A GUIDE TO DEVELOPING A TORNADO EMERGENCY PLAN FOR SCHOOLS

Also includes information for

Instruction of Tornado Safety

The Michigan Committee for

Severe Weather Awareness

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I. INTRODUCTION

A. Purpose of guide

The purpose of this guide is to help school administrators and teachers design a tornado emergency plan for their school. While not every possible situation is covered by the guide, it will provide enough information to serve as a starting point and a general outline of actions to take. **Remember, safety is always the foremost concern. The ultimate goal is to "quickly inform teachers and students anywhere on the school grounds to the threat of a tornado and to move them as quickly as possible to a pre-designated shelter."** *Tornadoes occur with rapid onset and, perhaps, no warning. Decisions must be made fast and actions taken immediately. One cannot wait for the storms to strike to plan what must be done to save lives. Prepare now and develop an emergency action plan for your school.*

B. Who will develop your plan?

Before you begin, it is recommended that one person be designated as the "Severe Weather Coordinator". Such a person may be a teacher or administrator with an interest in weather who is willing to attend local NWS spotter training programs (no fees). The coordinator would also be responsible for developing the plan and working with the local school board, administrators and teachers to implement the plan. For any plan to work efficiently, it must be practiced. ***State law now requires that all public schools conduct a minimum of two tornado safety drills per school year. Tornado safety instruction should be a part of these drills.*** It is important to understand why certain actions are being taken, to know the weather terms that are being used, and to know what visual clues can signal you to potential dangers ahead.

II. UNDERSTANDING THE DANGER: WHY AN EMERGENCY PLAN IS NEEDED

A. Tornadoes

It is 1:30 pm and the school principal has just learned that the National Weather Service has issued a Severe Thunderstorm Watch. Thunderstorms are building to the west and are expected to hit the school district in less than an hour. He decides to cancel all outdoor activities, make sure shelter areas are unlocked, and make an announcement to inform the teachers and staff.

At 2:05 pm, it begins to get very dark outside and there is a rumble of thunder. The designated spotter steps out to have a look. The sky appears as if its boiling and has taken on a green tinge. The wind picks up and the trees begin to sway. A cool blast hits him and a cloud of dust blows across the

parking lot. "This storm doesn't look good." He reenters the building and hears the NOAA Weather Radio tone-alert, and is told the National Weather Service has just issued a Severe Thunderstorm Warning for their county. Suddenly, he hears a roar of wind and a crash. The storm has let loose a downburst - a sudden, strong rush of wind.

He rushes toward the source of the noise. A branch from a nearby tree shattered a window in a classroom. A few children were injured from the flying glass. Two will need stitches. He evacuates the classrooms on the windward side and moves the children into the interior music room which has no windows. They will be safer in there.

Hail begins to fall and grow larger in size. The physical education instructor is barely heard above the roar of the hail striking the gymnasium roof and skylights. She moves the students into the locker rooms where it is safer. Large hail can impact at 100 mph. Suddenly, the skylights shatter.

The principal decides to play it safe and move all students into the interior hallways. The lights flicker and the power goes out. He can't announce it on the PA system so he grabs a bull horn and begins rapidly moving through the school. The students and teachers empty out of the classrooms, a little confused. Some are excited by the commotion and some are scared by the storm. The hallways are noisy with anxious voices, but quiet down when a roar, similar to the sound of a train drowns them out. Teachers yell "Get down! Drop to your knees and cover your head!" Glass is heard breaking.

It is all over in just a couple of minutes. Only ten minutes had passed since the thunder began. A tornado had struck the school. The classrooms on the south side of the school were destroyed. The cafeteria and gymnasium roofs were gone. Children and teachers were shaken, but injuries were relatively minor. No one was killed.

About 18 tornadoes touch down in Michigan every year. Many more storms produce downbursts and hail. Because the principal in this scenario took the proper actions, lives were saved.

B. Conclusions

Tornadoes occur with rapid onset and, perhaps, no warning. Decisions must be made fast and actions taken immediately. One cannot wait for the storms to strike to plan what must be done to save lives. *Prepare now and develop an emergency action plan for your school*.

III. DESIGNING YOUR PLAN

A. How to receive Emergency Weather Information:

Because tornadoes can occur with little, if any, warning, minutes and even seconds can mean saving lives! In just five minutes, a tornado may travel two to four miles on the ground. From the time the National Weather Service (NWS) issues a warning, to the time you receive that warning via radio or television, critical minutes may have elapsed. You must be listening when the initial warning is announced or an even greater amount of time will pass!

The fastest, most accurate and reliable means of receiving critical weather information at your school is through a NOAA Weather Radio with battery backup and a "tone alert" feature. NOAA Weather Radio (NWR) is operated directly from NWS Offices and is part of our country's National Warning System. NOAA Weather Radio is also an integral part of the new Emergency Alert System, of which all television and radio stations are a part of. When the NWS issues a tornado warning, the "tone alert" (1050 Hertz) is instantly sounded followed by warning information.

The NWR "tone alert" is activated when weather warnings as well as severe thunderstorm, flash flood, hurricane, and tornado watches are issued (See appendix A for Watch/Warning definitions). NWR broadcasts 24 hours a day, seven days a week with current weather and forecast information, and also provides special updates about sudden weather changes and potentially hazardous weather. For more information on NWR see appendix D.

If your school is not in a reliable NWR listening area, then below are some suggested alternatives -

1. If you have cable television access, the Weather Channel uses NWS products and broadcasts warnings immediately upon receipt from NWS via a satellite link. Some cable companies include a channel with a local NWS radar display and use NWR as a voice-over.
2. Monitor your local news station.

Phone call-down systems used in some school districts are not advised for receipt of warning information due to 1) substantial delays in receipt of emergency information, 2) chance of incorrect or incomplete information being passed, 3) lack of reliability of phone systems during storms, and 4) the NWS advises people not to use telephones during an electrical storm.

Your source(s) for emergency weather information should be located in the main office or near the person(s) responsible for enacting the plan. Main offices are good because generally there are people around who could hear the alert, and it is close to the public address (PA) system. If using a NWR,

the radio should be set at all times in "Alert" mode. Some radios will automatically turn on when an alert sounds while others must be manually turned on. It is probably better to have the type that automatically turns on in case you are out of the room when the tone is activated. If using NWR, the information cycles every few minutes, so if you don't get all the information you need the first time through, it will repeat shortly.

Listen for three things: 1) the type of watch or warning, 2) where it is in effect, and 3) how long it is in effect for. The person(s) monitoring must know what action they should take based on this information. It is suggested you have a map nearby for easy reference to counties and towns to locate storms and their movement in reference to your school. There is no need to take emergency action if the warning is not for your location. However, keep in mind, that even if the warning is not for the school's immediate location, weather may change rapidly, and activation of the school's designated, trained spotters is advised. Any watch or warning issued in an adjacent county should heighten your awareness to the potential for severe weather to affect your school district, especially if the warning is for a county northwest of you and the storms are moving southeast!

B. How will the School Administration Alert Teachers and Students to Take Action?

Most schools utilize a public address (PA) system to talk directly to students and teachers. In some cases, electricity may be lost during a storm before you have activated your plan. Therefore, it is critical to have a back-up alerting device such as a compressed air horn or megaphone.

If your school has mobile classrooms or detached gymnasiums that are not part of a PA or intercom system, then special arrangements should be made to notify these areas and to direct the occupants to evacuate to a main building *before* the storm arrives. Sending "runners" outside to mobile classrooms is not advisable due to the danger posed by lightning and the approaching storm. Wireless communication devices are an effective means for such communication. "Walkie-talkies" may be the least expensive. The plan must also address before and after school activities, and have clear instructions for guests that may not be familiar with the building.

Handicapped or learning-disabled students may also require special attention. You may want a teacher to be assigned to each student requiring special attention to see that the student moves to the appropriate place of safety. Your emergency action plan should also provide for hearing impaired students, who may not hear warnings or special announcements.

To ensure appropriate action and understanding of your "Call to Action," you must rehearse (See part H of this section on drills and the need for tornado instruction).

C. Tornado and High Wind Safety Zones in Your School:

This may be the most time consuming and complex phase of designing your plan. Schools are sufficiently complex and diverse in design that it is impossible to describe an exact plan here that will apply to every school. Due to this complexity, it is recommended that this phase of the plan be accomplished with the help of an engineer or architect familiar with the school's design. We recommend that you also contact your local emergency manager. Here are a few general guidelines and basic concepts that can be discussed.

The greatest dangers from high winds (tornado, thunderstorm downburst, etc.) are -

1. roof failure
2. breaking glass, and
3. flying debris (airborne missiles).

The most dangerous locations are generally large rooms with big expansive roofs such as cafeterias, gymnasiums, and auditoriums. The collapse of the room's load-bearing wall may lead to the failure of the entire roof. *Rooms with large windows that may shatter from being struck by airborne missiles or from severe winds are also extremely dangerous.* While windows on the side of the school facing the storm are most susceptible, as the storm passes, any windows could potentially shatter. This is one of the reasons that IT IS NO LONGER ADVISED THAT YOU OPEN ANY WINDOWS! Greater damage may occur from this action, and valuable time that should be used getting to safety is often lost.

Small interior rooms, bathrooms, and windowless, interior hallways that are away from exterior doors offer the best protection. Interior load-bearing walls (with short roof spans) provide better protection than temporary or non-load-bearing walls and structures. If your school has more than one story, evacuate the upper level of your school. The lowest level is always the safest.

Schools designed for the "open classroom" concept used in the early 1970s have a difficult task of finding safe areas due to a lack of interior load-bearing walls, large spanning roofs and the use of a lot of glass. You may not be able to find enough "ideal" space to occupy your whole student body. It may be a matter of determining the lesser of evils. Below is a list beginning with THE MOST DANGEROUS AREAS:

1. Windows on exterior walls
2. Rooms with large roof spans; mobile classrooms
3. Exterior walls of upper level;

4. Interior walls of upper level; exterior walls of lower level and interior glass.

5. Interior, lower level, non-load-bearing walls.

Fortunately, the majority of tornadoes will not destroy well constructed buildings, and damage in about 70% of cases should not go beyond damage to mobile classrooms, rooms with large roofspans, and windows on exterior walls. Using these considerations, you may want to rank areas according to safety. Then begin by filling the safest areas first with students and continue until you have found space for the entire student body.

Again, it is best to have an engineer or architect advise your school on the safest areas since schools are built with varied designs and purposes. The priorities listed above are based on broad generalities.

D. When to Activate Your Plan and When it is Safe to Return to Normal Activities:

Your severe weather safety plan may work best with phases of activation. In a tornado watch, outdoor activities should be postponed. Should storms approach, you may want to move students from the most susceptible areas such as mobile classrooms and gymnasiums as a precaution even though a warning has yet to be issued. You may want to post teachers or school personnel trained in spotting severe weather to watch the storms as they approach for the need to take special actions (see section IV on basic tornado spotting techniques). Your plan should also include secondary forms of communication which would be used should power be lost. Your plan should also address the time of day. You may find it more difficult to implement your safety plan during recesses, class changes, or near the beginning or end of the school day.

If a tornado warning is issued for your county an immediate and complete "Call to Action" is needed. If the storm has not yet reached your school, begin moving students from unsafe areas as listed above and post a trained teacher or school employee to keep an eye on the storms as they approach. (From your drills you should know approximately how long it will take to move students into "tornado safe areas.") As the storm nears, move all students to tornado safe areas (interior halls, etc.) and have students and teachers drop immediately into the protective position (see diagram 1). Remember that winds may pick-up at the onset of the storm and may or may not drop off prior to the tornado, and that rain may or may not be occurring. Large hail is a signal that you are near the part of the storm in which the tornado would occur. Once the storm has past, students may return to classrooms. If your school is hit, a pre-designated safety team should assess damage and injuries....and then notify appropriate law enforcement and medical personnel. Stay alert for the potential for additional storms. One special

consideration would be the complication of activating a full "Call to Action" plan during class changes, when the halls are crowded and students may not know where to go. It may be best to hold classes beyond your regular dismissal time until the severe weather threat has passed. Likewise, at the end of the school day, students may need to be held from boarding buses until the danger has passed.

Remember also, that straight-line winds from severe thunderstorms can approach 110mph and can cause as much damage as a moderate tornado. If a severe thunderstorm warning is issued for your county, at a minimum, move students out of mobile classrooms and away from windows.

You should have at least several people who know how to shut off the main power (electricity) and gas (if applicable). After a tornado or severe thunderstorm, it may be necessary to shut off the gas and electric supply to the building if damage has occurred to the school.

E. <u>When to Hold Departure of School Buses</u>:

You will want to consider holding the departure of students to buses whenever watches or warnings are in effect. There are three primary considerations:

1. Upon departure, how long before ALL the students have been deposited safely at home? Include time for the students to walk from their bus stop to their home.
2. How much time do you have before the storms are expected to impact your district? Tornado watches are sometimes issued a couple hours in advance of thunderstorm development. Watches are generally issued for large areas, so even once storms have developed, it may be a couple hours before the storms reach you. *On the other hand, it may be a rapidly developing situation with less than an hour before the storms arrive. If you feel that severe weather is not imminent, buses may depart....but notify the drivers about the severe weather threat.*
3. If a *warning* is in effect for your county at dismissal time, delay departure of the buses. Escort students that have been already loaded onto the buses back into the school.

If condition 2 is less than condition 1, then a delayed departure is recommended. Buses provide no protection from severe storms.

If a *watch* is in effect at dismissal time, your decision become a bit more difficult. Watches are normally issued hours before severe weather is expected to hit but, on some occasions, it may be for

rapidly developing situations with less that an hour before the storms arrive. Your decision will be based upon a judgement call...if you feel the severe weather is not imminent, then buses may depart...but drivers should be notified about the weather situation and instructed to be especially alert to the potential for dangerous weather. If you have any indication that the storm will arrive before students arrive safely at home, then bus departure should be delayed. *It is best to err on the side of caution, because school buses provide no protection from severe storms.*

Another consideration may be if a large number of children from your district live in mobile homes. Mobile homes are extremely susceptible to high winds even when properly anchored and tied down, and a storm that would produce minor damage to a school could completely destroy a mobile home. The school provides a much safer environment than a mobile home, and this should be taken into account when deciding whether to send students home, or them at school.

Finally, it must be conveyed to parents that they should *not* pick up their children at school during severe weather. They need to understand that the child is far safer at the school with the severe weather plan in place than on the road when a severe storm strikes. The next section will discuss what bus drivers should do if faced with a tornado approaching.

F. School Bus Actions:

All school bus drivers should be trained on how to handle severe weather situations. Although tornadoes are the primary concern here, large hail, high winds and flooding also pose significant threats. Bus drivers should be able to react quickly and take charge of a severe weather situation.

NEVER ATTEMPT TO OUTRUN A TORNADO! If a bus driver has reason to believe a tornado is approaching, the following steps should be taken.

1. If you have the time to get to a designated tornado shelter or well-constructed building that you can unload students into, then certainly do so as fast as possible. In a building, move them into the interior or basement of the building away from windows and doors.

2. If no sturdy shelter is available, look for a ditch or low-lying area (preferably without water). Make sure the bus is parked well away (preferably downwind) from the location you have selected. Unload the students to the low-lying area and have them get in position with their hands over their head (See diagram 1).

G. Safety During Athletic Events

Protecting athletes and spectators once severe storms or tornadoes begin moving into an area is essentially impossible because there is so little time to act and because safe shelter is much more difficult to find for tornadoes than for other types of severe weather. Suggesting that everyone go home when there is an imminent tornado is not acceptable, because automobiles are not safe shelters under these conditions.

The single most effective tornado precaution an athletic program can take is to obtain accurate, current weather information and shut down athletic events when violent weather threatens.

For tornado safety, athletic programs should:

1. Designate a chain of command for making the decision to remove individuals from an athletic site.

2. Designate an individual who will obtain a weather forecast each day before a practice or event and monitor weather forecasts constantly when there is any threat of severe storms or tornadoes.

3. Athletes and coaching staff should know where the closest "safe shelter" is. Safe shelter for tornadoes is defined as the basement of a sturdy building, away from windows, glass doors and chimneys. If a basement is not available, an interior hallway on the lowest floor is best. Rooms with large, free-span roofs like gymnasiums should be avoided. The inside of an automobile is not a safe place if a tornado is imminent. If no safe building is nearby, individuals should seek shelter in a ditch, ravine, or other place below ground level and stay as low as possible.

4. Tornado watch or severe thunderstorm watch: If a watch is issued during a practice, practice can continue, as long as coaching staff and athletes know how to get to nearby safe shelter and Weather Radio is being continually monitored. *However, if a watch is issued 3 hours before a game or during a game, the competition should be canceled or suspended. This is the policy of the Michigan High School Athletic Association (MHSAA).*

5. Tornado warning or severe thunderstorm warning: If a warning is issued during either a practice or game, athletic activity should be suspended and all participants moved as rapidly as possible to safe shelter. Athletic activity should not be resumed until the National Weather Service suspends the warning.

Extreme weather conditions threaten the health of athletes, staff and spectators. Before any athletic season begins, policies should be defined for modifying or canceling practices and games under conditions of lightning, severe storms, tornado watch and warning, extreme heat and extreme cold. There are no national standards for such policies.

Each athletic program should work with medical advisors, athletic trainers and administrators to come up with a policy that is scientifically valid and acceptable in the community.

H. Need for Periodic Drills and Tornado Safety Instruction:

In order to have an effective severe weather emergency plan, you must have periodic severe weather drills and severe weather safety training. Drills not only teach students and instructors the actions they need to take, but will allow you to evaluate your plan's effectiveness. Did everyone hear the message, did they understand what to do, and were they able to get to the designated areas of safety in a reasonable amount of time? It is suggested that you conduct such drills in conjunction with a tornado education and awareness program so that students and teachers understand the dangers of tornadoes and better comprehend the actions that they are asked to take.

In Michigan, the NWS runs an annual statewide "Severe Weather Awareness Week" campaign starting with the last Sunday in March before the onset of the severe weather season. This campaign is coordinated through the state and local government emergency management agencies and the news media and includes a proclamation from the governor. This may be an opportune time for your school to conduct a drill and program. You can contact a member of the Michigan Committee for Severe Weather Awareness, or your local emergency manager if you would like a speaker to come to your school and discuss tornado safety. The committee also recommends that a drill be conducted as close to the beginning of the school year as possible. This will familiarize new students with your procedures and act as a refresher for returning students. While tornadoes are often advertised as a "springtime" event, it is not uncommon in Michigan to have outbreaks of tornadoes in September and October.

If you would like a pamphlet on conducting School Tornado Drills, contact a member of The Michigan Committee for Severe Weather Awareness, listed in Appendix F.

IV. Tornado Spotting

A. Some Basic Tornado Spotting Techniques

Your local National Weather Service Office provides tornado spotter training under a program called SKYWARN. It is provided free of charge with the request that when you do encounter severe weather, you report it to the National Weather Service. The spotter training class includes slides and video that help you learn how to pick out visual clues from clouds to help determine the severity of a storm. It is highly recommended that at the least one person from your school, preferably the "Severe Weather Coordinator" for your school emergency plan, take the training. Spotter and Safety training are normally conducted during the late winter and early spring, just prior to the severe weather season. Contact your local emergency manager to find out about training sessions in your area, or contact your servicing National Weather Service Office. Addresses and phone numbers for your servicing Weather Service Office are located Appendix D.

The following information is not a substitute for official training.

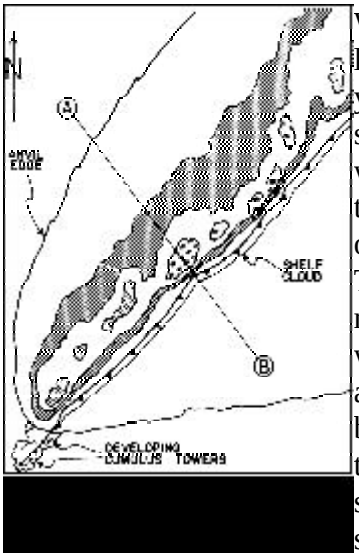
Color: A very dark (black) thunderstorm or one taking an eerie look (brownish, green, or yellow cloud colors) may be an indication of a severe thunderstorm. The colors and darkness of the cloud are caused by the storm's massive size and the blockage of sunlight. This storm may bring hail, very heavy rain, and damaging winds.

Sound: The sound of a freight train is the roar of wind as it moves through trees and buildings. It may indicate an approaching tornado or severe downburst. You should take protective action immediately.

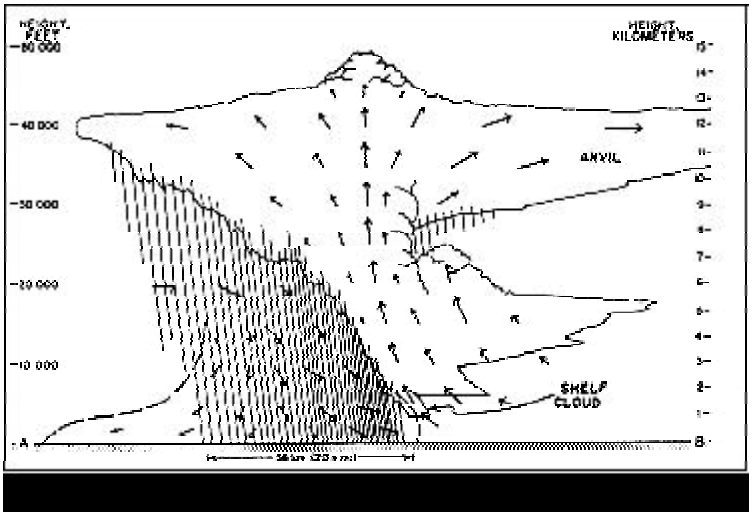
Funnel / Tornado: A funnel is a small rotating funnel-shaped cloud. It does not touch the ground. If the funnel-shaped cloud is touching the ground, it is a tornado. Only a very small percentage of funnels turn into tornadoes. It is possible for the rotating column of damaging winds from a tornado to be on the ground with the visible funnel only extending half-way to the ground. Look for debris, leaves and dust rising into the air and listen for the sound of a freight train. People often confuse low clouds, commonly called "scud", for tornadoes or funnel clouds. It is important to look for organized, counterclockwise rotation about a vertical axis.

Waterspouts: When a tornado moves over water, it is called a waterspout. Waterspouts can also occur in more benign situations and these usually are not severe but still may have winds over 50 mph. If a waterspout continues over land, it - by definition - becomes a tornado.

Squall lines: Sometimes thunderstorms form a solid line of storms called a "squall line". The squall line thunderstorm can also become severe and is unlike the supercell thunderstorm (see diagrams 2 and 3 showing map and side views of a typical severe thunderstorm). The supercell storm has its updraft on the right-rear quadrant of the storm. With a squall line, the warm air feeding the storm is all out ahead of it, so the updraft on the front (approaching) portion of the storm dominates.



When a squall line approaches, you may see a shelf cloud which denotes the leading edge of the storm. Tornadoes rarely occur with squall lines and they tend to be less severe than those with supercell storms. Still,



winds can reach in excess of 100 mph which is enough to damage roofs, break windows and drop trees. If a tornado were to occur with a squall line, it would be found in the updraft region of the storm behind the shelf cloud.

If you spot severe weather and are reporting it to your local National Weather Service office, remember the acronym "TEL", which stands for *T*ime, *E*ffects, and *L*ocation. Note the *time* you observed it, its *effects* (damage you witnessed), and its *location* and movement.

APPENDIX A : NATIONAL WEATHER SERVICE PRODUCTS (What to listen for)

1. *WARNINGS* - The hazard (tornado, flash flood, etc) is imminent. The probability of occurrence is extremely high. Warnings are issued based on eyewitness reports or clear signatures from remote sensing devices such as radar and satellite. Lead-time for thunderstorm type events is generally 30 minutes or less. Lead-time for hurricanes, river floods, and winter storms can be 6 to 18 hours.

2. *WATCHES* - Meteorologists have determined that conditions appear right for the development of the hazard. Probability of occurrence is greater than 60% in the watch area. Watches generally cover larger areas than warnings. In the case of thunderstorms, less than 30% of the watch area may experience the hazard. However, with larger storms such as hurricanes and winter storms, the entire watch area may be affected. Severe thunderstorm and tornado watches are usually issued 1 to 2 hours before the event begins. With flash floods, it can be 3 to 12 hours. For flood and winter storm watches, lead-times are usually 12 to 36 hours.

3. *ADVISORIES* - An advisory is issued for weather that is expected to be a disruption to the normal routine and an inconvenience, but it is not expected to be life-threatening. Advisories are issued for 3 to 6 inches of snow in the Lower Peninsula, 3 to 8 inches of snow in the Upper Peninsula, dense fog, minor street flooding, etc. The time frame is similar to that of a warning.

4. STATEMENTS **-** statements are issued to update current weather situations or highlight significant 4. changes to come. Statements are also used to explain why watches, advisories, or warnings have been issued. Three special types of statements are ...

a) "Outlooks" or "Potential " Statements - During the warm season, the NWS Forecast Office issues "Severe Weather Outlooks" each morning discussing where and if storms will develop and how intense they may be. Outlooks may also discuss possible heavy rain and flood events. The Storm Prediction Center issues special statements when there is the potential for a severe thunderstorm or tornado outbreak.

b) "NOWCASTs" or "Short Term Forecasts" - These statements discuss the short-range forecasts for the next 1 to 6 hours. During active weather, these statements are issued more frequently.

c) Public Information Statements - These statements provide information of special interest such as a summary of recent records set, weather safety information, special activities (weather related) that may be occurring, etc.

5. *FORECASTS* - general weather information provided daily.

a) 1 to 2 day forecasts are issued twice a day at 445 AM and 445 PM, and are updated as needed. Special weather events are highlighted with headlines at the top of the forecasts such as ... "Tornado watch number 111 in effect until 6 PM.""Flash flood watch is in effect until 8 AM EDT Wednesday."

b) "NOWCASTS" are issued to highlight expected conditions over the next few hours.

c) 3 to 5 day extended forecasts are issued twice a day (445 AM and 445 PM) as part of the state-wide forecast product.

d) National 6 to 10 day outlooks are issued at 5 PM Mon, Wed, and Fri.

e) National 30 day outlooks are issued around the 15th and 30th of each month.

f) National 90 day outlooks are issued around the 30th of each month.

Note: The forecast outlooks (from day 6 on) are not detailed forecasts but a statement of trends. They state whether conditions are expected to be colder or warmer than normal and drier or wetter than normal for that period of time.

APPENDIX B. GLOSSARY OF WEATHER TERMS

TORNADO AND ASSOCIATED SEVERE WEATHER TERMS:

Anvil - The spreading out (by strong winds) of the upper portion of the thunderstorm. It usually has a fibrous or smooth appearance. With long lasting thunderstorms, the anvil may spread 100 miles downwind

Downburst - A sudden rush of cool air toward ground that can impact with speeds over 70mph and produce damage similar to that of a tornado. It usually occurs near the leading edge of the storm or may occur in heavy rain.

Downdraft - A column of cool air that sinks toward the ground. It is most often accompanied by rain.

Funnel cloud - a funnel-shaped cloud extending from a towering cumulus or thunderstorm. It is associated with a rotating column of air that has condensed to form a cloud.

Gust front - the leading edge of the thunderstorm's downdraft of air as it spreads out away from the storm. It is usually felt as a change to gusty, cool winds and may precede the thunderstorm's rain by several minutes

Hail - Precipitation in the form of balls or clumps of ice.

Severe thunderstorm - A thunderstorm producing damaging winds or winds greater than 58 mph and/or hail three-quarter of an inch or greater.

Shelf cloud - a low-level, wedge-shaped cloud attached to the thunderstorm. It forms above the gust front as warm air ahead of the storm rides over the cool outflow from the thunderstorm.

Squall line - a solid line or band of active thunderstorms.

Thunderstorm (cumulonimbus) - the towering cumulus cloud has continued to grow in height and width and now lightning is occurring. The storm may extend 5 to 10 miles high into the atmosphere

and 5 to 25 miles across. Heavy rains and gusty winds often accompany the storms.

Tornado - a violently rotating column of air in contact with the ground and extending to the thunderstorm base often seen extending from near the wall cloud. It can be a few yards across to a mile wide.

Wall cloud - this cloud appears as an abrupt lowering of the cloud base from the relatively flat rain-free base. It is attached to a thunderstorm and may be rotating. This is the portion of the thunderstorm from which the tornado often descends.

Updraft - Warm, moist, rising air. As the air rises, it condenses into a visible cumulus or cumulonimbus cloud. The updraft fuels the storm. In an ordinary thunderstorm, air rises at 40 mph and in a severe thunderstorm speeds may reach over 100 mph.

APPENDIX C. GENERAL TORNADO SAFETY

The greatest danger is from flying debris (airborne missiles) and the collapse of a building's roof and/or wall structure. The following actions are designed for protection from these dangers. Take action if a tornado approaches or a tornado warning is issued.

In a building (home, school, etc.) move to the basement. If no basement, move to a small, interior room or hallway on the lowest level. Stay away from windows and exterior doors. If at all possible, get under something (such as a table) and place something over your head (such as a pillow, mattress, blanket, or coat) for added protection.

DO NOT STAY IN A MOBILE HOME OR ANY TYPE OF TEMPORARY SHELTER. If in a mobile home or temporary shelter, get out. Move away from the shelter so that the debris does not fall on you. Look for a low area, preferably a ditch or ravine if nearby. Take the protective position on your elbows and knees with your hands over your head.

DO NOT TRY TO OUTRUN A TORNADO IN A CAR, BUS OR TRUCK. If in a car, truck or bus, STOP. Get out. Move away from the vehicle so it does not topple on you. Find a low area, preferably a ditch or ravine if nearby. Take the protective position on your elbows and knees with your hands over your head.

If on foot with no well constructed shelter nearby, find a low area, preferably a ditch or ravine if nearby. Take the protective position on your elbows and knees with your hands over your head.

After the storm, if a tornado has struck your neighborhood, turn off gas at the main switch to your building. If live electrical wires are down, turn off power at the main switch. Instruct people not to touch loose electrical wires or broken utility lines. Do not touch electrical equipment in wet areas until it has been dried and tested. Food, clothing, shelter, and first aid will be available at Red Cross shelters.

Remember, straight-line winds from severe thunderstorms can also produce winds over 100mph, equal to the strength of a moderate tornado. At a minimum, when severe thunderstorm warnings are issued for your area, remain indoors and stay away from windows.

APPENDIX D. NATIONAL WEATHER SERVICE CONTACTS

NOAA WEATHER RADIO FREQUENCIES AND COVERAGE

For weather information, preparedness materials, and NOAA Weather Radio coverage (Figure 1), contact the National Weather Service Office that serves your area. This is the office with "warning responsibility" for your area (Figure 2). All offices are open 24 hours a day, 7 days a week. All phone numbers listed are answered Monday through Friday, 8 am to 4 pm. Other preparedness and Safety brochures can also be obtained through your local chapter of the American Red Cross.

MIC=Meteorologist in Charge; WCM=Warning Coordination Meteorologist

DETROIT/PONTIAC FORECAST OFFICE (DTX) (248) 625-3309 ext. 726
NOAA - National Weather Service Contact: Darin Figurskey, WCM
9200 White Lake Road Dean Gulezian, MIC
White Lake, Michigan 48386

NOAA Weather Radios -
Transmitter Location: Southfield, MI - Frequency 162.550 MHZ
Flint(Clio), MI - Frequency 162.475 MHZ

GRAND RAPIDS FORECAST OFFICE (GRR) (616) 949-0643 ext. 726
NOAA - National Weather Service Contact: Mike Heathfield, WCM
4899 South Complex Drive, S.E. Dan Houser, MIC
Grand Rapids, Michigan 49512-4034

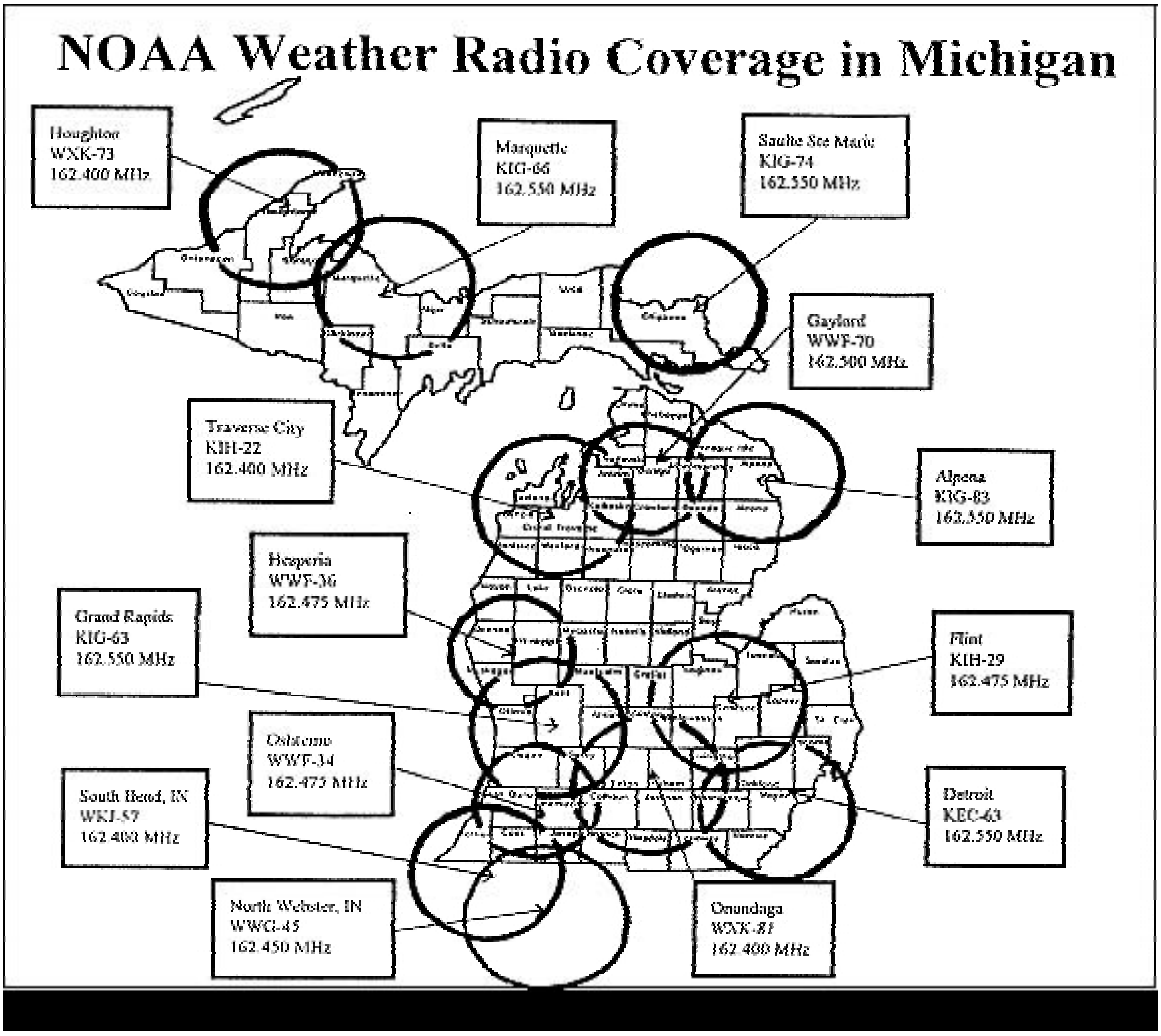
NOAA Weather Radios -
Transmitter Location: Hesperia, MI - Frequency 162.475 MHZ
Grand Rapids, MI - Frequency 162.550 MHZ
Onondaga, MI - Frequency 162.400 MHZ
Oshtemo(Kalamazoo), MI - Frequency 162.475 MHZ

GAYLORD FORECAST OFFICE (APX) (517) 731-1194 ext. 726
NOAA - National Weather Service Contact: Brain Hirsch, WCM
8800 Passemheim Hill Road Gary Campbell, MIC
Gaylord, Michigan 49735-9454

NOAA Weather Radios -
Transmitter Location: Alpena, MI - Frequency 162.550 MHZ
Traverse City, MI - Frequency 162.400 MHZ
Sault Ste. Marie, MI - Frequency 162.550 MHZ
Gaylord, MI - Frequency 162.500 MHZ

MARQUETTE FORECAST OFFICE (MQT) (906) 475-5782 ext. 726
NOAA - National Weather Service Contact: Jack Pellett, WCM
122 Airport Drive South John Machowski, MIC
Negaunee, Michigan 49866

NOAA Weather Radios -
Transmitter Location: Marquette, MI - Frequency 162.550 MHZ
Houghton, MI - Frequency 162.400 MHZ


NOAA Weather Radio Coverage in Michigan
Houghton
WXK-73
162.400 MHz
Marquette
KIG-66
162.550 MHz
Sault Ste Marie
KIG-74
162.550 MHz
Gaylord
WWF-70
162.500 MHz
Traverse City
KIH-22
162.400 MHz
Alpena
KIG-83
163.350 MHz
Hesperia
WWF-36
162.475 MHz
Grand Rapids
KIG-63
162.550 MHz
Flint
KIH-29
162.475 MHz
Ostcomo
WWF-34
162.475 MHz
South Bend, IN
WKJ-57
162.400 MHz
Detroit
KEC-63
162.550 MHz
North Webster, IN
WWG-45
162.450 MHz
Onondaga
WXK-81
162.400 MHz

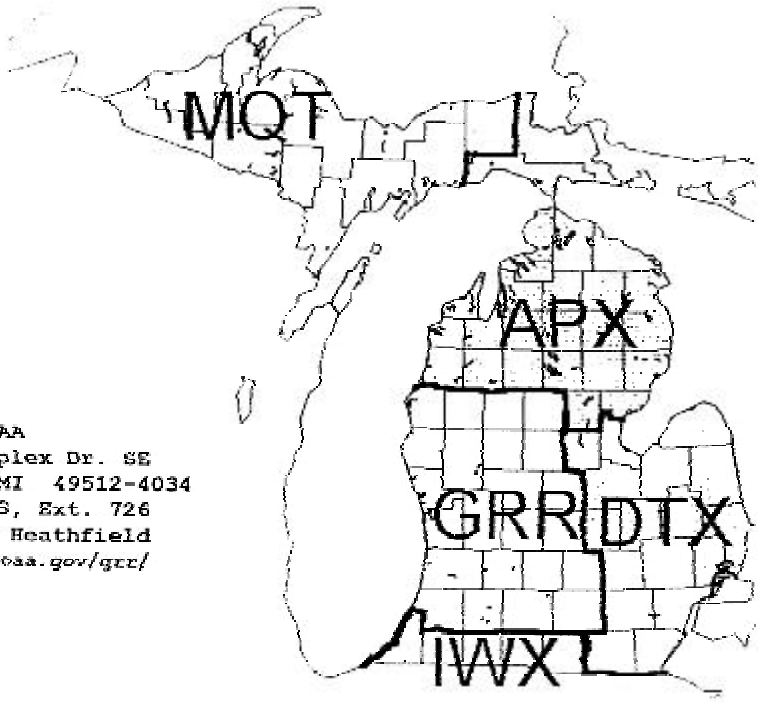
NATIONAL WEATHER SERVICE OFFICES

MARQUETTE:

NWS Office, NOAA
112 Airport Dr. South
Negaunee, MI 49866
(906) 475-5782, Ext. 726
Contact: Jack Pellett
http://www.crh.noaa.gov/mqt/

GAYLORD:

NWS Office, NOAA
8800 Passenheim Rd.
Gaylord, MI 49735-9454
(517) 731-1194, Ext. 726
Contact: Brian Hirsch
http://www.crh.noaa.gov/apx/



GRAND RAPIDS:

NWS Office, NOAA
4899 South Complex Dr. SE
Grand Rapids, MI 49512-4034
(616) 949-0643, Ext. 726
Contact: Mike Heathfield
http://www.crh.noaa.gov/grr/

NORTHERN INDIANA:

NWS Office, NOAA
7550 East 850 N.
Syracuse, IN 46567
(219) 834-5178, Ext. 726
Contact: Jane Hollingsworth
http://www.crh.noaa.gov/iwx/

DETROIT/PONTIAC:

NWS Office, NOAA
9200 White Lake Rd.
White Lake, MI 48386-1126
(248) 625-3309, Ext. 726
Contact: Darin Figurskey
http://www.crh.noaa.gov/dtx/

APPENDIX E. EMERGENCY MANAGEMENT - STATE

1. MICHIGAN

Emergency Management Division

Michigan Department of State Police

4000 Collins Road

P.O. Box 30636

Lansing, Michigan 48909-8136

Webb site: www.mspemd.org

(517) 333-5038 - Public @ Governmental Affairs

APPENDIX F. THE MICHIGAN COMMITTEE FOR SEVERE WEATHER AWARENESS MEMBERS

This Committee was formed in 1991 to coordinate public information efforts regarding flood, tornado and winter safety.

The Michigan Committee for
Severe Weather Awareness
404 Kalamazoo Plaza, Suite 100
Lansing, Michigan 48933
(517) 482-1643

Lori White
Michigan Association of Insurance Companies
404 Kalamazoo Plaza, Suite 100
Lansing, MI 48933
(517) 482-1643

Mark Walton
National Weather Service
4899 South Complex Drive, S.E.
Grand Rapids, MI 49512-4034
(616) 949-0643 ext. 493

Grace Ranger
Michigan Emergency Management Association
Genesee County Emergency Mgmt., 1101 Beach,
Room G-25
Flint, MI 48502
(810) 257-3064

Paul Gross
Meteorologist, WDIV-TV
550 W. Lafayette
Detroit, MI 48226-3140
(313) 222-0444

David Chapman
Science Teacher, Okemos High School
2800 Jolly Road
Okemos, MI 48864
(517) 351-7900 ext. 3186

Gary Campbell
National Weather Service
880 Passenheim
Gaylord, MI 49735-9454
(517) 731-1194 ext. 726

Anne Readett
Office of Highway Safety Planning
4000 Collins Road, P.O. Box 30633
Lansing, MI 48909
(517) 333-5317

George Hosek
Michigan Department of Environmental Quality
P.O. Box 30458
Lansing, MI 48909-7958
(517) 335-3182

Gary Mitchell
Michigan Association of Insurance Agents
P.O. Box 80620
Lansing, MI 48908-0620
(517) 323-9473

Michael Prince
Michigan State Police Emergency Management
Div.
4000 Collins Road
Lansing, MI 48909-8136
(517) 333-5038

Judy Bukovac
American Red Cross
4428 Seneca
Okemos, MI 48864
(517) 349-1952

Karen Petersmarck, PhD, MPH
Michigan Department of Community Health
3423 N. Martin Luther King, Jr. Blvd.
Lansing, MI 48909
(517) 335-9492

Darin Figurskey
National Weather Service
9200 White Lake Rd.
White Lake, MI 48386-1126
(248) 625-3309 ext. 726

Jim Green
Allegan Emergency Coordinator
112 Locust Street
Allegan, MI 49010
(616) 673-5511

APPENDIX G. TORNADO SAFETY PLAN CHECKLIST

Use the following checklist for the evaluation or design of a tornado safety plan for your school. The plan should be designed so that teachers and students anywhere on the school grounds can be quickly alerted and follow a preset plan of action to maximize safety.

1) Who is responsible for activating the plan? Is there a back-up?

2) What is/are the primary means of receiving tornado information? NOAA Weather Radio with an alert feature and battery backup is recommended (found in electronic stores costing approximately $30-80).

3) What method do you employ to alert teachers and students? Is there a back-up that does not require electricity? (Electricity may be lost as the storm approaches).

4) Make provisions for the following problem areas:

    a) Students that are in mobile classrooms that may be far from the main building and that may be disconnected from an intercom system.

    b) Students that may be in the cafeteria or gymnasium during the storm.

    c) Learning-disabled students, or any other students who may be in a position to not hear the warning or alert or be able to respond on their own accord. Assign a teacher to each student with special needs, ensuring that the student arrives at a place of safety.

    d) Students who are outside, including after-school activities. Remember, if you are close enough to hear thunder, then you are close enough to be struck by lightning. Also, students who are outside are at risk from the dangers of large hail and severe thunderstorm winds.

    e) Before and after school events.

5) Four main problems for schools in a tornado:

    a) Forces caused by winds and the airflow around the building.

    b) Forces caused by other objects (debris) impacting school walls.

    c) C. Gas leaks and electrical hazards after the storm. Have someone knowledgeable in turning off gas and electricity at the school during school hours if appropriate.

    d) "Wind Tunnel Effect" - When blown by tornado-strength winds, debris (such as fragments of glass, wood, and metal) can cause serious injury when accelerated by relatively narrow hallways in schools.

6) Safest places to be in a school: (assuming no underground shelter)

   a) Interior hallway on the lowest level.

   b) Away from windows.

   c) In a small room, such as a bathroom, surrounded by load-bearing walls.

   d) In a room without small objects that can serve as projectiles (such as tableware).

7) Some other aspects of designing a plan:

   a) Practice your plan. Have drills semi-annually (Fall and Spring).

   b) Include tornado safety instruction as part of the drill period.

   c) Encourage teachers and administrators to develop a plan for their families at home. The knowledge that their families know what to do at home will enable them to focus their attention on the students. The American Red Cross has brochures on developing a "Family Protection Plan."

   d) Educate school administrators about the structure of tornadoes and the basic sequence of events as a storm approaches. Also explain the concepts of wall clouds, rotating wall clouds, and the preferred locations for these features within the storm. (It is recommended they attend the NWS SKYWARN severe spotter training class - no fee). Emphasize the variability that may exist with each storm and the need to understand basic storm structure to assist in determining the degree of threat at a school.

   e) For optimum planning purposes, an engineer and the local school board should participate in the design of an emergency plan. The emergency plan should respond to increasing severity of weather, beginning with the Severe Weather Outlook.

   f) Encourage administrators to contact the nearest National Weather Service Office or Local Emergency Services Coordinator for assistance in answering ANY questions that may arise in developing a plan.

Appendix H. Acknowledgments

The Michigan Committee for Severe Weather Awareness would like to acknowledge Barbara McNaught Watson, WCM at the NWS office in Sterling, Virginia, for developing the original guide which this plan is based upon. The committee would also like to thank Gary Campbell, MIC at the NWS office in Gaylord, Michigan, and Mark Walton, Service Hydrologist at the NWS office in Grand Rapids, Michigan, for organizing and editing the Tornado Emergency Plan for Schools. Finally, we would like to acknowledge Jennifer Dick, and John Denman, student interns at the NWS office in Grand Rapids, Michigan, and the rest of the members of the Michigan Committee for Severe Weather Awareness for there review and editorial assistance in the development of the Tornado Emergency Plan For Schools.