, and visitors which utilize campus each day is the university's top priority.

MITIGATION STRATEGIES

Land use and development are not directly tied to the prevention or discouragement of terrorism. However, structures can be designed with safety devices meant to protect the populations inside. Things like two-way fire alarm panels, security cameras and alarm boxes are currently in use on campuses nationwide.

ACTIVE AGGRESSOR EVENT MITIGATION ACTIONS

Active Aggressor Event Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 17: Increase the resiliency of the university to terrorism					
Objective 17.1: Develop additional planning mechanisms related to terrorism (Ongoing: 06/01/2021-06/01/2026)					
17.1.1 Continue to refine site preparation plans **for active aggressor events**	DPS	06/01/2021-06/01/2026	Staff Time and Resources	Operating Budget	(Ongoing: 06/01/2021-06/01/2026)

HIRA SUMMARY

One of the primary attributes of active aggressors is its unexpected nature. This makes planning for potential attacks virtually impossible. The key to terrorism mitigation lies in the planning phase, and understanding the potential vulnerability of a specific area.

CIVIL DISTURBANCE

Hazard Assessment Chart											
Non-Natural Hazard	**Likelihood**		**Consequence**		**Resilience**		**Warning Time**		**Duration**		**Risk Factor**
Civil Disturbance	**2**	**0.6**	**1**	**0.3**	**1**	**0.2**	**4**	**0.4**	**4**	**0.4**	**1.9**
LOW RISK HAZARD (1.0 – 1.9)											

HAZARD IDENTIFICATION

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. Civil disturbance is typically a symptom of, and a form of protest against, major socio-political problems. Typically, the severity of the action coincides with the level of public outrage. In addition to a form of protest against major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly. The scale and scope of civil disturbance events varies widely. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather.

REGULATORY ENVIRONMENT

The response to civil disturbance incidents usually falls to the responsible law enforcement agency. Spontaneous events may result in deployment of police forces to contend with the protestors, and the resulting crowds. Planned marches or events are often scheduled in advance, with a permitting process that allows law enforcement to adequately prepare for potential situations.

HAZARD EVENTS/HISTORICAL OCCURRENCES

The university has seen a variety of civil disturbance episodes in the past.

MAGNITUDE/SEVERITY

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full-scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. Often that which was intended to be a peaceful demonstration to the public and the government can escalate into general chaos. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories (Blumer, 1946):

- Casual Crowd: A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.

- Cohesive Crowd: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- Expressive Crowd: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- Aggressive Crowd: An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional, and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators, though not all demonstrators are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent, and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories (Alvarez and Bachman, 2007):

- Aggressive Mob: An aggressive mob is one that attacks, riots and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- Escape Mob: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control can be characterized by unreasonable terror.
- Acquisitive Mob: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- Expressive Mob: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent-up emotions in highly charged situations.

FREQUENCY/PROBABILITY OF OCCURRENCES

Civil disturbance is always a possibility. However, it may be possible to recognize the potential for an event to occur in the near-term. For example, an upcoming significant sporting event at one of the colleges or universities in the Commonwealth may result in gathering of large crowds. Local law enforcement should anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances.

INVENTORY ASSETS EXPOSED TO CIVIL DISTURBANCE

All university assets can be considered at risk from a civil disturbance. This includes over 117,000 students, faculty, and staff, or 100 percent of the university population and all buildings and infrastructure. Although infrastructure is generally not directly impacted by civil disturbances, they can become unusable as a result of certain kinds of events. Sit-ins and protests can impede entry and exits from buildings.

POTENTIAL LOSSES

The impacts of civil disturbance events are contingent upon numerous factors including issues, politics, and method of response. Generally, the impact of civil disturbance events is nominal and short-lived unless acts of sabotage are performed. There may be minor injuries to first responders or participants from physical confrontations, and vandalism may cause minimal damage to property, facilities, and infrastructure. Adequate law enforcement at planned civil disturbance events and around likely target locations like the offices of state agencies minimizes the chances of a small assembly of individuals turning into a significant disturbance.

MITIGATION STRATEGIES

All public spaces can be the location of a civil disturbance, and as such, much of the university is susceptible to this hazard. However, the university Department of Public Safety has implemented procedures to provide safe spaces for civil protest which may mitigate the escalation to civil disturbances, but has also accounted for strategies within these procedures to respond to civil disturbances should they occur.

CIVIL DISTURBANCE EVENT MITIGATION ACTIONS

Civil Disturbance Event Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 15: Reduce the impact of civil disturbance events to campus					
Objective 15.1: Develop additional planning mechanisms related to civil disturbances					
14.1.1 Continue to enhance and refine protocols for anticipated civil disturbances	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	(Ongoing: 06/01/2021-06/01/2026)

CIVIL DISTURBANCE HIRA SUMMARY

The vulnerability of individual jurisdictions is difficult to determine because civil disturbance hazards are tied to the current political and economic climate. Universities invite a variety of speakers through the course of the year, and impromptu crowds can develop at virtually any time. These events generally do not directly impact infrastructure and buildings.

MITIGATION STRATEGY

The intent of the Mitigation Strategy is to provide the university with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

The development of the strategy included a thorough review of natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to help the university achieve compatible economic, environmental, and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation and assigned target completion deadlines. Funding sources are identified that can be used to assist in project implementation.

- *Mitigation goals* are general guidelines that explain what the university wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.

- *Mitigation objectives* describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.

- *Mitigation Actions* provide more detailed descriptions of specific work tasks to help the university achieve prescribed goals and objectives.

Based on participation from The Ohio State Mitigation Planning Committee, the mitigation strategy was developed. Objectives were clarified to better document roles and responsibilities. Actions have been added to address particular hazards facing the university and the consensus achieved in how to address those actions.

The last step in updating the Mitigation Strategy is the creation Mitigation Action Plans (MAPs). The MAPs represent the key outcome of the mitigation planning process. MAPs include a prioritized list of proposed hazard mitigation actions (policies and projects) for the university, including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources, estimated target date for completion, and a current status. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The collection of actions also serves as an easily understood synopsis of activities for local decision makers.

In order to ensure that a broad range of mitigation actions were considered, the Mitigation Planning Committee analyzed a comprehensive range of specific mitigation actions for each hazard after it had completed the risk assessment. This helped to ensure that there was sufficient span and creativity in the mitigation actions considered.

There are four categories of mitigation actions which the university considered in developing its mitigation action plan. Those categories include:

- Local Plans and Regulations: These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
- Structure and Infrastructure Projects: These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance program.
- Natural Systems Protection: These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.
- Education and Awareness Program: These are actions to inform and educate students, faculty and staff about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among university officials, stakeholders, and the public is more likely to lead to direct actions.

PLANNING PROCESS FOR SETTING HAZARD MITIGATION GOALS AND OBJECTIVES

The mitigation strategy represents the key outcomes of the 2015 Ohio State University HMP planning process. The hazard mitigation planning process conducted by the Planning Committee is a typical problem-solving methodology:

- Estimate the impacts the problem could cause.
- Describe the problem.
- Assess what safeguards and resources exist that could potentially lessen those impacts.
- Develop Goals and Objectives with current capabilities to address problem.
- Using this information, determine what, if anything, can be done, and select those actions that are appropriate for the community.

UNIVERSITY CAPABILITY ASSESSMENT

The Ohio State University is not structured along the lines of a political jurisdiction. However, some of the processes of the university do mirror those of municipalities. Municipal capabilities like code and zoning enforcement and NFIP participation are not applicable at a university level. However, the university has the administrative and technical capabilities necessary to be able to implement mitigation strategies.

Table 5-1 University Authorities		
Policies	**Chapters**	**Authorities**
Governance	3335-1-02	Officers and Committees of the Board
	3335-1-03	Administration of the University
	3335-1-05	University Organization

http://trustees.osu.edu/rules/bylaws-of-the-board-of-trustees/

Table 5-2 University Planning Mechanisms	
Planning Initiative	**Effective Date**
The Ohio State University Framework Plan	August 2010
Climate Action Plan	April 6, 2011
Comprehensive Emergency Management Plan (Update and Revision)	October 2017
Flood Emergency Response Plan	May 2018
Green Build and Energy Policy	August 2012
Building Emergency Action Plan(s) Template (Update and Revision)	October 2020
Framework 3.0 (Update and Revision)	Summer 2022

Table 5-3 Administrative & Technical Capabilities	
Field	**Responsible Office**
Real Estate Transactions, Physical and Space Planning, and facilities related information	Planning and Real Estate (PARE)
Campus Design and Construction, Environmental Health and Safety, Campus Maintenance (roads, landscaping, and grounds) and Utilities	Facilities Operations and Development

Table 5-3 Administrative & Technical Capabilities	
Emergency Management	Department of Public Safety, Office of Student Life, Safety and Emergency Preparedness at the Wexner Medical Center

MITIGATION GOALS, OBJECTIVES, AND ACTIONS

Goals and objectives discussed in this section help describe what actions should occur, using increasingly narrow descriptors. Long-term goals are developed which can be accomplished by objectives. To achieve the stated objectives "mitigation actions" provide specific measurable descriptors on how to accomplish the objective. The goals, objectives, and actions form the basis for the development of a Mitigation Action Strategy and specific mitigation projects to be considered for implementation.

The process consists of 1) setting goals and objectives, 2) considering mitigation alternatives, 3) identifying strategies or "actions", and 4) developing a prioritized action plan resulting in a mitigation strategy.

MITIGATION ACTION DEVELOPMENT

To begin the process of identifying mitigation actions, the HMP Planning Committee reviewed the identified hazards, as well as the mitigation goals and objectives. Based upon priorities and risk assessment results, mitigation actions were developed. Most importantly, the newly developed mitigation actions acknowledge updated risk assessment information outlined in Section 4.

MITIGATION COSTS

Cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For structural projects, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure.

While detailed analysis was not conducted during the mitigation action development process, these factors were of primary concern when selecting measures. For measures that do not result in a quantifiable reduction of damages, such as public education and outreach, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions.

MITIGATION ACTION RANKINGS

The following tables contains mitigation goals, the number of actions related to each hazard (not completed in last planning cycle), and estimated cost of the actions. All of these actions are viewed as important for the long-term mitigation of hazards to the university and its daily populations, however, a ranking of High, Medium, or Low have been assigned to each Hazard goal. High meaning that completion of this goal is critical to life safety at the university, medium meaning that although important the goal may not be critical to life safety but would still significantly enhance mitigation efforts, and low meaning that it is neither critical, nor would it significantly enhance mitigation efforts.

Mitigation Action Rankings				
Mitigation Goal #	**Hazard**	**Proposed Mitigation Actions**	**Priority**	**Estimated Cost**
Goal 1	Flooding	3	High	$1,220,000*
Goal 2	Severe Summer Storms	7	Low	$2,850,000*
Goal 3	Severe Winter Storms	7	Low	$3,100,000*
Goal 4	Extreme Temperatures	2	Low	$1,500,000*
Goal 5	Tornado	2	Medium	$320,000*
Goal 6	Seismic Events	1	Low	$60,000*
Goal 7	Drought	1	Low	$15,000*
Goal 8	Utility Failure	2	High	$525,000*
Goal 9	Terrorism	4	High	$55,000*
Goal 10	Public Health-Related Emergencies	2	Low	$40,000*
Goal 11	Hazardous Materials	1	Low	$5,000*
Goal 12	Transportation	1	Low	$5,000*
Goal 13	Civil Disturbance	1	Medium	$5,000*
Goal 14	Cyber-Threat	2	High	$15,000*
Goal 15	Active Aggressor	1	High	$25,000*

*These totals include projects that have costs based on potential scope, or are based on a per unit basis. Please see the following tables for detailed information.

GOALS AND OBJECTIVES

The Planning Committee discussed goals and objectives for this plan at distinct points in the planning process. In May 2022 (Planning Committee Meeting), the Planning Committee discussed the results of the risk assessment and the identified issues/weaknesses to be addressed by the Mitigation Goals and Objectives. The following goals and objectives have been updated as part the planning effort:

2022 Mitigation Plan Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Priority**	**Status Update**
Flooding Mitigation Actions					
GOAL 1: Minimize the impact of flooding on the lives, property and infrastructure of The Ohio State University					
Objective 1.1: Further develop planning mechanisms related to flooding					
1.1.1 Evaluate current building design standards and evaluate changes to increase resilience	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$ 1,200,000.00	High	Ongoing. 06/01/2021-06/01/2026
Objective 1.2: Undertake structural and infrastructure improvements to increase resilience to flooding					
1.2.1 Develop and implement infrastructure improvements to existing storm and sanitary sewers	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2017	TBD by Scope	High	Ongoing. 06/01/2021-06/01/2026
1.2.2 Re-engineer and raise Cannon Drive to serve as both a roadway embankment and a levee to protect campus against a 500-year flood	Associate VP of Facilities, Operations and Development	01/01/2021-12/31/2024	TBD by Scope	High	Ongoing. 06/01/2021-06/01/2026
Objective 1.3: Develop and deploy public education campaigns related to flooding					
1.3.1 Develop a public education campaign to be delivered throughout the university conveying flood risk and actions	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$ 20,000.00	Medium	Ongoing. 06/01/2021-06/01/2026
Summer Storm Mitigation Actions					
GOAL 2: Minimize the impact of summer storms on the lives, property and infrastructure of The Ohio State University					
Objective 2.1: Further develop planning mechanisms related to summer storms					

2022 Mitigation Plan Actions					
2.1.1 Develop site preparation plans for known storm events	Assistant Vice President and Director of Public Safety; Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Medium	Ongoing. 06/01/2021-06/01/2026
2.1.2 Evaluate current building standards and evaluate changes to increase resilience	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$ 300,000.00	Medium	Ongoing. 06/01/2021-06/01/2026
Objective 2.2: Undertake structural and infrastructure improvements to increase resilience to summer storms					
2.2.1 Conduct a tree-trimming program on campus	Facilities Operations and Development /Grounds	06/01/2016 – 6/1/2021	$1,000,000/$300,000	Low	Ongoing. 06/01/2021-06/01/2026
2.2.2 Upgrade and improve lightning systems on buildings	Various (Operations (incl. Med Center), Student Life, Athletics, Business Advancement)	06/01/2016 – 6/1/2017	TBD by Scope	Low	Ongoing. 06/01/2021-06/01/2026
2.2.3 Undertake structural projects to increase resilience of buildings to the effects of summer storms	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	3-5% of Current Replacement Value of Buildings	Low	Ongoing. 06/01/2021-06/01/2026
2.2.4 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already equipped with backup power	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$500,000 per generator	Medium	Ongoing. 06/01/2021-06/01/2026

Objective 2.3: Develop and deploy public education campaigns related to summer storms					
2.3.1 Develop a public education campaign to be delivered throughout the university conveying summer storm risk	Assistant Vice President and Director of Public Safety	06/01/2016 – 06/01/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026
Winter Storm Mitigation Actions					
GOAL 3: Minimize the impact of winter storms on the lives, property and infrastructure of The Ohio State University					
Objective 3.1: Further develop planning mechanisms related to winter storms					
3.1.1 Develop site preparation plans for known storm events	Assistant Vice President and Director of Public Safety; Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	Medium	Ongoing. 06/01/2021-06/01/2026
3.1.2 Evaluate current building standards and evaluate changes to increase resilience	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	$ 300,000.00	Medium	Ongoing. 06/01/2021-06/01/2026
Objective 3.2: Undertake structural and infrastructure improvements to increase resilience to winter **storms**					
3.2.1 Conduct a tree-trimming program on campus	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$1,000,000/$300,000	Low	Ongoing. 06/01/2021-06/01/2026
3.2.3 Increase salt **storage capacity to 2,000 tons**	Director, Landscape Services	06/01/2016 – 6/1/2019	300000	Low	Ongoing. 06/01/2021-06/01/2026
3.2.4 Undertake structural projects to increase resilience of buildings to the effects of winter storms	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	3-5% of Current Replacement Value of Buildings	Low	Ongoing. 06/01/2021-06/01/2026

3.2.5 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already **equipped with backup power**	Various – Depending on ownership of building	06/01/2016 – 6/1/2021	$500,000 per generator	Low	Ongoing. 06/01/2021-06/01/2026
Objective 3.3: Develop and deploy public education campaigns related to winter storms					
3.3.1 Develop a public education campaign to be delivered throughout the university **conveying winter storm risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026
Extreme Temperature Mitigation Actions					
GOAL 4: Increase the university's resilience to extreme temperatures					
Objective 4.1: Undertake structural and infrastructure improvements to increase resilience to extreme temperatures					
4.1.1 Evaluate mechanical system and building envelope improvements in buildings to increase resilience **to extreme cold temperatures**	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	$25,000 per building	Low	Ongoing. 06/01/2021-06/01/2026
Objective 4.2: Develop and deploy public education campaigns related to extreme temperatures					
4.2.1 Develop a public education campaign to be delivered throughout the university conveying extreme temperature risk	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026

Tornado/High Wind Mitigation Actions					
GOAL 5: Understand the impact of, and increase resiliency to, tornadoes and high wind events					
Objective 5.1: Further develop planning mechanisms related to tornadoes and high wind events					
5.1.1 Evaluate current building standards to ensure tornado safety for **occupants**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	$300,000	Medium	Ongoing. 06/01/2021-06/01/2026
Objective 5.2: Develop and deploy public education campaigns related to tornadoes and high wind events					
5.2.1 Develop a public education campaign to be delivered throughout the **university**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$20,000	Medium	Ongoing. 06/01/2021-06/01/2026
Seismic Event Mitigation Actions					
GOAL 6: Understand the impact of, and increase resiliency to, seismic events					
Objective 6.1: Develop and deploy public education campaigns related to seismic events					
6.1.1 Develop a public education campaign to be delivered throughout the university **conveying seismic risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026
Drought Mitigation Actions					
GOAL 7: Understand the impact of, and increase resiliency to, drought events					
Objective 7.1: Develop and deploy public education campaigns related to drought events					
7.1.1 Develop a public education campaign to be delivered throughout the university **conveying drought risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026

Utility Failure Mitigation Actions					
GOAL 8: Increase the resiliency of the university to utility failures					
Objective 8.1: Further develop planning mechanisms related to utilities					
8.1.1 Develop a water prioritization plan (loss of pressure/services from the city of **Columbus)**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2021	Staff Time and Resources	High	Ongoing. 06/01/2021-06/01/2026
Objective 8.2: Undertake structural and infrastructure improvements to increase resilience to utility failure					
8.2.1 Purchase additional generators for emergency power (research facilities, hospital facilities, other identified critical infrastructure) at structures that are not already **equipped with backup power**	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	$500,000 per generator	Medium	Ongoing. 06/01/2021-06/01/2026
Terrorism Mitigation Actions					
GOAL 9: Increase the resiliency of the university to terrorism					
Objective 9.1: Develop additional planning mechanisms related to terrorism					
9.1.1 Continue to refine site preparation plans **for large-scale events**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	TBD by Event	High	Ongoing. 06/01/2021-06/01/2026
9.1.2 Provide additional training for first responders related to terrorism and active shooters	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$25,000 per Year	Medium	Ongoing. 06/01/2021-06/01/2026
9.1.3 Continue to enhance protocols for high-profile public events on campus	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	TBD by Event	Medium	Ongoing. 06/01/2021-06/01/2026

Objective 9.2: Develop and deploy public education campaigns related to terrorism					
9.2.1 Continue to educate the campus about the way to react to the dangers of a potential terrorism threat	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	$30,000	High	Ongoing. 06/01/2021-06/01/2026
Public Health-Related Emergency Mitigation Actions					
GOAL 10: Understand the impact of and recovery from health related emergencies					
Objective 10.1: Develop and deploy public education campaigns related to health related emergencies					
10.1.1 Conduct public education and outreach regarding emerging health emergencies to the student population	Student Life, Director of Risk and Emergency Management	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026
10.1.2 Conduct public education and outreach regarding emerging health emergencies to faculty and staff	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	Ongoing. 06/01/2021-06/01/2026
Hazardous Materials Mitigation Actions					
GOAL 11: Increase the university's ability to respond to and recover from a HazMat release					
Objective 11.1: Develop and deploy public education campaigns related to hazardous materials releases					
11.1.1 Conduct public education and outreach regarding **hazardous materials releases**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	(Ongoing: 06/01/2021-06/01/2026)

Transportation Incident Mitigation Actions					
GOAL 12: Increase the resiliency of the university to transportation incidents					
Objective 12.1: Develop and deploy public education campaigns related to hazardous materials releases					
12.1.1 Continue to conduct public education and outreach regarding **transportation incidents**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Low	(Ongoing: 06/01/2021-06/01/2026)
Civil Disturbance Event Mitigation Actions					
GOAL 13: Reduce the impact of civil disturbance events to campus					
Objective 13.1: Develop additional planning mechanisms related to civil disturbances					
13.1.1 Continue to enhance and refine protocols for anticipated civil disturbances	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Medium	(Ongoing: 06/01/2021-06/01/2026)
Cyber-Threat Event Mitigation Actions					
GOAL 14: Reduce the impact of cyber-threat events to campus					
Objective 14.1: Develop additional planning mechanisms related to cyber-threat events					
14.1.1 Continue to enhance and refine protocols for anticipated cyber-threat events	Office of the Chief Information Officer	06/01/2016 – 6/1/2021	Staff Time and Resources	High	(Ongoing: 06/01/2021-06/01/2026)
14.1.2 Continue to enhance protocols to help prevent potential IT intrusions that are malicious	Office of the Chief Information Officer	06/01/2016 – 6/1/2021	Staff Time and Resources	High	(Ongoing: 06/01/2021-06/01/2026)
Active Aggressor Event Mitigation Actions					
GOAL 15: Increase the resiliency of the university to terrorism					
Objective 15.1: Develop additional planning mechanisms related to active aggressor events on campus.					
15.1.1 Continue to refine site preparation plans **for active aggressor events**	DPS	06/01/2021-06/01/2026	Staff Time and Resources	High	(Ongoing: 06/01/2021-06/01/2026)

INFESTATION MITIGATION ACTIONS (NO LONGER ASSESSED)

Infestation Mitigation Actions (NO LONGER ASSESSED)					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 5: Increase the university's resilience to infestation					
Objective 5.1: Further develop planning mechanisms related to infestation					
5.1.1 Develop protocols for infestation as new threats arise	Associate VP of Facilities, Operations and Development; Student Life, Director of Risk and Emergency Management; Safety and Emergency Preparedness Director, Wexner Medical Center	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets, FEMA HMA Programs	Canceled
5.1.2 Partner with regional and state agencies to track and monitor infestations	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	Canceled
Objective 5.2: Develop and deploy public education campaigns related to infestation					
5.2.1 Develop a public education campaign to be delivered throughout the university **conveying infestation risk**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budgets	Canceled

FIRE INCIDENT MITIGATION ACTIONS (NO LONGER ASSESSED)

Fire Incident Mitigation Actions (NO LONGER ASSESSED)					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Status Update**
GOAL 12: Increase the resiliency of the university to fire incidents					
Objective 12.1: Undertake structural and infrastructure improvements to increase resilience to fire					
12.1.1 Evaluate hydrant placement on campus, and determine need for **additional units**	Associate VP of Facilities, Operations and Development	06/01/2016 – 6/1/2017	$15,000 per unit	Operating Budget	Completed. 2017
Objective 12.2: Develop and deploy public education campaigns related to fire incidents					
12.2.1 Conduct public education and outreach **regarding fire safety**	Assistant Vice President and Director of Public Safety	06/01/2016 – 6/1/2021	Staff Time and Resources	Operating Budget	Completed. 2019

PLAN MAINTENANCE

As a living document it is important that this plan becomes a tool in university resources to ensure reductions in possible damage from a hazard event. This section discusses plan adoption, implementation, monitoring, evaluating, and updating the 2022 HMP. Plan implementation and maintenance procedures will ensure that the 2022 HMP remains relevant and continues to address the changing environment at The Ohio State University. This section describes the incorporation of the 2022 HMP into existing planning mechanisms, and how the staff will continue to engage the public.

The OSU Hazard Mitigation Plan 2022 (2022 HMP) will be reviewed and updated on a five-year cycle by the Division of Emergency Management and the Emergency Operations Center (EOC) Group. Submissions for plan changes will be accepted through the Division of Emergency Management throughout the duration of the cycle. Changes will be noted within the OSU 2022 HMP. A planning workshop will be scheduled to review and orient key shareholders with the OSU 2022 HMP on an annual basis.

EVALUATION, MONITORING AND UPDATING

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in regard to identified mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis.

The Ohio State University Hazard Mitigation Planning Committee established for this Plan is designated to lead plan maintenance processes of monitoring, evaluation and updating with support and representation from all participating municipalities. The Mitigation Planning Committee will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from university representatives and other important stakeholders.

The Mitigation Planning Committee will oversee the progress made on the implementation of action items identified and modify actions, as needed, to reflect changing conditions. The Mitigation Planning Committee will meet annually to evaluate the plan and discuss specific coordination efforts that may be needed.

The annual evaluation of the 2022 Hazard Mitigation Plan will not only include an investigation of whether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating losses. A review of the qualitative and quantitative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be made regarding whether actions should be discontinued, or modified in any way in light of new developments in the community. Progress will be documented by the Mitigation Planning Committee for use in the next Hazard Mitigation Plan update. Finally, the Mitigation Planning Committee will monitor and incorporate elements of this Plan into other planning mechanisms.

This Plan will be updated by the FEMA approved five-year anniversary date, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future plan updates will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness of the 2022 Hazard Mitigation Plan.

- Has the nature or magnitude of hazards affecting the university changed?
- Are there new hazards that have the potential to impact the university?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the local hazard, risk and vulnerability summary, mitigation strategy, and other components of the plan will be incorporated during future updates.

UPDATE PROCESS FOR PLAN PRIOR TO 5-YEAR UPDATE

Any interested party wishing for an update of this Plan sooner than the 5-year update will submit such a request to the HMP Committee for consideration. The request shall be accompanied by a detailed rationale. The request will be evaluated, and a determination will be made as to whether the update request should be acted upon. If the decision is in the affirmative, an assignment will be made for an individual to author the update. The draft updated section along with a detailed rationale will be submitted to the Mitigation Planning Committee. The committee will circulate the draft updated section of the plan for comment and after an appropriate period of time, the committee shall make a decision to update the plan at least partially based on the feedback received.

PLAN UPDATE AND MAINTENANCE

This section describes the schedule and process for monitoring, evaluating, and updating the 2022 HMP.

SCHEDULE

Monitoring the progress of the mitigation actions will be on-going throughout the five-year period between the adoption of the HMP and the next update effort. The HMP Planning Committee will meet on an annual basis to monitor the status of the implementation of mitigation actions and develop updates as necessary.

The HMP will be updated every five years, as required by DMA 2000. The update process will begin at least one year prior to the expiration of the HMP. However, should a significant disaster occur, the HMP Planning Committee will reconvene within 30 days of the disaster to review and update the 2022 HMP as appropriate.

PROCESS

The HMP Planning Committee will coordinate with responsible agencies/organizations identified for each mitigation action. These responsible agencies/organizations will monitor and evaluate the progress made on the implementation of mitigation actions and report to the HMP Planning Committee on an annual basis. Working with the HMP Planning Committee, these responsible agencies/organizations will be asked to assess the effectiveness of the mitigation actions and modify the mitigation actions as appropriate.

Future updates to the HMP will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. Issues that arise during monitoring and evaluating the HMP, which require changes to the risk assessment, mitigation strategy and other components of the HMP, will be incorporated into the next update of the HMP. The questions identified above would remain valid during the preparation of the update.

INCORPORATION INTO EXISTING PLANNING MECHANISMS

An important implementation mechanism is to incorporate the recommendation and underlying principles of the 2022 HMP into planning and development such as capital improvement budgeting, general plans and comprehensive plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of the entity attempting to implement risk reducing actions. The integration of a variety of departments on the HMP Planning Committee provides an opportunity for constant and pervasive efforts to network, identify, and highlight mitigation activities and opportunities. This collaborative effort is also important to monitor funding opportunities which can be leveraged to implement the mitigation actions. HMP mitigation planners will actively incorporate information from:

- **University Comprehensive Planning:** The 2022 HMP will provide information that can be incorporated into comprehensive plans during the next plan update. Specific risk and vulnerability information from the 2022 HMP will assist to identify areas where development may be at risk to potential hazards.
- **The Ohio State University Comprehensive Emergency Management Plan (CEMP):** The 2022 HMP highlights hazards that the university is vulnerable to. This information would be valuable to include in future updates to the CEMP.

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