Oregon Military Department
Office of Emergency Management (OEM)
HAZARD ANALYSIS METHODOLOGY

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HISTORY, BACKGROUND, AND OVERVIEW

This hazard analysis methodology was first developed by FEMA circa 1983, and gradually refined by OEM over many years. During 1984, the predecessor agency to OEM (the Emergency Management Division) conducted workshops around the State of Oregon that resulted in all of Oregon's 36 counties producing the first versions of analyses using this methodology. In addition, many cities have also conducted an analysis using this method. For a time, the Oregon Health Authority (OHA) was requiring local health departments to conduct an analysis based on this methodology.

Via the Emergency Management Performance Grant (EMPG), OEM has periodically required updates to these analyses for local governments participating in EMPG, and today the vast majority of the local natural hazard mitigation plans (NHMPs) in the State of Oregon, at both the county and city level utilize this methodology. The Oregon NHMP also incorporates this method.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible); one order of magnitude from lowest to highest. Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events, and probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score, and probability approximately 40%.

For local/Tribal governments, conducting the hazard analysis described in this document is a useful early step in planning for hazard mitigation, response, and recovery. This method provides the jurisdiction with a sense of hazard priorities, or relative risk. It "quantifies" the risk of one hazard compared with another, and in doing so allows for the ranking of hazards. By doing this analysis, planning can first be focused where the risk is greatest.

Among other things, this hazard analysis can:

- help establish priorities for planning, capability development, and hazard mitigation;
- serve as a tool in the identification of hazard mitigation measures;
- be one tool in conducting a hazard-based needs analysis;
- serve to educate the public and public officials about hazards and vulnerabilities; and
- help communities make objective judgments about acceptable risk.

For OEM and other state and regional organizations, this analysis allows comparison of the same hazard across various jurisdictions; for example, the score for the flood hazard in each county in a four-county region. Each hazard analysis produced using this methodology is ultimately comprised of two main pieces: a hazard analysis matrix (table) and a narrative.

POSSIBLE HAZARDS TO CONSIDER

NATURAL HAZARDS

In accordance with Statewide Planning Goal 7, local governments “shall… reduce risk to people and property from (as applicable)… floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires.” Jurisdictions should also develop scores, *where applicable*, for coastal hazards in addition to erosion, for drought, dust storms, windstorms, snow/ice/extreme cold, and for volcanic hazards.

With respect to volcanic hazards, score direct hazards such as blast and lahar separately from secondary hazards such as ashfall.

Please do not create a "catchall" category for "severe weather" or “winter storm,” but rather score floods, windstorms, and snow/ice/extreme cold separately. The terms “severe weather” and "winter storm," though used frequently around the state, mean different things in different places. For example, a winter storm on the South Coast is typically very different than a winter storm in the Columbia River Gorge.

TECHNOLOGICAL/PERSON-CAUSED HAZARDS

Jurisdictions should also develop scores for technological or person-caused hazards such as dam failure and hazardous materials. You may score fixed site and transportation hazards separately; some jurisdictions score radiological hazards separately. Though not required as part of this analysis, at your option, you may want to score riots and acts terrorism.

COMPLETING THE HAZARD ANALYSIS MATRIX

The matrix is intended to be completed by your Planning Team based on best available data, which is available from a variety of sources including FEMA, USGS, NOAA, NWS, USDA, USACE, CVO, DOGAMI, OWRD, OCCRI, OCS, ODF, etc. The intent is that the analysis will utilize already available data on the hazards examined, and not simply represent the subjective judgement of your Team.

The Hazard Analysis Matrix Worksheet on page 5 is provided for you and your Team to complete. Depending on your approach to completing the Matrix, you may benefit by transferring this worksheet onto a large format, such as a flipchart, dry erase board, etc., to assist in facilitating your meeting.

In this analysis, *severity ratings* are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability based as follows:

LOW = choose the most appropriate number between 1 to 3 points
MEDIUM = choose the most appropriate number between 4 to 7 points
HIGH = choose the most appropriate number between 8 to 10 points

Weight factors also apply to each of the four categories as shown below.

HISTORY (weight factor for category = 2)

History is the record of previous occurrences. Events to include in assessing history of a hazard in your jurisdiction are events for which the following types of activities were required:

- The EOC or alternate EOC was activated;
- Three or more EOP functions were implemented, e.g., alert & warning, evacuation, shelter, etc.;
- An extraordinary multi-jurisdictional response was required; and/or
- A Local or Tribal Emergency was declared.

LOW – score at 1 to 3 points based on…	0 - 1 event past 100 years
MEDIUM – score at 4 to 7 points based on…	2 - 3 events past100 years
HIGH – score at 8 to 10 points based on…	4 + events past100 years

VULNERABILITY (weight factor for category = 5)

Vulnerability is the percentage of population and property likely to be affected under an “average” occurrence of the hazard.

LOW – score at 1 to 3 points based on…	< 1% affected
MEDIUM – score at 4 to 7 points based on…	1 - 10% affected
HIGH – score at 8 to 10 points based on…	> 10% affected

MAXIMUM THREAT (weight factor for category = 10)

Maximum threat is the highest percentage of population and property that could be impacted under a worst-case scenario.

LOW – score at 1 to 3 points based on…	< 5% affected
MEDIUM – score at 4 to 7 points based on…	5 - 25% affected
HIGH – score at 8 to 10 points based on…	> 25% affected

PROBABILITY (weight factor for category = 7)

Probability is the likelihood of future occurrence within a specified period of time.

LOW – score at 1 to 3 points based on…	one incident likely within 75 to 100 years
MEDIUM – score at 4 to 7 points based on…	one incident likely within 35 to 75 years
HIGH – score at 8 to 10 points based on…	one incident likely within 10 to 35 years

By multiplying the *weight factors* associated with the categories by the *severity ratings*, we can arrive at a subscore for history, vulnerability, maximum threat, and probability for each hazard. Adding the subscores will produce a total score for each hazard.

For example, look at "landslide" on the “Sample Hazard Analysis Matrix” shown on page 6. The history of landslides is high in the sample jurisdiction. History has a weight factor of two (2), and in this case, high is scored with ten (10) points for the severity rating. 2 X 10 = subscore of 20. The vulnerability of the sample jurisdiction is medium. However, a landslide normally would not affect much more than 1% of the people and property in the jurisdiction. Vulnerability has a factor weight of five (5) and this Team decided on four (4) points for the severity rating. 5 X 4 = subscore of 20. After figuring maximum threat and probability, the total score for landslides is 133.

The total score isn't as important as how it compares with the total scores for other hazards the jurisdiction faces. By comparing scores, the jurisdiction can determine priorities: Which hazards should the jurisdiction be most concerned about? Which ones less so?

COMPLETING THE NARRATIVE

In addition to the matrix used to score the hazards, each local/Tribal hazard analysis should include a narrative that describes how these hazards affect that particular jurisdiction, especially critical facilities, key infrastructure, and the most important facilities of the jurisdiction’s economic base.

One should provide this narrative minimally on those hazards receiving the highest total scores in the jurisdiction; for example, you may include history, areas of vulnerability, areas of planned or current mitigation measures, maps and displays, or any other facts or data that may be relevant.

Some jurisdictions include a brief section on hazards that were considered, but not scored (or scored, but not included in the written hazard analysis), offering the rationale for not scoring or not writing narrative about certain minor hazards.

OTHER METHODOLOGIES AND DRILLING INTO THE DETAILS

There are many ways of assessing risk. The OEM Hazard Analysis Methodology is intended to provide a “big picture” framework to which more detailed risk and vulnerability assessments are tied. Among the other prominent tools are various Geographic Information Systems (GIS), FEMA’s Hazards U.S. (HAZUS), the National Risk Index (NRI), and Oregon Department of Forestry's (wildfire) “Communities at Risk,” which utilizes the Quantitative Wildfire Risk Assessment. This is only a partial list of the many ways of evaluating risk.

The OEM Hazard Analysis Methodology can and should be one tool used in the development or revision of risk assessments required as part of the local/Tribal natural hazard mitigation planning process under 44 CFR 201.6(c)(2)/44 CFR 201.7(c)(2), which have as their bottom line using best available data.

HAZARD ANALYSIS MATRIX[1]
WORKSHEET

JURISDICTION:

Hazards		History WF = 2	Vulnerability WF = 5	Maximum Threat WF = 10	Probability WF = 7	Total Score
	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	
	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	
	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	
	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	
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	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	
	WF X SR Subscore	2 X ____ =	5 X ___ =	10 X ___ =	7 X ___ =	

DATE: ____

WF = weight factor
SR = severity rating

PREPARED BY:

AGENCY:

[1] This table is available in Microsoft Excel – if you want an Excel copy send an email message to joseph.murray@mil.state.or.us

SAMPLE HAZARD ANALYSIS MATRIX

Hazards		History WF = 2	Vulnerability WF = 5	Maximum Threat WF = 10	Probability WF = 7	Total Score
FLOOD	WF X SR Subscore	2 X 10 = 20	5 X 9 = 45	10 X 7 = 70	7 X 10 = 70	**205**
WILDFIRE	WF X SR Subscore	2 X 10 = 20	5 X 8 = 40	10 X 5 = 50	7 X 10 = 70	**180**
EARTHQUAKE	WF X SR Subscore	2 X 2 = 4	5 X 10 = 50	10 X 10 = 100	7 X 3 = 21	**175**
WINDSTORM	WF X SR Subscore	2 X 8 = 16	5 X 6 = 30	10 X 6 = 60	7 X 8 = 56	**162**
HAZMAT	WF X SR Subscore	2 X 7 = 14	5 X 5 = 25	10 X 6 = 60	7 X 6 = 42	**141**
LANDSLIDE	WF X SR Subscore	2 X 10 = 20	5 X 4 = 20	10 X 3 = 30	7 X 9 = 63	**133**
DAM FAILURE	WF X SR Subscore	2 X 1 = 2	5 X 5 = 25	10 X 2 = 20	7 X 2 = 14	**61**

SEVERITY RATINGS (to be applied to the four categories)

LOW = 1 - 3 points
MEDIUM = 4 - 7 points
HIGH = 8 - 10 points

WF = weight factor
SR = severity rating

The following categories are used in developing the scores for this analysis:

HISTORY (record of previous occurrences)

LOW 0 - 1 event per 100 years
MEDIUM 2 - 3 events per 100 years
HIGH 4 + events per 100 years

VULNERABILITY (percentage of population and property likely to be affected)

LOW < 1% affected
MEDIUM 1 - 10% affected
HIGH > 10% affected

MAX. THREAT (percentage of population and property that could be impacted under a worst-case scenario)

LOW < 5% affected
MEDIUM 5 - 25% affected
HIGH > 25% affected

PROBABILITY (the likelihood of occurrence within a specified period of time)

LOW one incident likely within a 75 to 100 year period
MEDIUM one incident likely within a 35 to 75 year period
HIGH one incident likely within a 10 to 35 year period