Chapter 7 - Risk and Vulnerability Assessment

Hazard Ranking Methodology

After a thorough review of the community profile, a county hazard ranking was completed using a three-step process. The first step was selecting evaluation criteria, the second step assigned relative weights to each of the rating criteria, and the third step assigned point values in each of the selected criteria for each of the hazards.

Evaluation Criteria

Selection of evaluation criteria was accomplished by determining what aspects of the hazards were of most concern to the community. This process was completed by assigning a level of importance ranging from "Always Important" to "Not Worth Considering" to each hazard aspect. **Table 7.1** shows a complete list of all aspects considered and level of importance assigned by the committee.

Table 7.1
Crawford County
Hazard Evaluation Criteria

Hazard Aspect	Always Very Important	Usually Important	Sometimes Important	Rarely of Importance	Not worth Considering
Historical Occurrence	X				
Size of Affected Area		X			
Speed of Onset				X	
Population Impact	X				
Negative Economic effects	X				
Duration of Threat				X	
Seasonal Risk Pattern				X	
Predictability of Hazard			X		
Collateral Damage			X		
Availability of Warning System		X			
Ability to Mitigate	X				
Percent of Population Affected		X			
Environmental Impact			X		
Capacity to Cause Damage	X				
Public Awareness		X			
OtherConsiderations					

Each evaluation criteria was then assigned a "weight" to express the level of importance each criteria will have in ranking hazards. The sum of weights of all of evaluation criteria must equal 100%. Each criterion was then assigned a percentage value based on the relative importance that criterion would have in ranking the selected hazards. Point values of 1-10 were assigned using the scoring parameters as outlined in the Evaluation Measure Benchmark Factors shown

below. Using a spreadsheet, values were entered and calculated to provide a hazard ranking as shown in **Table 7.2**.Hazard Analysis Evaluation Measures

Hazard Analysis Evaluation Measures

The committee chose to use a common set of 7 evaluation measures to evaluate each hazard facing the community. Those measures are: 1) likelihood of occurrence; 2) potential for damage; 3) effected area; 4) ability to mitigate; 5) population effected; 6) number of casualties and 7) economic impact. Each corresponding benchmark factor has been assigned a specific point value (10, 7, 4 or 1 point), based on each factor's relative severity and negative impacts. Since some factors need to be given more consideration than others, each criterion was weighted. A percentage value has been assigned to each measure based on the relative significance of the measure. The sum of all of measures must equal 100 percent. The following is a synopsis of each hazard evaluation measure, weight and benchmark factor used in this analysis:

Likelihood of Occurrence

Likelihood of occurrence measures the frequency with which a particular hazard occurs. The more frequently a hazard event occurs, the more potential there is for damage and negative impact on a community.

Capacity to Cause Physical Damages

The capacity to cause physical damages refers to the destructive capacity of the hazard. While destructive capacity of some hazard events, such as floods and tornadoes, is often immediate and readily apparent, some hazards may have significant destructive capacity that is less obvious as it may occur over an extended period of time such as extreme temperatures or drought.

Size of Effected Area

Each hazard affects a geographic area. For example, a blizzard might affect an entire state or even several states, while a flood might only affect a portion of a county or municipality. Although size of the affected area is not always indicative of the destructive potential of the hazard (a tornado is a good example), generally the larger the affected area, the more problematic the hazard event is on a community.

Mitigative Potential

Mitigative potential refers to the relative ease with which a particular hazard event can be mitigated against through the application of structural or non-structural (or both) mitigation measures. Generally, the easier a hazard event is to mitigate against, the less of a future threat it may pose to a community in terms of loss of life and property.

Percent of Population Affected

Percent of Population affected refers to the percent of the county population that may be effected directly or indirectly by the hazard event.

Potential for Causing Casualties

Potential for causing casualties refers to the number of casualties (deaths and injuries) that can be expected if a particular hazard event occurs.

Economic Effects

Economic effects are the monetary damages incurred from a hazard event, and include both public and private damage. Direct physical damage costs as well as indirect impact costs such as lost business and tax revenue are included as part of the total monetary damages.

Evaluation Measure Benchmark Factors

Likelihood of Occurrence	
Excessive Occurrence	10 pts
High Occurrence	7 pts
Medium Occurrence	4 pts
Low Occurrence	1 pt

Affected Area	
Large Area	10 pts
Small Area	7 pts
Multiple Sites	4 pts
Single Site	1 pt

Population Impact	
High Impact	10 pts l
Medium Impact	7 pts
Low Impact	4 pts
No Impact (none)	1 pt

Mitigative Potential	
Easy to Mitigate	10 pts
Possible to Mitigate	7 pts
Difficult to Mitigate	4 pts
Impossible to Mitigate	1 pt

Economic Effects	
Significant Effects	10 pts
Medium Effects	7 pts
Low Effects	4 pts
Minimal Effects	1 pt

Percent of Population Affected	
60% to 100%	10 pts
30% to 60%	7 pts
15% to 30%	4 pts
15% or less	1 pts

Damage Capacity	
High Capacity	10 pts
Medium Capacity	7 pts
Low Capacity	4 pts
No Capacity	1 pt

Table 7.2
Crawford County Hazard Rating - Evaluation Criteria

	Chance of Occurrence	Amount of Damage	Area Affected	Population Affected	Number of Casualties	Economic Effect	Ability to Mitigate		
WEIGHT =========>	20%	15%	10%	10%	20%	10%	15%	100%	
Hazard								Score	Rank
Wildfire	9	9	8	9	7	8	8	8.25	1
Fixed Site Hazmat	8	7	5	5	8	5	8	6.95	2
Structural Fire	9	9	3	3	7	3	8	6.65	3
Transportation Hazmat	8	8	5	5	7	3	7	6.55	4
Severe Winds	9	8	8	8	4	8	2	6.50	5
Infrastructure Failure	7	7	4	8	3	7	8	6.15	6
Tornados	5	8	2	5	8	7	2	5.50	7
Winter Weather Hazard	9	4	8	8	1	7	4	5.50	7
Public Health	5	3	5	6	5	6	6	5.05	8
Terrorism/Sabotage/WMD	1	8	7	7	7	7	1	5.05	8
Extreme Temperature	8	3	8	8	1	4	5	5.00	9
Hail	9	7	7	7	1	5	0	4.95	10
Transportation Accident	9	1	1	2	9	1	5	4.90	11
Oil/Gas Well Incident	8	1	4	4	2	3	4	3.85	12
Nuclear Attack	0	4	5	8	4	8	0	3.5	13
Lightning	9	2	1	1	3	1	0	3.00	14
Pipeline Accident	8	2	1	1	1	4	1	2.85	15
Dam Failure	1	3	3	2	1	3	7	2.70	16
Riverine Flooding	1	3	3	2	1	3	7	2.70	16
Drought	2	1	7	7	1	1	1	2.40	17
Civil Disturbance	1	2	1	1	1	3	8	2.40	17
Scrap Tire Fire	1	1	2	1	1	3	8	2.35	18
Earthquake	0	2	4	5	2	6	0	2.20	19
Subsidence	1	2	1	1	1	1	1	1.15	20
Shoreline Flooding	1	1	1	1	0	1	3	1.10	21

A summary of the hazard rankings derived from the hazard evaluation process is shown in (Table 7.3), below.

Table 7.3, Summary Hazard Rankings for Crawford County	
High Rankings	**Score**
Wildfire	8.25
Fixed Site Hazmat	6.95
Structural Fire	6.65
Transportation Hazmat	6.55
Severe Winds	6.50
Infrastructure Failure	6.15
Moderate Ranking	
Tornados	5.50
Winter Weather Hazard	5.50
Public Health	5.05
Terror/sabotage/WMD	5.05
Extreme Temperatures	5.00
Hail	4.95
Low Ranking	
Transportation Accidents	4.90
Oil/Gas Well incident	3.85
Nuclear Attack	3.50
Lightning	3.00
Pipeline Accident	2.85
Dam Failure	2.70
Riverine Flooding	2.70

Risk Assessment and Vulnerability Assessment Summary

Risk Assessment

The goals of risk assessment are to determine where hazards exist, and develop an understanding of how often they will arise and how much harm they cause. Based on the weighted hazard ranking process recommended in the Michigan Hazard Analysis workbook, a composite of hazards and their relative risk are presented below. This list will be used as the foundation for developing hazard mitigation goals and strategies in subsequent chapters.

- **High Risk:** -- very likely to occur during hazard mitigation planning horizon of 20 years, and/or effect all or most of the county.

- **Medium Risk:** -- somewhat likely to occur during hazard mitigation planning horizon of 20 years, and/or effect a significant area of the County.

- **Low Risk:** -- means it is not likely to occur, or cover only a limited area within county.

Vulnerability Assessment

This step looks at such points as population concentrations, age-specific populations, development pressures, types of housing (older homes, mobile homes), presence of agriculture, sprawl (spreading resources too thin), and other issues that may make Crawford County more vulnerable to specific hazards. The following criteria were used to rank vulnerability as low, medium or high for each hazard. Further, analysis of hazards ranked as high risk, relies on information presented in earlier chapters.

- **High Vulnerability:** -- If an event occurred it would have severe impacts over large geographic areas or more densely populated areas and have a serious financial impact on County residents and businesses.

- **Medium Vulnerability:** -- If an event occurred it would have confined impacts on the safety of residents but would have a financial impact on County residents and businesses.

- **Low Vulnerability:** -- If an event occurred it would have very minimal impact on the safety of County residents and minimal financial impact on County residents and businesses.

Based on the weighted hazard ranking process recommended in the Michigan Hazard Analysis workbook, the 2002 Crawford County Hazard Analysis and community input, a composite of hazards and their relative risk and vulnerability are presented in Table 7.4. This list will be used as the foundation for developing hazard mitigation goals and strategies in subsequent chapters

Vulnerable Situations in Crawford County

Wildfire

By far the most significant hazard facing Crawford county comes from wildfire. As indicated in Figure 2-3, dispersed residential development and extensive jack pine/red oak forest cover present a major threat to population and property in the county.

The large number of permanent and seasonal homes in northeastern Michigan, coupled with the increase in tourists during the most dry (and therefore most vulnerable) times of the year, greatly increases the risk from wildfires.

> "The threat of life and property losses related to wildfires is a significant issue for federal, state and local fire and planning agencies who consider the mix of residential areas and wildlands. The wildland fire threat is part of the more general consideration of human development encroaching wildlands. The March, 2000, edition of the Journal of Forestry reflects this with urban encroachment and wildland fragmentation the principal subject with residential fire one of the specific issues. (Cohen 2000). Presently, the wildland fire threat to homes influences fire management and protections policies at national and local levels." (Jack D. Cohen, "What is the Wildland Fire Threat to Homes?)

Current research indicates lowering building ignition potential will significantly reduce chances of home destruction without extensive wildland fuel reduction. This becomes an issue of homeowner education and community involvement. Community/homeowner understanding of the methods of

lowering home ignition potential is the primary mitigative action to reduce wildland fire threat to residential areas.

As part of a nationwide effort to identify communities at high risk the following federal agencies developed a list of urban wildland interface communities in the vicinity of Federal lands that are at high risk from wildfire: Forest Service, Department of Agriculture; Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, and National Park Service, Department of the Interior. This was published in the **Federal Register** / Vol. 66, No. 160 / Friday, August 17, 2001; Urban Wildland Interface Communities within the Vicinity of Federal Lands that are at High Risk from Wildfire. State of Michigan, along with many other states, felt the urban wildland interface is not limited to communities in the vicinity of Federal land and developed a comprehensive state list of communities at risk.

Below is a list of Crawford County locations identified in the document.

- Beaver Creek Township
- Frederick Township
- City of Grayling
- Grayling Township
- Lovells Township
- S. Branch Township

Community centers and dispersed rural residential development interfaces with these high risk forest types of pine, oak and aspen. Therefore, with the exception of Maple Ridge Township, much of the remainder of Crawford County is highly vulnerable to wildfire hazards.

To adequately institute practices of lowering home ignitability it will require changing relationships between homeowners and local fire services. Instead of all fire protection responsibilities being with fire agencies, homeowners should take primary responsibility for adequately lowering home ignitability. The role of fire protection agencies becomes that of a community partner to provide homeowners the technical assistance needed to reduce home ignitability. To be successful, this partnership arrangement must be shared and implemented equally by homeowners and fire services. Projects designed to mitigate the threat of wild fire should evolve from the concepts and materials represented by “Firewise”. Firewise is an cooperative effort among federal, state, and private agencies and organizations to promote fire safety in the wildland/urban interface. The primary FireWise tenet is that it is unnecessary to lose homes or other buildings in wildfires if those homes or buildings are built and maintained according to simple FireWise principles. Firefighters cannot be everywhere when a wildfire occurs, but if homeowners follow FireWise suggestions, homes and buildings will survive wildfires without any firefighters being there to protect them. The Firewise program addresses the risk to homes in the wildland/urban interface to wildland fire and provides a potential vehicle upon which a partnership between homeowners and fire services can develop

Riverine and Urban Flooding:

Riverine flooding is defined as the periodic occurrence of overbank flows of rivers and streams resulting in partial or complete inundation of the adjacent floodplain. Riverine floods generally caused by prolonged, intense rainfall, snowmelt, ice jams, dam failures, or any combination of these factors. Most riverine flooding occurs in early spring and is the result of excessive rainfall and/or the combination of rainfall and snowmelt. Ice jams also cause flooding in winter and early spring.

National Flood Insurance Program

In 1968, Congress created the National Flood Insurance Program (NFIP). Since most homeowners' insurance policies did not cover flood, property owners who experienced a flood often found themselves financially devastated and unable to rebuild. The NFIP was formed to fill that gap. To ensure the program did not take on unnecessary risks, one of the key requirements to participate in the program was that communities had to adopt standards for new construction and development.

Pre-existing homes and businesses, though, could remain as they were. Owners of many of these older properties could obtain insurance at lower, subsidized, rates that did not reflect the property's real risk. In addition, as the initial flood risk identified by the NFIP has been updated over the years, many homes and businesses in areas where the revised risk was determined to be higher have also received discounted rates. This "Grandfathering" approach prevented rate increases for existing properties when the flood risk in their area increased.

In 2012, the U.S. Congress passed the Flood Insurance Reform Act of 2012 which calls on the Federal Emergency Management Agency (FEMA), and other agencies, to make a number of changes to the way the NFIP is run. As the law is implemented, some of these changes have already occurred, and others will be implemented in the coming months. Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk, make the program more financially stable, and change how Flood Insurance Rate Map (FIRM) updates impact policyholders. The changes will mean premium rate increases for some – but not all -- policyholders over time.

In April of 2012 FEMA completed a Countywide Flood Insurance Study and DFIRM (Digital Firm) Status for Crawford County. Beaver Creek, Frederic, Grayling, Lovells, Maple Forest, and South Branch Townships and the City of Grayling are participating in the NFIP.

A review of the State of Michigan database found no incidents of repetitive loss properties in Crawford County.

Table 7.4, Crawford County Risk and Vulnerability Assessment Summary		
Hazards in Crawford County	**Risk Assessment**	**Vulnerability Assessment**
Wildfire	**High**	**High**
Severe Summer Storm Hazards Severe Winds, Tornados, Lightening & Hail	**High**	**High**
Infrastructure Failure	**High**	**High**
Severe Winter Storm Hazards	**High**	**High**
Structural Fires	**High**	**Medium**
Hazardous Materials Fixed Site	**High**	**Medium**
Transportation of Hazardous Materials	**Medium**	**Medium**
Extreme Temperatures	**Medium**	**Medium**
Public Health	**Medium**	**Medium**
Riverine Flooding	**Medium**	**Medium**
Terrorism/Sabotage/WMD	**Medium**	**Medium**
Drought	**Medium**	**Medium**
Dam Failures	**Medium**	**Medium**
Petroleum and Natural Gas Pipeline Accidents	**Medium**	**Medium**
Oil and Gas Wells Accidents	**Medium**	**Low**
Transportation Accidents	**Medium**	**Low**
Nuclear Attack	**Low**	**High**
Civil Disturbance	**Low**	**Low**
Scrap Tire Fire	**Low**	**Low**
Shoreline Flooding	**Low**	**Low**
Earthquakes	**Low**	**Low**
Subsidence	**Low**	**Low**