Hazard Identification and Risk Assessment

As part of the plan update process, a Hazard Identification Risk Assessment (HIRA) has been completed for Baltimore County. Results from the Hazard Risk Survey completed by Stakeholders have been integrated into the updated HIRA.

A **risk** is the chance, high or low, that any hazard will occur and the severity or impact from that hazard.

Eleven (11) natural hazards have been identified and a hazard risk has been assigned to each. Only natural hazards are included in this assessment as they lend themselves better to data collection related to geographic extent than technological and man-made hazards. A separate risk assessment will be conducted for the technological and man-made hazards (i.e., transportation accident, hazardous material incident, dam failure, fire and explosion, mass power outage) identified in the previous plan version.

Natural Hazard Identification and Risk Assessment Ranking Results			
Hazards	**Composite Score**	**2014 Ranking**	**2021 Hazard Ranking**
Flood	25	**High**	**High**
Drought	16	**Medium**	**Medium**
Tornado	18.5	**Medium**	**Medium**
Thunderstorm	28.5	**Medium-High**	**High**
High Winds	22	**Medium**	**Medium-High**
Wildfire	17.5	**Medium**	**Medium**
Earthquake	10	**Medium-Low**	**Medium-Low**
Sinkhole	13	**Medium-Low**	**Medium-Low**
Winter Weather	20.5	**Medium-High**	**Medium-High**
Coastal Storm and Flooding	18.5	**High***	**Medium**
Pandemic and Emerging infectious Diseases	28	**No 2014 Ranking**	**High**
*This hazard was identified as “Flooding (Tidal/Coastal)” in the 2014 Plan Update.			

The methodology and data used to complete this HIRA has been included on the following pages, which will comprise Appendix A of the Plan Update.

Hazard Identification and Assessment (HIRA) Methodology

To assess the hazard risk for the eleven (11) natural hazards identified in this Plan Update a composite score method was undertaken. The composite score method was based on a blend of quantitative and qualitative factors extracted from the National Centers for Environmental Information (NCEI), Maryland Department of Health - Maryland's NEDSS And PRISM Databases, stakeholder survey, and other available data sources. These included:

- Historical impacts, in terms of human lives and property;
- Geographic extent;
- Historical occurrence;
- Future probability, and;
- Community perspective.

The following eight (8) ranking parameters were used to develop the composite risk score, which provide the hazard ranking results for the eleven (11) identified natural hazards. Each parameter was rated on a scale of one (1) to four (4).

Injuries and Death Ranking	
Death	4
N/A	3
Injury	2
None	1

Source: National Centers for Environmental Information

Property and Crop Damage Ranking	
> 2M	4
501K	3
50k	2
0	1

Source: National Centers for Environmental Information

Annualized Events Ranking	
2.51	4
1.01	3
0.11	2
0	1

Source: National Centers for Environmental Information, Maryland Dept. of Health – Maryland's NEDSS and PRISM Databases

Probability and Future Ranking	
Highly Likely	4
Likely	3
Occasional	2
Unlikely	1

Source: National Centers for Environmental Information, based upon annualized events

Community Perspective Ranking	
Very Concerned	4
Concerned	3
Somewhat Concerned	2
Not Concerned	1

Source: Baltimore County Hazard Mitigation Plan Update: Public Survey

Max Geographical Extent (Hazard Dependent) Ranking								
Ranking	**Coastal & Climate Change**	**Drought**	**Flood**	**Thunderstorm**	**Tornado & Earthquake**	**Wildfire**	**Wind**	**Winter Storm**
1	0.00	0	0.00	0-2 events	0-10 events	0	0.00	10”-19”
2	25.00	0.18	10.00	3-5 events	11-17 events	0.4674	60.00	20”-29”
3	50.00	0.3421	20.00	6-8 events	18-22 events	2.1545	74.00	30”-39”
4	75.00	0.49	30.00	>9 events	>23 event	3.9041	95.00	>40”
Source:	*COASTAL: Risk Area*	*DROUGHT: CDL MD*	*FLOOD: DFIRMS*	*THUNDERSTORM: NCDC*	*TORNADO: NCDC EARTHQUAKE: Maryland Geological Survey*	*WILDFIRE: MD DNR Forest Service*	*WIND: ASCE*	*WINTER STORM: National Weather Service*
Calculated Using:	% of Coastal Land Area	% Crop Area	% Area in 100-yr Floodplain	Average number based on: Number of events, 2"> hail and lightning events with Injuries/Deaths	Sum of all tornados weighted by F-scale (F1*1.5, F2*2, F3*3, F4*4); Number of Earthquake Events	Average annual acres burned (%)	ASCE Design Wind Speeds	Average Snowfall
Source: 2016 State of Maryland Hazard Mitigation Plan								

The following weighted risk factors were used in the equation below to determine the composite risk score for each identified hazard.

Weighted Risk Factors		
Injuries	IN	1
Deaths	DT	1
Property Damage	PD	1
Crop Damage	CD	1
Geographic Extent (Hazard Dependent)	GE	1.5
Events (Annualized)	EV	1
Future Probability	FP	1
Community Perspective	CP	1.5

Equation: Composite Score = IN + DT + PD + CD + (GE*1.5) + EV + FP + (CP*1.5)

Hazard Ranking Results: Using the data tables above to populate the parameters, the composite score was determined for each identified hazard. Hazard Rankings were assigned accordingly using the adjacent Composite Score chart.

Composite Score	
Score (>=)	**Hazard Ranking**
0	**Medium-Low**
15	**Medium**
20	**Medium-High**
25	**High**

The following table provides the hazard risk ranking update results. Flood, Thunderstorm, and Pandemic and Emerging Infectious Diseases were ranked as “High” risk hazards. High Winds and Winter Weather were ranked as “Medium-High” risk hazards. Drought, Tornado, Wildfire, and Coastal Storm and Flooding were ranked as “Medium” risk hazards. Finally, Earthquake and Sinkhole were ranked as “Medium-Low” risk hazards.

Composite Scores										
Hazard	**Injuries & Deaths**		**Property & Crop Damage**		**Geographic Extent**	**Total Events Annualized**	**Future Probability**	**Community Perspective**	**Composite Score**	**HAZARD RANKING**
Flood (flash flood, heavy rain)	32 = 2	2 = 4	12.567M = 4	0 = 1	8.06% = 1	2.49 = 4	Likely = 3	Concerned = 4	25	**High**
Drought	0 = 1	0 = 1	0 = 1	4.2M = 4	20% = 2	0.42 = 2	Unlikely = 1	Somewhat Concerned = 2	16	**Medium**
Tornado	67 = 2	0 = 1	31.827M = 4	8k = 1	22 = 3	0.46 = 2	Unlikely = 1	Somewhat Concerned = 2	18.5	**Medium**
Thunderstorm (thunderstorm wind)	13 = 2	2 = 4	1.389M = 3	10.25k = 1	234 = 4	3.71 = 4	Highly Likely = 4	Concerned = 3	28.5	**High**
High Winds	18 = 2	3 = 4	1.389M = 3	10.25k = 1	90 = 3	0.80 = 2	Unlikely = 12	Concerned = 3	22	**Medium-High**
Wildfire	2 = 2	0 = 1	<= 50k = 1	0 = 1	0.095% = 1	6.0 = 4	Highly Likely = 4	Somewhat Concerned = 2	17.5	**Medium**
Earthquake	0 = 1	0 = 1	0 = 1	0 = 1	6 = 1	0.3 = 2	Unlikely = 1	Not Concerned = 1	10	**Medium-Low**
Sinkhole	>= 1 = 2	>= 1 = 4	0 = 1	0 = 1	50.96 sq miles = 1	N/A = 1	Unlikely = 1	Not Concerned = 1	13	**Medium-Low**
Winter Weather (winter storm)	18 = 2	3 = 4	0 = 1	0 = 1	18.3” = 1	4.11 = 4	Highly Likely = 4	Somewhat Concerned = 2	20.5	**Medium-High**

Composite Scores										
Hazard	**Injuries & Deaths**		**Property & Crop Damage**		**Geographic Extent**	**Total Events Annualized**	**Future Probability**	**Community Perspective**	**Composite Score**	**HAZARD RANKING**
Coastal Storm and Flooding (tropical storm, coastal flood)	0 = 1	1 = 1	407.645M = 4	50k = 2	3.23% = 1	0.47 = 2	Unlikely = 1	Very Concerned = 4	18.5	**Medium**
Pandemic and Emerging Infectious Diseases	* 44,639 = 2	* 1,044 = 4	0 = 1	0 = 1	** 100% = 4	*** 8,137.2 cases annually = 4	Highly Likely = 4	Very Concerned = 4	28	**High**

*Injuries & Deaths were based on Coronavirus Disease 2019 (COVID-19) Outbreak data provided by Maryland Department of Health as of January 20, 2021
**Pandemic & Emerging Infectious Diseases' geographic extent is countywide (100%).
*** Total Events/Annualized based on Cases of Selected Notifiable Conditions Reported Baltimore County, Maryland 2014-2018. *Source: Maryland Department of Health - Maryland's NEDSS And PRISM Databases*

DATA TABLES

The following data tables were developed and used to populate five (5) of the eight (8) parameters: Injuries, Death, Property Damage, Crop Damage, and Annualized Events.

Flood (Tidal/Coastal)

Flood Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent % in 100-yr Flood Zone (A, AE, AO &VE)**	**Days with Events (2003-2020)**
0	0	35k	0k	8.06% (55 sq. miles)	Total = 58 Annual Avg = 3.22
Note: data collected for 1950-present, no data available for this event type prior to 2003. *Source: NOAA/NCEI*					

Flash Flood Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent % in 100-yr Flood Zone (A, AE, AO &VE)**	**Days with Events (1996-2020)**
0	*2	12.217M	0k	8.06% (55 sq. miles)	Total = 93 Annual Avg = 3.72
Source: NOAA/NCEI ** Deaths were directly caused by flash flood, male and female, on 06/19/1996, 25k property damage included.* *Note: data collected for 1950-present, no data available for this event type prior to 1996*					

Heavy Rain Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent % in 100-yr Flood Zone (A, AE, AO &VE)**	**Days with Events (1997-2020)**
*32	0	0	0k	8.06% (55 sq. miles)	Total = 13 Annual Avg = 0.54
**A long-distance public bus ran off a rain-slicked highway and flipped onto its side. Thirty-two people were taken to various local hospitals.* *Note: data collected for 1950-present, no data available for this event type prior to 1997.* *Source: NOAA/NCEI*					

Drought

Drought Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1997-2020)**
0	0	0	4.2M	% Crop land cover from 2019 USDA CropLand Data = 20.0%	Total = 10 Annual Avg = 0.42
Note: data collected for 1950-present, no data available for this event type prior to 1997 *Source: NOAA/NCEI*					

Tornado

Tornado Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1973-2020)**
67	0	31.827M	8k	Sum of all events = 22	Total = 22 Annual Avg = 0.46
Note: data collected for 1950-present, no data available for this event type prior to 1973. *Source: NOAA/NCEI*					

Thunderstorm

Thunderstorm Wind Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1957-2020)**
13	2	1.389M	10.25k	Sum of all events = 234	Total = 234 Annual Avg = 3.71
Note: data collected for 1950-present, no data available for this event type prior to 1957. *Source: NOAA/NCEI*					

High Winds

High Wind Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1996-2020)**
13	2	1.389M	10.25k	ASCE Wind Design Speed = 90	Total = 20 Annual Avg = 0.80
Note: data collected for 1950-present, no data available for this event type prior to 1996. *Source: NOAA/NCEI*					

Earthquake

Earthquake Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Total Events (1990-Present)**
0	0	0	0	Sum of all events = 6	Total = 6 Annual Avg = 0.30
Source: Maryland Geological Survey (MGS), 1990-2010					

Sinkhole

Sinkhole Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1996-2020)**
>= 1	>= 1	0	0	Total extent of Cockeysville Marble formation (karst topography) = 50.96 square miles or 7.48% of total land area	N/A
Source: USGS Soil Survey and Baltimore County Hazard Mitigation Plan 2014					

Winter Weather

Winter Weather Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1997-2020)**
18	3	0	0	Average snowfall total: 18.3" (1996-present NOAA/NWS)	Total = 142 Annual Avg = 5.92
**Icy roads on I-95 in 55-car accident, 12 injuries and 2 fatalities.* *Note: data collected for 1950-present, no data available for this event type prior to 1997.* *Source: NOAA/NCEI*					

Winter Storm Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1998-2020)**
*1	0	*1.510M	0	Average snowfall total: 18.3" (1996-present NOAA/NWS)	Total = 53 Annual Avg = 2.30
**President's Weekend Snowstorm of 2003* *Note: data collected for 1950-present, no data available for this event type prior to 1998.* *Source: NOAA/NCEI*					

Coastal Storm and Flooding

Tropical Storm Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (1999-2020)**
0	*1	407.600M	50k	% of County in the Coastal Rural Legacy area = 3.23%	Total = 3 Annual Avg = 0.14
**Hurricane Isabel, 09/18/2003; 155M prop dmg/50k crop dmg* *Note: data collected for 1950-present, no data available for this event type prior to 1999.* *Source: NOAA/NCEI*					

Coastal Flood Hazard Data Table					
Injuries	**Deaths**	**Property Dmg**	**Crop Dmg**	**Geographic Extent**	**Days with Events (2006-2020)**
0	0	45k	0k	% of County in the Coastal Rural Legacy area = 3.23%	Total = 12 Annual Avg = 0.80
Note: data collected for 1950-present, no data available for this event type prior to 2006. *Source: NOAA/NCEI*					

Pandemic and Emerging Infectious Diseases

Cases of Selected Notifiable Conditions Reported Baltimore County, Maryland					
Condition	**2014**	**2015**	**2016**	**2017**	**2018**
Amebiasis	1	2	9	3	6
Anaplasmosis	1	1	1	2	2
Animal Bites	1590	1662	1827	2037	1678
Babesiosis	0	0	1	0	2
Botulism	2	3	1	2	1
Brucellosis	0	0	0	0	1
Campylobacteriosis	109	109	114	109	110
Chikungunya	4	0	0	0	0
Chlamydia	3450	3614	4190	4479	4463
Cholera	0	0	2	0	0
Coccidioidomycosis	0	0	3	0	1
Creutzfeldt-Jakob Disease	2	0	0	0	0
Cryptosporidiosis	11	9	10	8	9
Cyclosporiasis	1	0	0	4	6
Dengue Fever	2	0	1	2	1
Ehrlichiosis	1	0	2	2	1
Encephalitis – non-Arboviral	3	3	1	4	8
Giardiasis	23	17	39	27	23
Gonorrhea	708	1017	1321	1549	1309
H. influenzae – invasive disease	12	15	19	20	24
Hemolytic Uremic Syndrome post-diarrhea	1	0	0	0	0
Hepatitis A (acute symptomatic)	2	1	0	2	5
Hepatitis B (acute symptomatic)	5	6	9	5	10
Hepatitis C (acute symptomatic)	3	0	4	4	0
Hepatitis C - Perinatal	0	0	0	0	1
Hepatitis D (acute symptomatic)	0	0	1	0	0
Hepatitis E (acute symptomatic)	0	1	0	0	0
Kawasaki Syndrome	0	1	2	1	0
Legionellosis	27	24	26	33	68
Leptospirosis	0	0	0	0	1
Listeriosis	3	6	5	4	5
Lyme Disease	199	219	193	212	176
Malaria	19	12	19	21	19
Meningitis, aseptic	86	96	57	85	61

Cases of Selected Notifiable Conditions Reported Baltimore County, Maryland					
Condition	**2014**	**2015**	**2016**	**2017**	**2018**
Meningitis, fungal	3	4	3	11	6
Meningococcal Invasive	0	0	1	0	0
Microsporidiosis	0	0	1	2	4
Mumps (infectious parotitis)	0	0	2	1	2
Mycobacteriosis, Other than TB & Leprosy	69	83	71	102	110
Pertussis	13	5	7	6	10
Pneumonia – hospitalized healthcare worker	2	1	0	1	1
Rubella (congenital syndrome)	0	0	1	0	0
Salmonellosis – other than typhoid fever	106	112	98	115	100
Shiga toxin producing E. coli (STEC)	13	21	19	15	29
Shigellosis	39	51	22	53	26
Spotted Fever Rickettsiosis	0	0	0	1	5
Strep Group A – Invasive Disease	43	37	41	60	68
Strep Group B – Invasive Disease	118	116	113	116	99
Strep pneumoniae - Invasive Disease	67	60	71	79	70
Syphilis – congenital	4	4	1	4	4
Syphilis – primary and secondary	46	79	78	74	103
Tuberculosis	31	28	22	28	26
Tularemia	0	0	0	1	0
Typhoid Fever - acute	2	4	3	3	2
Vibriosis (non-cholera)	2	3	4	7	18
West Nile Virus Symptomatic Infections	0	10	0	0	9
Yersiniosis	3	4	3	1	3
Zika virus disease, non-congenital	0	0	12	1	0
Zika virus infection, non-congenital	0	0	3	4	1
TOTALS:	6826	7440	8433	9300	8687

** Data sources: Maryland's NEDSS and PRISM databases. Data is current as of 6/19/2019. These are active databases and counts may vary slightly over time, as well as differ slightly from counts published by the Centers for Disease Control and Prevention (CDC). HIV/AIDS data are not included here but available at http://phpa.dhmh.maryland.gov/OIDEOR/CHSE/SitePages/statistics.aspx.*