STEP 1c: RISK ASSESSMENT

This substep and the next one (Vulnerability Assessment) are closely related. Both use gathered information to summarize the risk that each hazard poses to your community. During these two steps, much useful information can be added to the sections that were started for each hazard in the Hazard Identification substep. The tasks involve finding where hazard risks overlap with the people and property you identified in the community profile. The goals of the risk assessment are to map out where hazards exist in your community, and to gain some idea of how often they arise and how much harm they might do in the future. Some hazards may affect your entire community, and may not need mapping if their likelihood and impacts seem to be about the same throughout the area. It will still be important to consider potential impacts they may have on different parts of your community—especially areas that may have a harder time preparing for and responding to an event. The Risk Assessment mainly involves collecting and thinking about this information, which will form the basis for the Vulnerability Assessment to follow. Useful sources of information include base maps from the public works department, road commission or planning department, floodplain information from National Flood Insurance Program Flood Insurance Rate Maps (FIRMs), and Section 302 sites from the Local Emergency Planning Committee (LEPC). Many of the web sites given in the last section (Step 1b: Hazard Identification) contain information that is detailed enough to use for Risk and Vulnerability Assessments in your community.

A valuable part of the Risk Assessment is the hypothetical consideration of "worst-case scenarios" in your assessments, by imagining what would happen if the worst possible catastrophe from each potential hazard actually occurred within your community. This type of analysis will suggest areas of overlap where one hazard causes another (such as severe winds causing infrastructure failures) and an assessment of the limits of your community's response capabilities (for example, a large transportation accident may temporarily overwhelm the Emergency Medical Service's capabilities in some areas).

This section of the workbook provides a general overview of the principles of risk assessment. Specific techniques (that can be used to assess each of the identified Michigan hazards) will be presented in Appendix B ("Detailed Techniques For A Hazard Analysis").

Different Degrees of Risk Assessment

The Risk and Vulnerability Assessment steps of a good hazard analysis involve estimating the *probability* of harm and also estimate the *severity* of harm in your community. This sort of analysis really started with the first steps of the Hazard Identification process, with the question "Is it possible for any of these hazards to affect our community?" Each hazard listed in this workbook (and its companion document, the "Michigan Hazard Analysis") should be considered. In your local hazard mitigation plan, each of the hazards listed in these documents must be addressed in some way. The extent to which they are addressed will depend on the extent that each can affect your community. Here is a list and description of the types of assessments that will be used:

1. Cursory Assessment

This will be used for hazards that are not considered possible or significant in your community. For example, if your community is located hundreds of miles from the nearest nuclear power plant, and you have determined that it is not likely to be affected by any incident from the nearest plants, a cursory analysis will be appropriate for addressing that hazard in your plan. A cursory analysis is merely a short statement explaining to your community **why** a particular hazard is not considered a threat. Careful thought should be given before *any* hazard is dismissed from analysis, because, however unlikely it might seem at first, if "the unthinkable" were actually to happen, people may be up in arms at the claim that it wasn't worth considering. The best kind of cursory analysis will give a reasonable assessment about why a potential hazard was considered a much lower priority than other hazards, at the time of writing.

FOR EXAMPLE: "The earthquake threat has been evaluated in our county and found to be of very low priority. Our county has no known fault areas within it, and no historical record of an earthquake event could be found. The effects from a major event in the New Madrid area were determined to be equivalent to Modified Mercalli Intensity Scale measurements in the range of I or II. Thus, in the worst of known scenarios, although it may be possible for some persons to feel minor seismic activity if they are located in the upper floors of buildings or in other sensitive locations, no damages to area structures are anticipated. The capacity of the county's infrastructure systems to withstand such minor trembling has been determined to be satisfactory. Because of the lack of vulnerabilities to this hazard, and the presence of other hazards that currently threaten our county, it was decided that no earthquake mitigation activities need to be undertaken."

A cursory analysis may sometimes be used for certain kinds of significant hazards in cases when there is very little available information about them, and a lack of time, expertise, or acceptable methods by which plan writers and analysts are able to evaluate them. The cursory analysis, in these cases, will summarize what is known, and should also explain why current knowledge is so limited. Statements about what might be done to improve knowledge of the hazard may be very helpful if they are included as an action step in the mitigation plan. For example, a county may know that there are subsidence dangers from old mines in an area, but because the exact locations of abandoned mines may currently be unknown, the county may not be able to evaluate the hazard beyond merely describing the possible effects of subsidence in populated or critical areas. An action step that can be included in the final plan would be to arrange for an information-gathering process to begin. With new information, a future update of their hazard mitigation plan can more adequately address the mine subsidence hazard. With the county's expanded ability to identify mine locations and likely collapse areas, it will be seen that real progress had been made possible by the first plan even though very little solid information had been known at the time! (In other words, part of the county's vulnerability was found to come from its lack of information. The action strategy of gaining information thus reduces the county's vulnerability in the long run!)

2. Standard Analysis

A standard analysis is appropriate for most hazards that could have a significant impact in your community but have not been determined to be highest priority. The amount of risk and vulnerability that merits being given highest priority will, of course, vary from community to community. The standard hazard analysis is one in which readily available data have been tracked down, evaluated, and explained using text and maps, as appropriate, but for which no specialized evaluation techniques were used. A standard analysis has only a limited amount of quantitative aspects to it and can be researched and summarized by a creative layperson without requiring any knowledge of probability theory, GIS, or quantitative research methods. Once the appropriate information has been collected and perused, the potential effects of many hazards can be summarized with just a few hours of thinking and typing, and the accuracy of such a summary should then be reviewed by local authorities and knowledgeable persons. Some hazards, such as flooding, generally require a bit more research and work to accurately explain and address. In such cases, the typed summary will need to be accompanied by information on: observed and potential flood elevations, maps showing the location of flooding, the number and types of structures that are at risk, estimates of flood depths during events of different severities, repercussions on the area's services, economy, quality of life, and so on. The "standard analysis" for some hazards may require several people or a small team to spend a considerable amount of time collecting and thinking about available information, and extrapolating a bit from this information so as to assess what risks the community may someday face as a community grows, weather patterns change, upstream drainage increases, and so on. Appendix B should be referred to, to see what sorts of analytic techniques might be usable in your hazard analysis for each hazard you have identified to be significant (or to help determine which hazards *are* significant).

3. Advanced Analysis

An advanced analysis is more complex than a standard analysis because it includes the application of theoretical or expert knowledge that requires significant time, expense, and training to be applied. Since grant funds have become available to help many communities develop their hazard mitigation plans, it is likely that high-priority hazards can be systematically analyzed by a wide range of specialists. In some cases, the results of engineering studies can be productively included in the hazard analysis. Demographic and economic calculations can be used to estimate future land development patterns. Geologists may estimate flood-prone areas using information on topography, soil classifications, and climatological data. Computer scientists or mathematicians may become involved in measuring and comparing a community's risks from different hazards, so as to indicate which vulnerabilities should be given highest priority. These sorts of research and analysis cannot be required for all hazards, not only because of the expense and time they may involve, but because the best methods for analyzing some types of hazards are still being explored. Please see Appendix B in this workbook for more details about techniques that might be used to more thoroughly examine specific hazards.

Risk Assessment Summary Table

Regardless of the extent to which each specific hazard is analyzed, it is important to establish hazard mitigation priorities by having some way to estimate or measure your community's risks. It will usually be necessary to include a summary of these risks in your hazard analysis, giving an overview of the most pertinent information

in a format that will help readers make comparisons between hazards. Below is an example that uses a table format. The first column names the hazard, and the other columns give summary information from the hazard analysis. Your summary table may vary depending on the amount of detail that went into your analysis. The column labeled "Significance of Impact" will be explained later in the next section on Vulnerability Assessment.

Risk Assessment Summary Table: (name of community) (year)

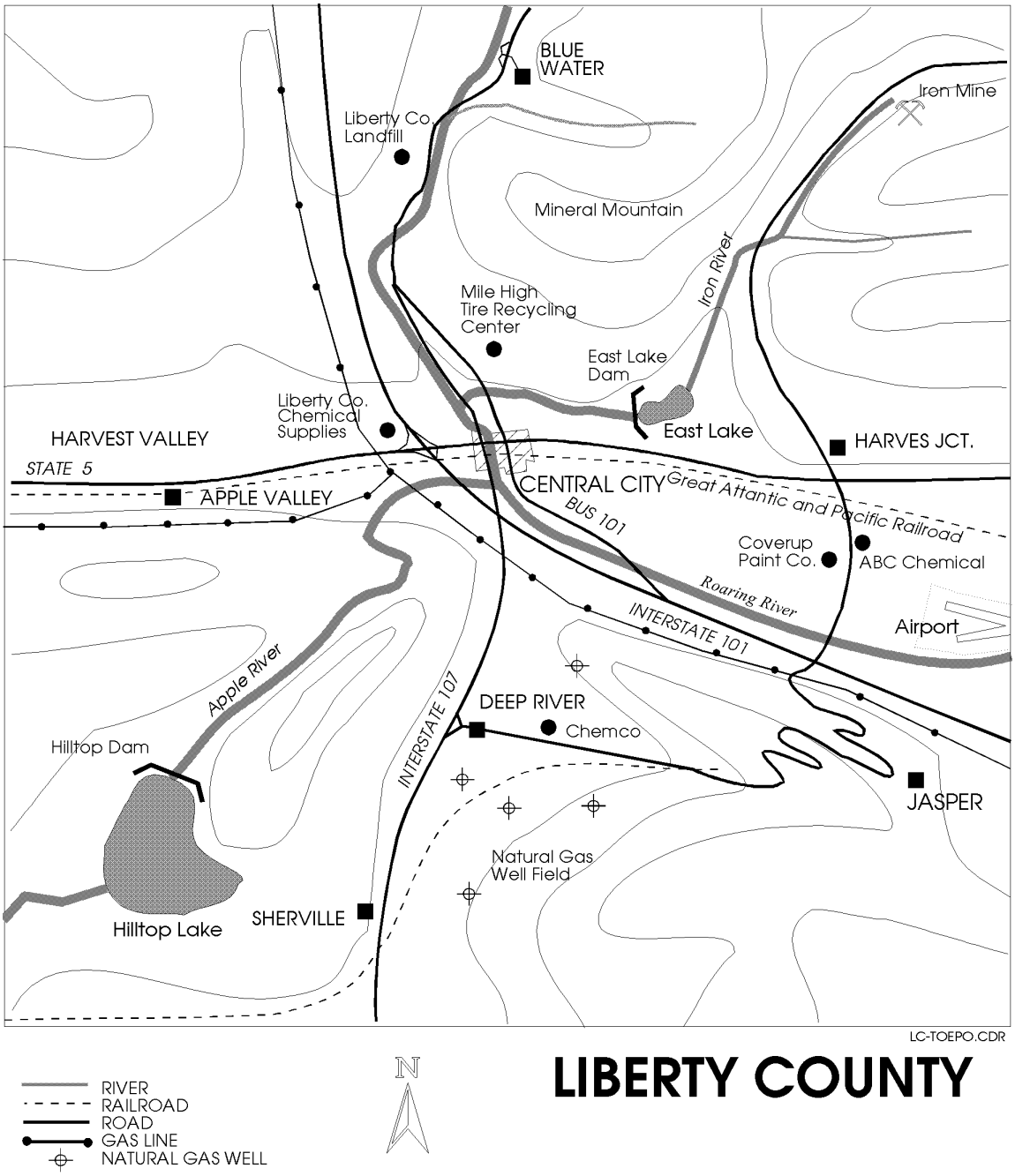
HAZARD	How Frequently has the Hazard Occurred in the Past?	How Likely is the Hazard to Occur in the Future?	Potential Geographic Size of the Affected Area	Population Impact Potential Population Impacted	Significance of Impact (Population, Economic, Environment, etc.)	Ranking (Priority of Mitigation Activities for this Hazard)
Civil Disturbances **FOR EXAMPLE:**	**Once every 5 years**	**About every 5 years**	**Several small sites**	**Up to 3,000 persons**	**Assessed hazard rating: 2.2**	**15th**
Drought **FOR EXAMPLE:**	**About every 20 years**	**About every 20 years**	**Entire county**	**4,000 in agricultural sector, 30,000 urban water supply customers**	**Assessed hazard rating: 2.4**	**14th**
Earthquakes **FOR EXAMPLE:**	**Only one known quake with damage—it was in the 1940s**	**New Madrid fault line event expected anytime**	**Weaker structures & infrastructure throughout county**	**About 75 persons are in structures not up to code; minor breakage expected in 10% of households and offices**	**Assessed hazard rating: 1.9**	**17th**
Extreme Temperatures **FOR EXAMPLE:**	**Once every 4 years (average of 5 very hot and 13 very cold days per year)**	**Once every 4 years?**	**Entire county**	**Heat: 3,000 outdoor workers at risk and 2,000 in homes without cooling. Cold: 400 outdoor workers, 30 poor families per year have utilities stopped from unpaid bills.**	**Assessed hazard rating: 4.4**	**7th**
Fire Hazards: Structural Fires **FOR EXAMPLE:**	**Regularly: Averages 3 deaths and 35 events per year:$380,000 in annual damages.**	**Mitigation programs lowered average to 29 events per year since 1998.**	**All structures at some risk. High-risk areas located in the village of Portown and the city of Loki.**	**50 persons live in high-risk areas, 450 more use high-risk heating systems**	**Assessed hazard rating: 6.5**	**4th**
Fire Hazards: Wildfires **FOR EXAMPLE:**	**Average of 4 minor events per year, a major event every 4 years.**	**Mitigation efforts now starting to reduce risk slightly.**	**45% of land area is forested, 13% of land area has high-risk forest types.**	**1,400 persons estimated to live in wildland/ urban interface area.**	**Assessed hazard rating: 7.7**	**1st**
Flood Hazards: Dam Failures **FOR EXAMPLE**	**No reported failures.**	**Limited failure every 50 years?**	**Areas downstream from 2 dams on Poseidon River.**	**650 persons live or work in structures in the dams' hydraulic shadow.**	**Assessed hazard rating: 6.4**	**5th**

Etc.

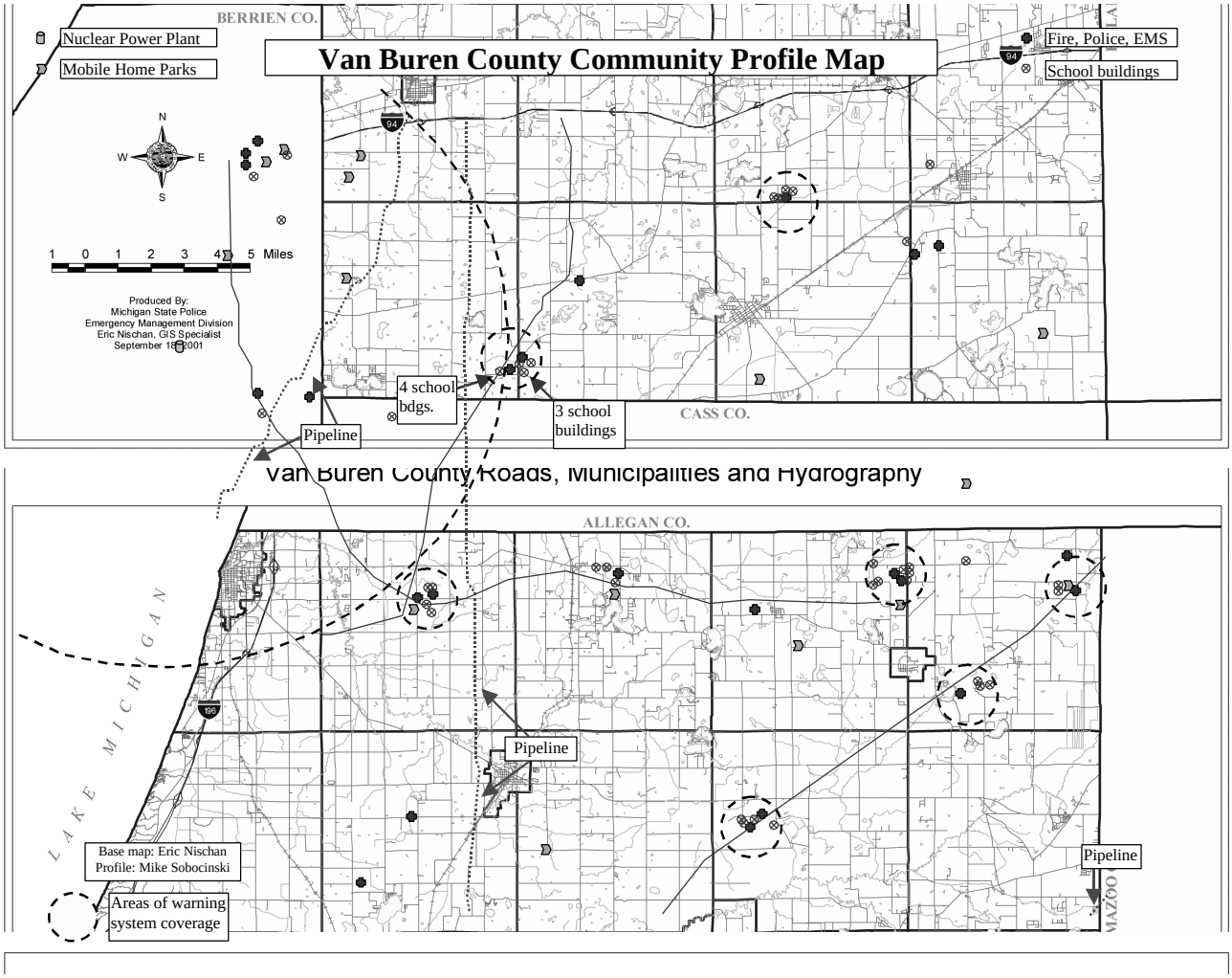
A hazards map is also essential for conveying accurate information to readers. The map shown below has a county-wide scale and, for illustration purposes, only includes a limited number of hazards and contains fictitious information. The page following shows an actual county-wide hazard identification map of Van Buren County.

Liberty County Hazards Map

(EXAMPLE)



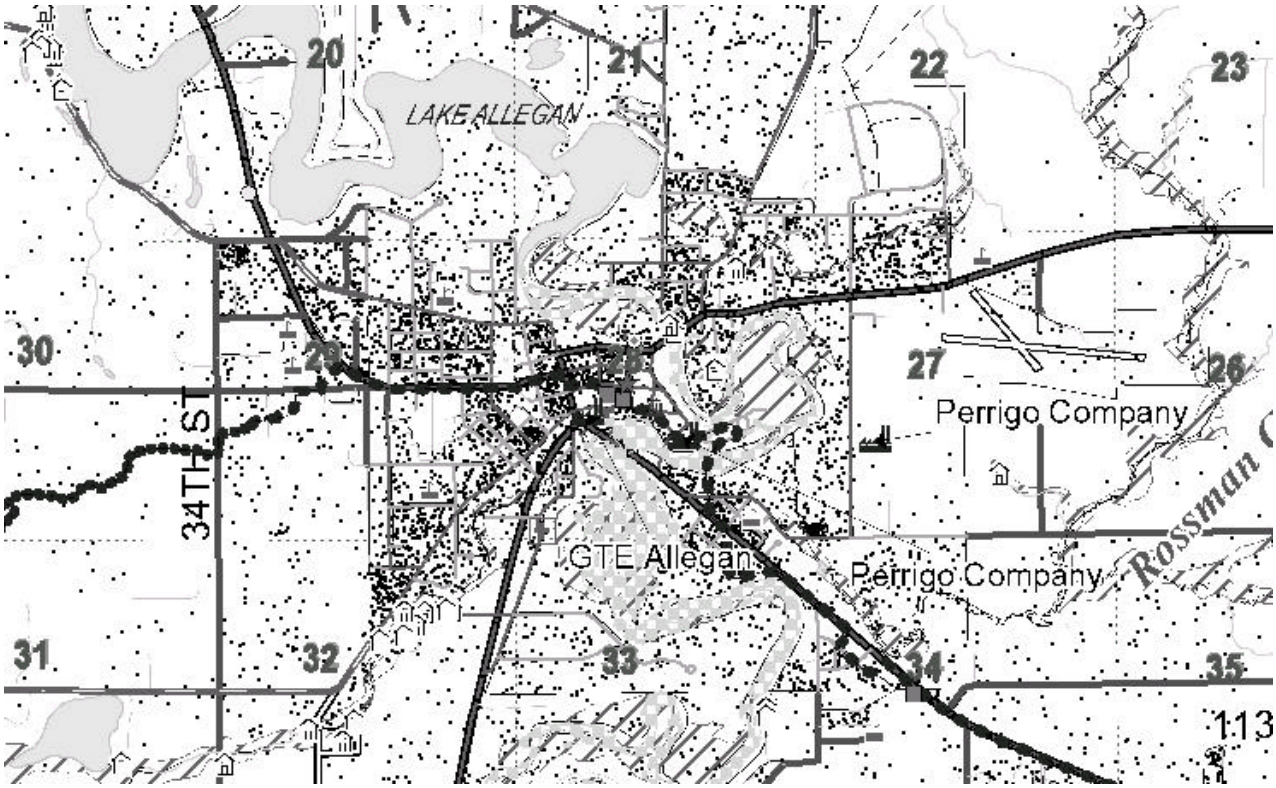
This map of Van Buren County combines community profile information with some possible hazards, on a county-wide scale. Naturally, this makes sense when some of a community's assets, such as a nuclear power plant or gas pipeline, might also contribute to a community's hazards in the case of a pipeline break or a serious radiological incident. This map was originally in color, to assist its users in identifying important community features, or how known hazards might affect important community assets. Also included are potential vulnerabilities, such as manufactured home parks that may be more vulnerable to severe wind events, or extensive rural areas that lack warning siren coverage.



A detailed hazard map will usually need to contain a lot of information, and typically will need to be presented at a smaller scale when identifying community vulnerabilities to hazards that are spatially distributed or concentrated. On a county level, broad weather patterns such as lake effect (heavy snowfall) precipitation areas can be clearly identified, but an analysis of floodplain areas or land use patterns will usually need to be done using a township or municipal-scale map. The next section (on Vulnerability Assessment) gives an example of a flood vulnerability map, on a scale that is small enough to identify individual houses, roads, and floodplain detail.

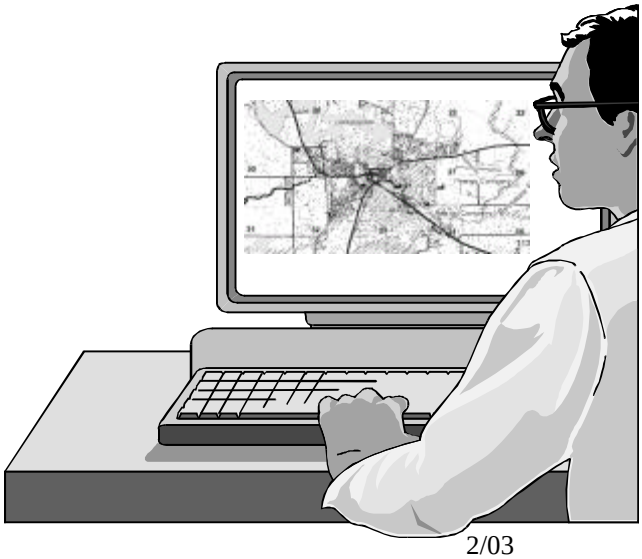
The last map in this section on Risk Assessment will illustrate some benefits that can be gained from using a Geographic Information System (GIS) to produce maps. A GIS is a computer database for geographic features that can include spatial analysis. For example, a floodplain area map can be "overlaid" on top of a parcel map, and the computer can then quickly count how many parcels are within the floodplain, and print out a list of their addresses. As another example, the computer can plot "buffer" zones (adjacent areas) around roads, pipelines, oil wells, and so on. Doing so will handily reveal all features within some specific distance of that community feature. A list of hazardous materials sites can therefore be illustrated on a map that shows all of their associated potential evacuation areas, and the community features that will be affected within those areas.

A GIS can be packed with useful hazard information. This portion of a map of the city of Allegan, for example, shows major streets, dots that represent population distribution (one dot equals one person), facilities that used hazardous materials, and so on. Based on elevation data, wetland locations, and other information, the computer plotted areas of flood hazards, and by comparing this with tax assessor's parcel data, was able to pinpoint properties that had more serious levels of flood risk. The original map was a color representation of the entire township and city, and included a detailed map legend—the black and white portion of the map reproduced below is meant to indicate the complexity of potential GIS applications. Final maps are easily adjusted, using GIS, to focus on key sections and features that will show individual hazard analysis themes with greater clarity. For more illustrations, see the example flood vulnerability maps that appear in the next section (on Vulnerability Assessment).



Risk Assessments for Multi-Jurisdictional Plans

If your plan is covering a region or county and thus includes a number of communities that have separate political structures (and land use authority) then you will need to assess whether the risks in some jurisdictions are significantly different than others. It may be helpful for you to review the section about "Sectoring" (see Step 1a, on Community Profiles). The basic principle is again that small communities may not have enough resources to create their own separate hazard mitigation plans, and thus can benefit from planning at the county or regional level. In addition, Michigan's principle of "home rule" organization means that effective participation, coordination and approval from multiple communities may only be possible if their distinct and independent natures are recognized within the plan. If you are creating a multi-jurisdictional plan, you should have already created separate community profile sections for the different communities covered by the plan. As your hazard analysis assesses risks and vulnerabilities and finds issues and concerns that are distinct from a county or regional-level analysis, it will be appropriate to include such information in the plan's subsections pertaining to each affected community.



Instead of simply containing community profile information, these "community subsections" will now expand to include risk assessment and vulnerability information for each community, where such information differs from the broader county or region. As plan development proceeds, more material, such as specific projects and action items, can be added to each community subsection as it is found appropriate and politically acceptable to do so.

Using Community Profile Information to Enhance Your Risk Assessment

The Community Profile section (see Step 1a in this workbook) should already contain information about critical facilities and infrastructure. This information will continue to be used in your plan's risk and vulnerability assessments.

Critical facilities are defined by FEMA as “facilities in either the public or private sector that provide essential products and services to the general public, are otherwise necessary to preserve the welfare and quality of life in the community, or fulfill important public safety, emergency response, and/or disaster recovery functions.” Some of the key types of structures that need to be included in the section are airports, roadways, railroads, utilities, hospitals, schools, water/sewage treatment facilities, communications systems, hazardous materials sites, community shelters. Other critical structures, such as Emergency Operations Centers and important government offices, should also be included. The risk assessment would determine the likelihood of these structures or their services being seriously affected by different hazards. A vulnerability assessment would estimate the extent (and costs) of possible effects from known hazards on these facilities and infrastructure.

In addition to the key points of existing infrastructure and critical facilities in the community, information on land development trends should also be considered (especially areas of proposed development or proposed projects that have yet to be built). A proposed new airport runway, school, commercial area or housing subdivision should be included so as to coordinate hazard mitigation planning with comprehensive planning, capital improvements, and other growth or redevelopment activities in your community. Proposed projects could be labeled on maps in a way that is distinct from already existing structures, but can have hazard impacts assessed on them in a way that is similar to currently developed areas. The result could suggest that some areas are less suitable for development than had previously been realized.

As your analysis proceeds into a vulnerability assessment, please note that it must contain listings or maps depicting the vulnerable regions and the critical facilities and structures within those regions. For high-priority hazards, this part of the analysis must include a listing of important structures/facilities in the vulnerable areas, and an estimate of the number and type of structures are present in that area. For high-priority hazards, the more detail that is provided, the better. Enough information about the economic costs of damages and lost services should be included so that some estimate can be made about whether mitigation projects will be justifiable in that area. Remember that your plan would like to explain to FEMA why your community deserves to receive federal funds for hazard mitigation projects!.

FEMA has provided guidance about acceptable and unacceptable amounts of detail for hazard analyses that are being submitted to meet federal requirements under the Disaster Mitigation Act of 2000. Based on that guidance, fictitious examples of an incomplete and an acceptable way to identify vulnerable structures appear below:

INCOMPLETE: Since flooding is a major hazard in Example County, there are several vulnerable facilities at risk in low-lying areas if a severe flood occurs. Two nursing homes, the County Jail, an abandoned paper mill, and two new housing subdivisions are located in some of the low lying areas. A proposed campground may also be affected.

ACCEPTABLE: A 100-year flood in Example County on the Roaring River would inundate the structures identified on the accompanying map (Map X: Areas Vulnerable to a 100-Year Flood). The North County Nursing Home and South County Nursing Home, Example County Jail, and General Paper Mill site would all experience flooding, as labeled on Map X. In addition, such a flood would affect approximately 57 single-family homes in Riverbend Township, and would cover the 95-acre parcel on the site of the proposed County Campground, also shown on Map F. Average flood depths at these sites are estimated at 2 feet, with damages estimated in the accompanying table (Table X: Estimated Flood Depths and Damages).

It is important to include special populations (such as nursing homes in the previous example) in your examination of vulnerable locations in the community. Special populations (like nursing homes, retirement apartments, non-English speaking neighborhoods, elementary schools) that need extra attention for evacuation

purposes in perilous situations have to be addressed. Including special populations in the vulnerability assessment will help your community be aware of special needs and concerns that a hazard may cause.

Assessing Trends While Proceeding on to the Vulnerability Assessment...
It is common that one step of the hazard analysis process will overlap with others. Information gained in the risk and vulnerability assessments may cause you to go back and insert additional information into your community profiles. New information may make you realize that some hazards may be more significant than was first realized, and thus more effort will then be placed on analyzing the risks from, and vulnerabilities to, those newly recognized hazards.

One of the items listed for inclusion in the Community Profile section (see Step 1a) is information on land use and development trends. The word trends must be emphasized because it means that it is not enough just to assess your community's current conditions, but to look at its past and anticipated future. Trends observed in the recent past can be very helpful to anticipate what the near future will be like. Much information suggested for your plan's the Community Profile (such as economic, population, and environmental information) can be very helpful in forecasting what your community will look like in the future.

Existing techniques for economic, demographic, and land use analysis will be very valuable in this activity. Population projections are a useful starting point. The basic components of them are to look at how many people are born, how many die, and how many move into or out of your community within a given period of time. Basic population projections look at the age and sex structures of your community, and predict from these how many persons will be born and how many will die, and thus how the population will change over time. More sophisticated models will include economic and ethnic data in cases where these are found to be helpful in predicting birth and death rates. A more difficult thing to assess is how many people will move to or from your community, since this will be affected by economic conditions and various other factors that may attract or drive away residents in your community. Many things might affect how many persons move into or out of your community, including trends in nearby communities, an overall region or state, or even national or international migrations.

You will also want to recall the things that limit or temporarily encourage growth. For example, if your city's population has grown over the last couple of decades, was this growth caused by the annexation of new territories? If so, then it might not be able to continue if it finds that it is now surrounded by areas that are able to resist further annexations. Is your community affected by suburban and exurban "sprawl" patterns? (The term "Exurban" refers to rural or outlying small-town areas that are distant from established job centers and thus have large numbers of residents who regularly commute to metropolitan areas that may be a considerable distance away.) Most suburban communities (very close to large cities and thus part of its urbanized area) have experienced rapid growth that lasts a few decades until their densities approach a certain level and then causes growth to jump over them to new suburbs a bit more distant from the central city. Care should be taken that population forecasts are realistic in these ways.

A description of land use and development trends is needed to help your community address hazard mitigation priorities in its future land use decisions. Your plan should include an overview of the current land use situation in relation to hazardous areas, and point out any projected land use changes in hazard-prone areas. Zoning will indicate where development is allowed to occur, and a buildout analysis can indicate whether permitted development levels are truly appropriate for the community's long-term welfare. Any exceptions or changes to current zoning (and planning that affects land use) should include a serious consideration of the potential impacts of identified hazards. The community's current and future land use maps should be included in the hazard mitigation plan. If such maps are unavailable, the plan must have a description of the land use of different areas of the community, and the meaning of land use trends should then follow from this information. Maps of projected land use in five-year time spans would be ideal for matching up with the scope of the hazard mitigation plan. Include a brief explanation along with the maps to highlight key areas of concern. Descriptions of likely land use changes and how they relate to hazard vulnerability and mitigation concerns may be substituted for maps, if maps are unavailable. An example of the type of information needed for the federal requirement to assess development trends could be to assess how future commercial development in a presently agricultural area will increase runoff to local creeks and streams.