# Criteria for Preparation of Flood Hazard Boundary and Flood Insurance Rate Maps (1974)

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# CRITERIA FOR PREPARATION
# OF
# FLOOD HAZARD BOUNDARY
# AND
# FLOOD INSURANCE RATE MAPS

Prepared by the
Panel on Flood Insurance Mapping Criteria
of the
Science and Engineering Committee
on Prevention and Mitigation of Flood Losses

Building Research Advisory Board

National Research Council

National Academy of Sciences
Washington, D.C.
1974

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The members of the panel selected to undertake this project and prepare this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. Responsibility for the detailed aspects of this report rests with that panel.

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PANEL ON
FLOOD INSURANCE MAPPING CRITERIA
of the
Science and Engineering Committee
on Prevention and Mitigation of Flood Losses

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# I. INTRODUCTION

## A. BACKGROUND

Established by the National Flood Insurance Act of 1968 (as amended), the Federal Insurance Administration (FIA) of the U.S. Department of Housing and Urban Development (HUD) is responsible for promoting the public welfare by ensuring the availability of insurance protection against the perils of flood and mudslide losses and by encouraging sound land-use practices by local communities as a condition for the insurance protection. In the context of its programs, the FIA has considerable opportunity to formulate programs that will reduce the annual property loss resulting from floods and mudslides.

To aid it in making the maximum feasible technically and scientifically sound contribution to disaster mitigation, the FIA requested that the National Academy of Sciences-National Academy of Engineering-National Research Council (NAS-NAE-NRC) provide it with continuous, objective review of and advice on its current technical programs, practices, and plans. In response to this request, the NAS entered into a contract with HUD and charged the Building Research Advisory Board (BRAB) with administration of an NRC Science and Engineering Committee on Prevention and Mitigation of Flood Losses (a joint effort of the NAS Divisions of Earth Sciences and Engineering) and any specific ad hoc panels of that committee needed to respond to specific tasks identified by the FIA.

## B. PURPOSE OF THIS REPORT

This report responds to the requirements of Task 3, Contract H-3568, concerned with studying and advising the FIA on how best to prepare the flood hazard

boundary maps and flood insurance rate maps required by the National Flood Insurance Act of 1968 (as amended), the National Flood Disaster Protection Act of 1973, and the rules and regulations issued pursuant thereto. This report is concerned with how such maps should be prepared, what information should be provided on the maps, and how such information should be displayed; the report is not concerned with how the information to be depicted on the maps should be developed, a matter dealt with under Tasks 1, 2, 5, and 6 of Contract H-3568.

## C. CONDUCT OF THE STUDY

This study was conducted by the Panel on Flood Insurance Mapping Criteria of the NRC Science and Engineering Committee on Prevention and Mitigation of Flood Losses. As part of the investigation, the current procedures used by the FIA to prepare flood hazard boundary maps and flood insurance rate maps, as well as the procedures used by other major cartographic organizations, were reviewed and discussed by the Panel as it developed the conclusions and recommendations presented in this report.

## D. ORGANIZATION OF THE REPORT

In addition to this introduction, the report is divided into three major sections: "Conclusions and Recommendations," in which the conclusions and recommendations of the Panel are presented without elaboration; "Criteria for Flood and Mudslide Insurance Rate Maps," in which the Panel presents production and graphics criteria; and "Discussion," in which the conclusions, recommendations, and criteria of the Panel are supported and further defined.

## II. CONCLUSIONS AND RECOMMENDATIONS

### A. CONCLUSIONS

1. The requirements of the National Flood Insurance Program call for production by the FIA, in the near future, of four distinct maps for each concerned community: (a) a flood hazard boundary map, (b) a mudslide hazard boundary map, (c) a flood insurance rate map, and (d) a mudslide insurance rate map.

2. The flood and mudslide insurance rate maps and hazard boundary maps currently issued by the FIA do not best serve the needs of their intended users and are not produced as cost effectively as they might be.

### B. RECOMMENDATIONS

1. To facilitate comparison and correlation of maps, the FIA should require that the same base map of a community be used to the degree possible in the preparation of the four maps required.

2. The FIA should modify those portions of its Flood Map Preparation Standard pertaining to the preparation of flood and mudslide insurance rate maps to reflect the production and graphics criteria presented in section III of this report.

3. The criteria recommended for insurance rate maps probably are equally applicable in the preparation of flood and mudslide hazard boundary maps; however, until the basic information to be presented on hazard boundary maps is determined, the FIA should not modify its current guidelines for preparing these maps.

## III. CRITERIA FOR FLOOD AND MUDSLIDE INSURANCE RATE MAPS

### A. PRODUCTION CRITERIA

1. Mudslide and flood insurance rate maps should be accordion Z-folded maps printed on No. 2, 50- or 60-pound, offset white paper approximately 25-7/8 inches long by up to 37-1/2 inches wide.

2. The maps should have a maximum of 10 panels, each approximately 3-3/4 inches wide by 27-7/8 inches long and having three subsections approximately 3-3/4 inches wide by 8-1/2 inches long.

### B. GRAPHICS CRITERIA

1. The entire community area should be depicted legibly on the front side of the accordion Z-folded map at a scale not larger than 1 inch equals 500 feet. As a minimum this community map should show: (a) all mudslide/flood hazard zones; (b) all main arterial roads and streets; (c) all roads, streets, and other physical features that serve as the boundaries of or as reference points for the boundaries of Zones A, V, B, C, and D on flood insurance rate maps and Zones M, N, C, and P on mudslide insurance rate maps; (d) political boundaries; (e) natural and man-made landmarks pertinent to orientation, and (f) normal drainage lines (e.g., rivers, creeks, and waterways).

   In addition, provided that legibility can be maintained at the scale used, the following should be shown on the overall community map in Zones A, V, and M: (a) all streets and roads, (b) the boundaries of all subzones of Zones A and V, and (c) the 100-year flood elevation reference lines (i.e., water surface contours).

2. If the additional information for Zones A, V, and M cannot be depicted legibly on the overall community map, inserts of these zones, keyed to the overall map and depicting the additional information, should be prepared. These inserts should show all the information depicted on the overall community map in these areas.

   Inserts keyed to the overall community map also should be prepared to show the boundaries between Zones B and C (and Zone D and any other zone) on flood insurance rate maps, and between Zones N and C on mudslide insurance rate maps, if the scale chosen to depict the map of the overall community is too small to clearly indicate these or some portion of these boundaries on that map.

   All inserts should be prepared at the same scale and should be shown, first, in any space available on the front side of the map, second, on the back side of the map, and, third, on the front and back sides of additional accordion Z-folded sheets of the same size as the primary map sheet.

3. The overall community and insert maps should be prepared using two high-contrast colors with low opacity, which are available in a range of tones (e.g., Capico Warning Red and Corsair Blue or equivalent pairs). These colors should be used as indicated below:

   RED: Solid--Lettering to identify Zone A, Zone V, and Zone M areas

   Tint, 50%, 150 Line Screen--Zone A, Zone V, and Zone M areas

   BLUE: Solid--All map features, except drainage patterns; all lettering, except for Zones A, V, and M designations; the 100-year flood elevation reference lines (i.e., water surface contours)

Tint, 15%, 150 Line Screen--Zone B and Zone M areas

Tint, 30%, 150 Line Screen--Drainage patterns (rivers, creeks)

PURPLE: Tint, 5%, Combination of Red and Blue, 150 Line Screen--Zone D and Zone P areas

WHITE SPACE: Guttering of 1/32 inch between subzones in Zones A and V to delineate boundaries; Zone C areas; and block background for zone labeling.

4. One front panel subsection of the map should be devoted to presentation of a standardized title block containing the name and other identification of the community, the date the hazard zones were established or became effective, the date the map was prepared, the page number if more than one page is involved, and other information the FIA may deem necessary for purposes of identification. On a flood insurance rate map this panel should feature a standard alert statement regarding the availability of a mudslide insurance rate map and, conversely, this panel on a mudslide insurance rate map should reflect the availability of a flood insurance rate map. A second front panel subsection should feature an indication of magnetic north, the bar scale (both English and metric), and legend.

5. Symbols used on the map to depict features should correspond to those used by the U.S. Geological Survey except that roads and streets should be designated by single lines and the 100-year flood elevation reference lines should be designated with the wavy lines currently used by the FIA. Size of all lettering should be consistent with map scale but should be readily readable without magnification.

In connection with the second responsibility, 24 CFR, chap. 7, par. 1914.2, authorizes the FIA to prepare the following maps:

1. Emergency Flood Insurance Map--This map is used to delineate an area for which the Administrator has authorized the sale of flood insurance under the emergency program.[2] Such a map will usually be issued only when the area for which the sale of flood insurance has been authorized does not conform precisely to the boundaries of the eligible community.

2. Flood Insurance Rate Map--This map is prepared after the rate-making study for the community has been completed and actuarial rates have been established, and it enables the Administrator to authorize the sale of flood insurance under the regular program. It indicates the actuarial rate zones applicable to the community. The symbols used to designate these zones are as follows:

| Zone Symbol | Category |
|---|---|
| A[3] | Area of special flood hazards |
| V[3] | Area of special flood hazards with velocity |
| B | Area of moderate flood hazards |
| C | Area of minimal flood hazards |
| D | Area of undetermined, but possible, flood hazards |
| M | Area of special mudslide hazards |
| N | Area of moderate mudslide hazards |
| C | Area of minimal mudslide hazards |
| P | Area of undetermined, but possible, mudslide hazards |

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[2]The "emergency program" or Emergency Flood Insurance Program refers to the National Flood Insurance Program, authorized by the Act of 1968, when implemented on an emergency basis and without the need for individual community rate-making studies in accordance with sec. 1336 of the Act, 42 USC 4056.

[3]As a result of experience gained with rate-making studies in a number of communities, the FIA has subdivided Zones A and V into 30 subzones each and has established standard rates for all subzones so that individual community rate-making studies are unnecessary.

Areas identified as subject to both flood and mudslide hazards are designated by use of the proper symbols in combination. For example, the combination "AN" would indicate an area subject to both special flood hazards and moderate mudslide hazards. Areas subject to only one hazard or where both hazards are minimal are identified by only one symbol.

3. Flood Hazard Boundary Map--This map is issued or approved by the Administrator for use in determining whether individual properties are or are not within the flood plain area having special flood hazards and/or the mudslide area having special mudslide hazards.[4]

To meet its dual responsibilities with respect to a particular community seeking admittance to the National Flood Insurance Program, the FIA contracts with private and public organizations having the professional engineering/geologic/hydrologic/hydraulic competency needed to perform the required flood and/or mudslide insurance studies. Among the products of an insurance study of a community are a flood hazard boundary map (in the case of a flood insurance study), a mudslide hazard boundary map (in the case of a mudslide insurance study), and an insurance rate map (in the case of either a flood or mudslide insurance study).

The purpose of the flood hazard boundary map is to depict, for riverine areas, the location of cross sections, the areal extent of overland flooding associated with the 100-year flood (Zone A), and the areal extent associated with the 500-year flood (Zone B). If, without cluttering the

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[4]24 CFR, chap. 7, par. 1909.1, requires that this map be of sufficient scale and clarity to permit the ready identification of individual building sites as being either in or out of the area having special flood hazards.

map, the floodway[5] can be shown, it is included. In addition, in coastal areas the areal extent of inland flow associated with the 100-year tidal flood (Zone V) is depicted on the flood hazard boundary map. If areas of undetermined but possible flood hazard (Zone D) exist in either a coastal or a riverine area, the boundaries of these areas also are shown on the map. The 100-year flood elevation reference lines (water surface contours) currently are not shown on the map.

The purpose of the mudslide hazard boundary map is to depict the areal extent of three categories of mudslide hazard: minimal (Zone C), moderate (Zone N), and high (Zone M). If areas of undetermined but possible mudslide hazard (Zone P) exist, these areas also are shown on the map.

Hazard boundary maps are intended to serve primarily as a land-use and -control tool and, as such, show boundaries of zone areas where they actually run through the community (i.e., as a curvilinear line). As a land-use tool, these maps will be used by the local community to regulate land use in general and construction in particular. With respect to construction, for example, participation in the National Flood Insurance Program requires communities to adopt regulations that, in effect, stipulate that any new structure constructed in the area subject to inundation by the 100-year flood must have its lowest floor, including the basement, either built above the published elevation of the 100-year flood or flood-proofed to that elevation.[6]

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[5]As defined by FIA, a floodway is " . . . the channel of a river or other watercourse, and the adjacent land areas, required to carry and discharge a flood of a given magnitude without increasing the water surface elevation at any point more than a specified amount and without producing hazardous velocities." The floodway component of a Flood Insurance Study indicates what portions of a flood plain could be obstructed without increasing the water-surface elevation of the 100-year flood more than 1 foot at any point.

[6]It is not known at this time how regulations will relate to new construction in mudslide hazard areas.

Although the flood hazard boundary map as currently prepared does not indicate to what height the level of the first floor of a structure must be built, the map alerts users to the fact that the construction would or would not be in the high-hazard zone and, if it is, that the height to which the first floor is to be built must be determined. Probable users of the hazard boundary maps, whether for floods or mudslides, therefore would include developers, real estate agents, lending institutions, and possibly even individual property owners in addition to community planning and construction permit agencies.

Mudslide/flood insurance rate maps are prepared from the hazard boundary maps and divide a community into areas of hazard according to FIA flood or mudslide hazard zones. The maps are prepared primarily for use by the insurance community in its determination of appropriate insurance rates, which vary from subzone to subzone and zone to zone, to be charged for specific structures. As currently prepared, these maps show the boundaries of all subzones of Zones A and V and Zones B, C, D, M, N, C, and P, as applicable. To the extent practical, boundaries of the zones and subzones are moved outward from the curvilinear boundary lines shown on the hazard boundary map to coincide with easily identifiable features such as streets, roads, railroads, powerlines, and community limit lines; property lines normally are not used as boundary lines. When moving the boundary outward to coincide with an existing street or road or other landmark entails a considerable distance or when no street or road exists beyond the actual boundary of the flood reach, dimensional distances from some remotely located landmark are provided. This information in itself would be adequate to determine the appropriate insurance rate to be charged if it could be determined from other information shown on the map just where a structure lies. However, because of the FIA policy that actual elevations prevail, property owners have the option of taking the zone rate or the rate established for specific heights of the first floor level of the structure above or below the water level of the 100-year flood. Accordingly, the 100-year flood elevation reference lines (which make it possible to determine the height of the first floor of an existing or proposed structure relative to the water level of the 100-year

flood if the elevation of the first floor is known) also are shown on flood insurance rate maps.[7]

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[7]When the flood insurance program was voluntary, the practice of blocking out zone boundaries on rate maps to coincide with streets, roads, and other landmarks outside the published boundary of the 100-year flood did not pose particular problems. According to the FIA, there is concern now that continuation of the practice may possibly result in inequities to owners of properties falling within that area between the actual boundary of the 100-year flood as depicted on the hazard boundary map and the boundaries reflected on the insurance rate map--i.e., if the insurance rate map is misused by individuals associated with lending institutions, real estate companies, or the insurance agent himself, inequities such as the following could result: unnecessary decreases in the market value and marketability of some properties; some property owners being inadvertently overcharged for flood insurance coverage; and some property owners being unnecessarily required to purchase insurance. While outside the scope of the Panel's assignment, the FIA might well examine various alternatives to the current practice of depicting the boundaries of the 100-year flood on rate maps. Such alternatives might include: (1) use of a curvilinear boundary line that is congruent with the boundary line shown on the hazard boundary map (this alternative would, at least theoretically, provide identification of the true peril of flooding to which a particular property is subjected; however, to be effective as a tool for the insurance agent, all structures abutting or on the curvilinear line would have to be identified [e.g., by street number, lot number, or post office address] and such a requirement is apt to increase the cost of map preparation by a factor of from 3 to 10); (2) use of a curvilinear boundary line with area on both sides of the line blocked out along identifiable permanent landmarks (roads, streets, railroads, etc.) in a manner similar to that currently employed (all sorts of options are possible with this method--e.g., the blocked out area could be defined as Zone B and insurance made optional with the provision that if not taken, the property owner must sign a waiver that he will not file suit against the FIA if damage results from the 100-year flood); (3) block the boundary inside the curvilinear line along identifiable permanent landmarks in the same manner as the boundaries are currently blocked outside the curvilinear line (this practice might well increase the risk to the FIA because some structures actually lying within Zone A would be shown as lying within Zone B; however, the risk should be negligible because the areas in concern would be in the fringe area of the 100-year flood where water elevations approach zero). It also must be pointed out that unless the risk to the FIA is increased (e.g., Method 3 above), any method of depicting the zone boundaries (with the exception of the curvilinear line having all properties abutting or on the line fully identified) will result in the inequities previously described. Further, with the exception of the curvilinear line having all properties abutting or on the line fully identified, use of any other method that ensures that all structures actually lying within the reaches of the 100-year flood are included within the boundaries shown on the insurance rate map in many cases will require proof that the elevation of the first floor is above the water level of the 100-year flood; this burden of proof rests with the property owner and is likely to cost $100 or more to obtain.

To meet the identified and diverse needs of participants in the National Flood Insurance Program, it is obvious that the FIA must continue to issue, at least during the near future, the two distinct types of map now prepared for each community: (a) a hazard boundary map to be used primarily for land-use and -control purposes, and (b) an insurance rate map to be used fundamentally by the insurance community to determine the appropriate insurance rate to be charged for specific properties. Because it frequently will be necessary to correlate information found on one map with that on the other, the same base map should be used to the extent possible in the preparation of both the hazard boundary and insurance rate maps.

While it would appear to be economically desirable to have both the mudslide and flood hazard zones of a community shown on the same map and the FIA has done this in the past, this is not necessarily the case. Current FIA operating procedures require that these maps be prepared by the organization conducting the flood or mudslide insurance study, and generally an organization having the competency to conduct a hydrologic/hydraulic study to determine the flood hazard does not have comparable competency in the soils/geologic sciences required for the conduct of a mudslide study. Also, the mudslide and flood studies normally are not conducted concurrently, and although the FIA could furnish the results of one study to the contractor conducting the second study and have all results shown on one map, significant management and technical problems could evolve. Furthermore, it has been necessary for the FIA to rescind the results of some mudslide studies and, obviously, the maps reflecting the results; when the results of the rescinded mudslide studies were combined with results of flood studies, it was necessary to rescind the results of both studies. Finally, as will be discussed subsequently, multiple-color maps are recommended for use by the FIA. Given this recommendation, it is possible that 16 different tints would be required to reflect the results of both mudslide and flood insurance studies on the same map, and the resulting maps would be visually cluttered and difficult to use. Thus, it is concluded that, for the immediate future, the FIA should issue separate flood hazard boundary and mudslide hazard boundary maps and therefore separate flood insurance and mudslide insurance rate maps. As

noted above, however, the same base map should be used for all four maps to the extent possible.

## B. MAP PRODUCTION AND GRAPHICS

Generally, the organizations conducting the technical flood insurance studies of communities do not prepare the original base maps on which to superimpose their technical findings and zone boundary recommendations. Rather, they are encouraged to utilize the most recently prepared existing maps available and generally these are furnished by the community. Regarding actual preparation of the maps, FIA guidelines require that they be prepared to a scale between 1 inch equals 400 feet and 1 inch equals 1000 feet for urban and developing areas and to a minimum scale of 1 inch equals 2000 feet in undeveloped rural areas. The maps are placed on 11-by-17-inch panels, and the common sides of adjacent panels are labeled "Joins XX" in order to relate one panel to another. Two hundred or more panels have been required to map some particularly large communities. Currently, FIA is producing maps both in black and white and in various color combinations.

This process does not produce maps that satisfactorily serve the needs of their intended users and is not cost-effective. For example, to fill insurance community needs the flood insurance rate map should: (1) convey sufficient information and detail to permit rapid orientation; (2) be readily interpretable by nontechnical readers; (3) be compact, portable, and durable; (4) be readable in poor light and limited space conditions; and (5) be easily and economically revisable and reproducible. These needs are not met with multiple 11-by-17-inch panels depicting various sections of a community.

Thus, the Panel developed the specific production and graphics criteria (see section III) for preparation of flood and mudslide insurance rate maps and recommends them to the FIA for implementation to effect more cost-effective production of maps more responsive to the needs of their intended users. The criteria are discussed below in more detail and the rationale given for their recommendation.

The Panel wishes to note that, while there are indications that the production and graphics criteria for mudslide/flood hazard boundary maps could be essentially the same as those recommended in this report for the mudslide/flood insurance rate maps (i.e., the hazard boundary maps also could be accordion Z-folded two-color maps printed on both sides of No. 2, 50- or 60-pound white paper), it does not now deem it practical to offer definitive advice on how the FIA guidelines for preparing hazard boundary maps should be modified because investigations are still in progress to determine what technical information should be developed through flood or mudslide insurance studies and communicated to local communities for subsequent land-use and -control purposes. Clearly, for example, local officials need to know the estimated height of flood waters in various parts of the community, but it has not yet been determined whether they also need to know the pattern of overland flow (such as might be inferred from a topographic presentation) and the flow velocity and direction (such as might be inferred from a hydrologic presentation). Further, it has not yet been decided which information should be communicated in a report, which in a map, and how these two types of document can be related to one another most effectively. Thus, it does not seem prudent to modify the guidelines by which hazard boundary maps are prepared until such information is available and the relevant decisions have been made.

## C. CRITERIA FOR INSURANCE RATE MAPS

> *Mudslide/flood insurance rate maps should be accordion Z-folded maps printed on No. 2, 50- or 60-pound, offset white paper approximately 25-7/8 inches long by up to 37-1/2 inches wide. The maps should have a maximum of 10 panels, each approximately 3-3/4 inches wide by 25-7/8 inches long and having three subsections approximately 3-3/4 inches wide and 8-1/2 inches long.*

This criterion assumes that photo-offset printing, a planographic process involving deep-etch printing plates made by photographing the image to be produced, will be used. This process, used extensively throughout the nation and considered by the printing industry to produce a quality product at an economical and competitive price, is well suited for preparing the

desired FIA maps because it results in good line and screened color reproduction and lends itself to large quantity runs.

No. 2, 50- or 60-pound offset white paper is used extensively by the map-making industry and is readily available through all normal supply channels as a standard item. The paper is sufficiently thick to permit printing on both sides (this attribute is enhanced by the smooth surface of the paper, which tends to prevent the ink from penetrating deeply); offers good shrinkage resistance when exposed to moisture, an important consideration for hazard boundary maps; and has better folding characteristics than coated paper. Furthermore, its durability and tear resistance should assure a map service life that will meet the needs of the various map users, particularly the insurance community. White paper, in addition to being readily available and comparatively inexpensive, provides a visually pleasing background for the recommended color schemes; in addition, white space around lettering gives it prominence and clarity.

Additionally, No. 2, 50- or 60-pound offset white paper is available for printing combinations of the 25-7/8-inch-by-37-1/2-inch size, the dimensions of a standard road map. The actual width of the map (i.e., number of panels) will be dictated by the size and required detail for a specific community.

For example, if the entire community (using the recommended scale) can be depicted on three panels plus those needed for other required information, the actual map size would be 25-7/8 inches long by 11-1/4 inches wide. Generally, communities to be mapped for FIA purposes will be small, considering the fact that approximately 15,000 are expected to participate in the insurance program. Thus, more often than not something smaller than a 10-panel map will be adequate; in such cases, the 25-7/8-inch-by-37-1/2-inch paper provides the flexibility of printing multiple copies of a map on one sheet. The maximum length of 37-1/2 inches (10 panels) is dictated by the capacity of the reproduction and folding equipment most commonly used. However, there will be few, if any, communities that cannot be depicted in the required detail and at a readable scale on paper of this size.

Regardless of the number of panels actually required to depict the community, when accordion Z-folded, the map would be only 3-3/4 inches wide and 8-1/2 inches long, the dimensions of a panel subsection. When so folded, the map is compact, extremely portable, and easy to handle in a limited space--critical needs of the insurance salesman. Furthermore, maps in such form are more easily inventoried and can be mailed in standard map envelopes. With respect to mailing, the accordion Z-folded maps should reduce significantly the cost currently associated with the distribution of the multiple 11-by-17-inch-panel maps being used by the FIA. Figure 1 illustrates the dimensions and folds of a typical accordion Z-folded map.

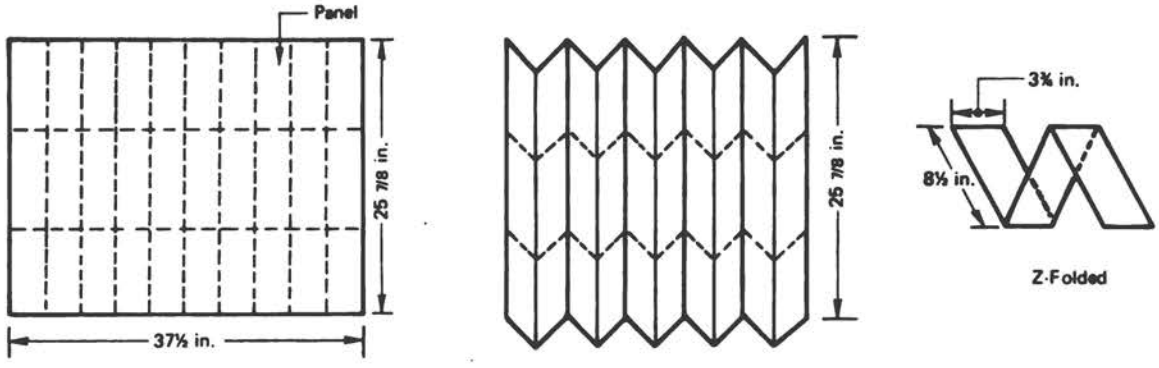


FIGURE 1 Typical accordion Z-folded map.

*The entire community should be depicted legibly on the front side of the accordion Z-folded map at a scale not larger than 1 inch equals 500 feet. As a minimum this community map should show: (a) all mudslide/flood hazard zones; (b) all major arterial roads and streets; (c) all roads, streets, and other physical features that serve as the boundaries of or as reference points for the boundaries of Zones A, V, B, C, and D on the flood insurance rate maps and Zones M, N, C, and P on the mudslide insurance rate maps; (d) political boundaries; (e) natural and man-made landmarks pertinent to orientation; and (f) normal drainage lines (e.g., rivers, creeks, and waterways).*

The above criterion relates to two fundamental user needs--orientation and information. Depicting the entire community on one side of the map sheet with identified hazard zones, natural and man-made landmarks,

major arterial roads and streets, political boundaries, and drainage patterns combine to aid the user in orienting himself immediately. Of particular importance is that hazard zone size is placed in perspective in the context of the whole community. This contrasts significantly with the present method of depicting the community on multiple 11-by-17-inch panels stapled together, which does little to aid orientation and introduces the risk of losing panels that may become detached.

In addition to aiding in orientation, political boundaries are necessary because in many areas small developments or sections contiguous to a larger community use the same mailing address as the larger community, and these smaller sections may not have been included as a part of the community study. With the political boundaries shown, this could be determined by the insurance salesman. Also, the jurisdiction of one insurance company may be restricted (e.g., to a community that is contiguous to another), particularly if different states are involved.

The recommended scale (i.e., not larger than 1 inch equals 500 feet) is exceptionally large and will allow virtually any degree of detail to be shown on the maps. Using such a scale is preferable over a significantly smaller scale because symbols are clearer and position of ground features can be more correctly determined; however, a much smaller scale can be used and clarity of detail required for the insurance rate maps maintained. The smallest scale to be used, which might be as small as 1 inch equals 4000 or more feet, will be that required to depict the entire community on the 10-panel map. Generally, however, most of the communities to be mapped would require less than 10 panels even if depicted at a scale of 1 inch equals 500 feet, and in virtually all cases, use of the smallest scale would not be necessary. Thus the scale actually used for a specific map would be determined on the basis of what would be required to make the necessary detail and information discernible on one map sheet without magnification.

*In addition, provided that legibility can be maintained at the scale used, the following should be shown on the*

*overall community map in all Zones A, V, and M: (a) all streets and roads, (b) the boundaries of all subzones of Zones A and V, and (c) the 100-year flood elevation reference lines (i.e., water surface contours).*

The need for depicting hazard zone boundaries is obvious; the chargeable insurance rate is predicated on zones and subzones therein. The fact that the insurance is mandatory within Zones A, V, and M necessitates that all streets and roads within these zones be depicted so that it can be clearly determined whether a property actually lies within these zones (or subzones) and what insurance rate is appropriate. If not shown, the agent would have to use a road map of the community, increasing the number of maps he would need and possibly decreasing his efficiency. The contour lines showing the 100-year flood elevations will be required by the insurance agent in determining the appropriate rates when the first floor elevation of a structure is above or below the elevation of the 100-year flood if the homeowner exercises this option rather than accepting the zone rate. The 100-year flood elevation lines also represent one reason why different insurance rates are set for various subzones. If this additional information--the most important information on a flood insurance rate map--can be shown legibly (i.e., without magnification) on the overall community map at the scale used, all the informational requirements would be depicted on one sheet, thus providing optimum realization of the purposes of flood insurance rate maps.

*If the additional information for Zones A, V, and M cannot be depicted legibly on the overall community map, inserts of these zones, keyed to the overall map and depicting the additional information, should be prepared. These inserts should show all the information depicted on the overall community map in these areas.*

*Inserts keyed to the overall community map also should be prepared to show the boundaries between Zones B and C (and Zone D and any other zone) on flood insurance rate maps, and between Zones N and C on mudslide insurance rate maps, if the scale chosen to depict the map of the overall community is too small to clearly indicate these or some portion of these boundaries on that map.*

If, in the case of an urban community, it is necessary to use a scale smaller than 1 inch equals 1000 feet to depict the entire community on one map sheet, it is likely that in many cases all the information required in the critical subzones of Zones A and V and Zone M cannot be presented with sufficient clarity or without visually cluttering the map. Also, in some instances, it may not be possible in heavily developed areas to adequately depict portions of the boundaries between Zones B and C (and Zone D and any other zone) and between Zones N and C at the scale used for the overall map. Such problems can be dealt with readily by using map inserts keyed to the overall map. While no specific scale can be specified for the inserts, they would, of course, have to be at a scale larger than that used in the overall community map in order to convey the required detail more clearly. When such inserts are required, all information to be shown on the overall community map must be presented on the inserts because the inserts will be used as the overall map would be used without inserts--i.e., for the dual purposes of orientation and property location. To reduce clutter of the overall community map when inserts are required, only the minimum information requirements given previously need be met on the overall map.

> *All inserts should be prepared at the same scale and should be shown, first, in any space available on the front side of the map, second, on the back side of the map, and, third, on the front and back sides of additional accordion Z-folded sheets of the same size as the primary map sheet.*

This criterion should be applied to provide simplicity and compactness. When all inserts are drawn to the same scale, the potential for both judgmental and measurement errors is reduced. When the overall community map and all inserts are shown on the least number of map sheets, handling in the field is simplified and the potential for losing companion sheets is minimized. Placing inserts first in available space on the front side when possible will result in all information being shown on one sheet. If additional space is required, placing inserts next on the back side minimizes the number of sheets required. Depending on the number of panels required for

the overall community map and the inserts, various options are available. For example, if three panels are required to depict the overall community map and sufficient space is not available on the back side for the inserts, one can either use a second three-panel sheet or increase the number of panels of the primary map. Obviously, to reduce the number of sheets required, it would be desirable to increase the number of panels used to the maximum of 10 before going to the second sheet; however, if a second sheet is needed and must have 10 panels with little information on it, a better choice might be to prepare two six-panel sheets. Obviously, this choice must be made by the map compositor based on actual space requirements, thus emphasizing the importance of the competence of the map-producing organization.

*The overall community and insert maps should be prepared using two high-contrast colors with low opacity, which are available in a range of tones (e.g., Capico Warning Red and Corsair Blue or equivalent pairs). These colors should be used as follows:*

*RED: Solid--Lettering for designation of Zone A, Zone V, and Zone M areas*

*Tint, 50% 150 Line Screen--Zone A, Zone V, and Zone M areas*

*BLUE: Solid--All map features, except drainage pattern; all lettering, except for Zones A, V, and M designations; the 100-year flood elevation reference lines (i.e., water surface contours)*

*Tint, 15%, 150 Line Screen--Zone B and Zone M areas*

*Tint, 30%, 150 Line Screen--Drainage patterns (rivers, creeks, etc.)*

*PURPLE: Tint, 5%, Combination of Red and Blue, 150 Line Screen--Zone D and Zone P areas*

*WHITE SPACE: Guttering between subzones in Zones A and V of 1/32 inch to delineate boundaries; Zone C areas; and block background for zone labeling.*

Use of color rather than black-and-white maps is recommended because of the importance and use to be made of the insurance rate map--i.e., use of different colors, particularly high-contrast colors, permits emphasis to be placed on certain important areas of the community and will result in maps that are more readily understood, read, and remembered by their users. Low-opacity colors make use of as much of the available light as possible and their use will facilitate map reading in poorly illuminated spaces. Furthermore, two contrasting colors, such as the red and blue suggested in the criterion, can be used in various combinations to produce a broad range of high-contrast tints, thus eliminating the need to introduce a third color should the need arise. This feature would ensure maintenance of the same color or tint to depict certain areas or items even if new tints have to be introduced.

The economics of producing insurance rate maps in color is a matter of concern. In this regard, it is important to know that the same equipment is used to produce both two-color and black-and-white maps.

Furthermore, the principal cost of producing any map is associated with the layout and cartographic time required to produce the printing plates comprising the composite or sandwich package. For two-color printing of insurance rate maps, the composite or sandwich package could consist of as few as five printing plates as follows:

Plate 1--Solid Corsair Blue--Map features, some lettering, the 100-year flood elevation reference line

Plate 2--30% Tint Corsair Blue--Drainage patterns

Plate 3--50% Tint Capico Warning Red--Zone A (or Zone V or M as appropriate) areas

Plate 4--15% Tint Corsair Blue--Zone B (or Zone M as appropriate) areas

Plate 5--Solid Capico Warning Red--Some lettering

It is estimated that the cost of producing two-color maps would be less than approximately twice that of producing the same maps in black and white.

With respect to the uses of colors and tints suggested in the criterion, the recommendations reflect the Panel's experience and judgment concerning maximum utility of the two-color scheme.

> *One front-panel subsection of the map should be devoted to presentation of a standardized title block containing the name and other identification of the community, the date the hazard zones were established or became effective, the date the map was prepared, the page number if more than one page is involved, and other information the FIA may deem necessary for purposes of identification. On a flood insurance rate map this panel should feature a standard alert statement regarding the availability of a mudslide insurance rate map and, conversely, this panel on a mudslide insurance rate map should reflect the availability of a flood insurance rate map. A second front-panel subsection should feature an indication of magnetic north, the bar scale (both English and metric), and legend.*
>
> *Symbols used on the map to depict features should correspond to those used by the U.S. Geological Survey except that roads and streets should be designated by single lines and the elevations of the 100-year flood waters should be designated with the wavy lines currently used by the FIA. Size of all lettering should be consistent with map scale but should be readily readable without magnification.*

The need for most elements covered in the above criteria is fundamental and self-explanatory (i.e., the name and other identification of the community, dates, scale, legend, etc.). It should be pointed out, however, that all symbols appearing on the map must be presented in the legend to ensure proper interpretation of the map. Thus, if a standardized legend is to be used, all other symbols appearing on the base map used in preparation of the rate

maps would, of course, have to be removed. Inclusion of the counterpart map availability statement is based on the need to ensure that the maps are not misused (e.g., that properties in mudslide hazard areas are not charged on the basis of their location as shown on a flood insurance rate map).