# DEPARTMENT OF NATURAL RESOURCES

## COLORADO WATER CONSERVATION BOARD

# FLOODPLAIN DESIGNATION AND APPROVAL

**2 CCR 408-1**

**EDITORS NOTES ***

Authority Cited:

History and Amendments:
Pp. 1-25 adopted 12/11/87, effective 1/30/88, 11 CR 1.

A. G. Opinions:
11 AG 14

Annotations:

*This Title Page does not constitute an official part of any regulation. Information contained on the title page is provided by the Publisher from sources deemed reliable and is solely for information and historical purposes. See cautionary note in Introductory Materials, How to Use the CCR.

TABLE OF CONTENTS

# RULES AND REGULATIONS FOR THE DESIGNATION AND APPROVAL OF FLOODPLAINS AND OF STORM OR FLOODWATER RUNOFF CHANNELS IN COLORADO

December 11, 1987

Rule 1. Title: The formal title of these rules and regulations is "Rules and Regulations for the Designation and Approval of Floodplains and of Storm or Floodwater Runoff Channels in Colorado." The short title for these rules and regulations is "Floodplain Designation and Approval Rules." They may be referred to herein collectively as the "rules" or individually as a "rule."

Rule 2. Authority: These rules are promulgated pursuant to the authority granted the Colorado Water Conservation Board, hereafter referred to as "the Board", in Sections 37-60-106(1)(c), 37-60-106(1)(k), 37-60-108, 30-28-111(1) and (2), 31-23-301(1) and (3), and 24-65.1-403(3), C.R.S.

Rule 3. Purpose and Scope:

A. Purpose. The purpose of these rules is to provide reasonably uniform standards for the designation and approval of floodplains and of storm or floodwater runoff channels in Colorado, and to prescribe the process by which floodplains and channels will be designated and approved by the Colorado Water Conservation Board.

B. Scope.

1. Zoning. These rules apply to all floodplain information developed for zoning purposes for streams in the State of Colorado by, but not limited to, individuals, corporations, local government agencies, regional government agencies, state government agencies, Indian tribes, and federal government agencies.

2. Subdivisions. These rules do not apply to the approval of subdivision drainage reports, which is a responsibility of local government. However, local governments are encouraged to insure that site-specific floodplain delineations prepared during development activities are consistent with floodplain information designated and approved by the Board.

3. Design Criteria. These rules do not apply to the selection of optimal economic design criteria for the construction of roads, bridges, irrigation structures, or any other facility in the floodplain.

4. Dam Failure Floodplain. These rules do-not apply to the identification of the area potentially inundated by tne catastrophic or sudden failure of any man-made structure such as a dam, canal, irrigation ditch, pipeline, or other artificial channel.

Rule 4. Definitions:

A. Terms Defined Herein. The following definitions are applicable to these Floodplain Designation and Approval Rules:

1. "Adequate progress" means that funding for a project has been 100 percent authorized, at least 60 percent appropriated, and at least 50 percent expended.

2. "Approximate floodplain information" means floodplain information prepared by signifi- cantly reducing the level of detail for topographic mapping, hydrology, or hydraulic calculations to arrive at floodplain delineations without a comparison of water surface profiles with a topographic map of compatible accuracy.

3. "Basin" means the total land surface area from which precipitation is carried away by a stream or system of streams under the force of gravity and discharged through one or more outlets.

4. "Board" means the Colorado Water Conservation Board.

5. "Channel" means a place on the surface of the earth where water flows regularly or intermittently with a perceptible current between observable banks, although the location of such banks may vary under different conditions.

6. "Community" means any political subdivision in the state of Colorado which has authority to adopt and enforce floodplain management regulations through zoning, including, but not limited to, cities, towns, unincorporated areas in the counties, Indian tribes, and Urban Drainage and Flood Control Districts.

7. "Designation and approval" means certification by formal action of the Board that certain technical information developed through scientific study using accepted engineering methods is suitable for making land use decisions under statutorily authorized zoning powers.

8. "Detailed floodplain information" means floodplain information prepared utilizing topographic base mapping, hydrologic analysis, and hydraulic calculations to arrive at precise water surface profiles and floodplain delineations suitable for making land use decisions under statutorily authorized zoning powers.

9. "Development" means any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, and mining, dredging, filling, grading, paving, excavating or drilling operations.

10. "FEMA" means the Federal Emergency Management Agency.

11. "Flood" or "Flooding" means a general and temporary condition of partial or complete inundation of normally dry land areas from:

    a. The overflow of water from channels and reservoir spillways.

    b. The unusual and rapid accumulation or runoff of surface waters from any source.

    c. Mudslides (i.e., mudflows) which are proximately caused by flooding as defined in paragraph b of this definition and which are sufficiently fluid so as to flow on and over the surface of normally dry land areas, as when earth is carried by a current of water and deposited along the path of the current.

12. "Flood Contour" means a line shown on a map joining points of equal elevation on the surface of flood water which is perpendicular to the direction of flow.

13. "Floodplain" means the area of land susceptible to being inundated as a result of the occurrence of a flood including the area of land over which flood water would flow from the spillway of a reservoir.

14. "Floodplain management" means the operation of an overall program of corrective and preventive measures for reducing flood damage, including, but not limited to, zoning or land-use regulations, flood control works, and emergency preparedness plans.

15. "Floodplain management regulations" mean zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a floodplain ordinance, grading ordinance, or erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

16. "Flooded area map" means a drawing which shows in plan view the horizontal boundary of floods of various magnitudes or frequencies. Such maps include, but are not limited to, Flood Hazard Boundary Maps (FHBM) and Flood Insurance Rate Maps (FIRM) published by FEMA, Floodprone Area Maps published by the U.S. Geological Survey (USGS), Flooded Area Maps published by the Corps of Engineers (COE), Flood Hazard Area Maps published by the U.S. Soil Conservation Service (SCS), Flooded Area Maps published by the Board, and Flood Hazard Area Delineations (FHAD) published by the Urban Drainage and Flood Control District (UD&FCD).

17. "Foreseeable development" means the potential future development of, or changes in, the land uses that are likely to take place during the period of time covered by a community's adopted master land use plan, or over a 20-year period, whichever is longer.

18. "Freeboard" means the vertical distance in feet above a predicted water surface elevation which is intended to provide a margin of safety to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.

19. "HEC-2" means the most recently revised version of the computer program developed by the U.S. Army Corps of Engineer's (COE) Hydraulic Engineering Center (HEC) for calculating flood water surface elevations.

20. "Hydrologic analysis" means the determina- tion of the peak rate of flow, or discharge in cubic feet per second, for various selected probabilities for streams, channels, or basins based on a scientific analysis of the physical process.

21. "Hydraulic analysis" means the determination of flood elevations and velocities for various selected probabilities based on a scientific analysis of the movement and behavior of flood waters in channels or basins.

22. "Levee" means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from flooding.

23. "100-year flood" means a flood which has a magnitude (peak discharge) which is expected to be equaled or exceeded on the average once during any one-hundred year period (recurrence interval) and has a one-percent chance of being equaled or exceeded during any year (0.01 exceedance probability). The terms "one-hundred-year flood," "one percent chance flood," and "intermediate regional flood" are synonymous with the term "100-year flood."

24. "100-year floodplain" means that area of land susceptible to being inundated as a result of the occurrence of a one-hundred-year flood.

25. "Precise" means accurate to within 0.5 foot vertically or 5.0 feet horizontally.

26. "Project cost" means the total financial cost of a flood protection system (including design, land acquisition, construction, fees, overhead, and profits), unless the Board determines a given "cost" not to be a part of such project cost.

27. "Rational Method" means an empirical method used to determine the maximum rate of runoff based on the formula Q = CIA, where Q is approximately equal to the peak rate of flow in cubic feet per second, C is a runoff coefficient, I is the average intensity of rainfall, and A is the contributing basin area in acres.

28. "Storm or floodwater runoff channel" means a floodplain.

29. "Significant change" means a change in a water surface profile of 0.5 feet or more for a continuous distance of at least 500 feet, a change of floodplain boundary effecting 5 or more acres, a change in flood velocity of 2.0 feet per second or more at any cross- section, or a potential for damage to property greater than $500 due to a change in water surface elevations or velocities.

30. "Water surface profile" means a graph which shows the relationship between the vertical elevation of the top of flowing water and of the streambed with the horizontal distance along the stream channel.

31. "Work map" means the document used during the hydraulic analysis which typically shows a greater level of detail or information than the published or final flooded area map.

B. Terms Defined by Statutes. Any term used in these Floodplain Designation and Approval Rules that is not defined herein but is defined in Sections 37-60-101, 37-87-102, or 24-65.1-103, C.R.S., is used with the meaning given therein.

Rule 5. Standards for Delineation of Detailed Floodplain Information: To qualify as detailed floodplain information, the standards of this rule with consideration of the effects of dams and levees being subject to the criteria of rules 7 and 8, respectively, must be met.

A. Topographic Base Mapping

1. Work Map. The work map shall be a line drawing showing contours and topographic features or an orthophoto map showing contours on a photographic background. Work maps with a photographic background prepared by conventional rectification methods which meet the accuracy standards described herein shall be acceptable.

2. Features. The following minimum information shall be shown on the work maps:

a. Natural features such as hills, depressions, trees and vegetation.

b. Cultural features such as streets, roads, highways, railroads, airfields, levees, dikes, dams, buildings, fences, powerlines, and other prominent man-made features and landmarks.

c. Hydrologic features such as rivers, streams, lakes, reservoirs, irrigation ditches, canals, and channels (including both banks of a stream).

d. Reference features such as north arrow, grid lines, section corners, reference monuments, corporate limits, contours and spot elevations.

e. Geographic orientation and appropriate notations such as names of principal natural, cultural, hydrologic, and reference features.

The work map may contain, but is not required to show, property lines and section lines. Fences, power lines, trees, and vegetation in platted areas may be omitted if it would improve clarity.

3. Ground Control. The vertical ground control, contours, spot elevations, and cross-sections shall be based on United States Coast and Godetic Survey (USC&GS) or United

States Geological Survey (USGS) monuments related to the National Geodetic Vertical Datum of 1929 (NGVD). The horizontal ground control shall be based on a minimum of 2 USC&GS triangulation stations, or the equivalent. A minimum of third order leveling (closures within ±0.05 x square root of distance in miles) shall be used to tie temporary bench marks and reference monuments to the National Geodetic Vertical Datum of 1929 (NGVD); to determine the elevation of high-water marks; and where needed, to establish vertical control control for aerial photogrammetry.

The ground control surveys shall be supervised by a Land Surveyor licensed in the State of Colorado. All permanent and semi-permanent control markers used for ground control surveys shall be shown and their respective elevations labeled on the work map.

4. Contour Interval. The work map contour interval shall be 5 feet or such contour interval showing greater detail. The Board recommends a work map contour interval of 2 feet.

5. Scale. The work map scale shall be 1 inch equals 500 feet or such map scale showing greater detail. The Board recommends a work map scale of 1 inch equals 200 feet.

6. Spot elevations. Spot elevations shall be provided at all intersections of the center lines of streets and roads and where needed to supplement the contours. Spot elevations shall also be provided within 50 feet of any building or any small group of buildings that is not within the limits of a city or a town or a platted subdivision.

7. Cross Sections. The cross-section data shall be obtained by photogrammetric methods at the time of map compilation, from the map contours, or through field surveys. All cross section points derived photogrammetrically or from the contours shall meet the accuracy standards in rule 5.A.8. All field-surveyed cross section points shall be within ±0.5 foot of true elevations.

Cross sections shall be located perpendicular to the direction of flow at appreciable changes in flow area, roughness, or stream gradient. Additional cross sections shall be located at bridges, at the head and tail of

levees, at confluences with tributaries, and at all flow control structures. In general, more cross sections are needed to define energy losses in urban areas than in rural areas, where steeper slopes are encountered, and on smaller streams. Based on computed results, additional cross sections may be required if the slope of the energy grade line between successive cross sections decreases by more than 50 percent or increases by more than 100 percent. The location of the cross-sections shall be shown on the work maps.

8. Map Accuracy. Vertical map accuracy shall be such that at least 90 percent of all contours are within 1/2 of the contour interval, and the remaining contours are not in error by more than 1 contour interval. Horizontal map accuracy shall be such that at least 90 percent of the planimetric features are plotted to within 1/40 inch as measured at the map scale, and the remaining features are plotted to within 1/20 inch.

In areas where the ground is completely obscured by dense brush or tree cover, contours shall be plotted as accurately as possible from the stereoscopic model, while making full use of spot elevations obtained where the ground is visible. Spot elevations shall have the same vertical and horizontal tolerance as the contours. Where applicable, the work map shall carry the statement: "This map complies with National Map Accuracy Standards."

B. Hydrologic Analysis

1. Frequency. The hydrologic analysis shall include, at a minimum, calculations for the 10-, 50-, and 100-year frequency flood peak discharges. The Board recommends that the peak discharge for the 500-year flood be calculated in addition to the other discharges.

2. Methodology. Peak discharges developed from hydrologic analysis for floodplain management purposes shall be determined by one or more of the following methods depending on the length of systematic records available: statistical analysis or regional regression analysis of stream gage data, including historic flood data; comparisons with similar watersheds; or flood estimates using hydrologic models and precipitation records (synthetic analysis). All available streamflow data from

the drainage basin and adjacent basins shall be inventoried and documented.

a. When at least 50 years of streamflow records are available, a statistical analysis of the individual streamflow record and/or a regional regression analysis of the data shall be made to determine the flood peaks of selected recurrence intervals.

b. When from 25 to 50 years of streamflow records are available, the hydrologic analysis shall include a statistical analysis in accordance with rule 5.B.2.a and a comparison with similar watersheds.

c. When from 10 to 24 years of streamflow records are available, the hydrologic analysis shall include a statistical analysis in accordance with 5.B.2.a, comparisons with similar watersheds, and flood estimates using hydrologic models and precipitation records.

All drainage basin characteristics that affect the rainfall-runoff relationship shall be documented, including, but not limited to, delineation of basin and subbasin boundaries, size, shape, length, slope, general aspect, elevation extremes, time of concentration, land use, and soil types and compositions.

When actual precipitation records of major recorded storm events are available from area weather stations, such data shall be used in conjunction with rainfall data.

d. When less than 10 years of streamflow records are available, the selected flood frequency flows shall be calculated by comparison to similar watersheds and by estimates using hydrologic models and precipitation records.

3. Drainage Basin Conditions. The hydrologic analysis shall be based on drainage basin conditions that will exist in the community at least 12 months following completion of the report, except if future urbanization of a basin is likely to occur, the hydrologic analysis shall be based on foreseeable development in the basin.

4. Work in Progress. Where construction of publicly owned, operated and maintained flood control structure will not be completed within 12 months following completion of the report, but adequate progress has been made, the impact of the project shall be included in the hydrologic analysis.

5. Detention. The hydrologic analysis shall consider the effects of on-site detention for rooftops, parking lots, highways, road fills, railroad embankments, diversion dams, refuse embankments (e.g., solid waste disposal facilities), mill tailings impoundments, siltation ponds, livestock water tanks, erosion control dams, or other structures only if they have been designed and constructed with the purpose of impounding water for flood detention and are owned, operated, and maintained by a government body. Detention structures that are randomly located, privately owned, or privately maintained shall not be included in the hydrologic analyses unless it can be shown that they exacerbate downstream peak discharges.

6. Previous Studies. Where appropriate, available floodflow-frequency information shall be used so that previous work by Federal, State, or local agencies shall not be duplicated. Where such data are not available, where conditions have changed significantly, or where the methodologies or data used in previous studies are not appropriate, a new hydrologic analysis for each stream shall be prepared.

   A comparison of any proposed discharges with all published or unpublished floodflow- frequency data that exist for the study area shall be provided to the Board.

   Proposed flood discharges shall be compatible with those used in previously completed studies on the same watercourse. The results of a later floodflow-frequency analysis shall be considered, where they disagree with discharges used in completed studies, only when they can be shown to be significantly different statistically than the previously used discharges. The test for significance shall be based on the confidence limits of the latest analysis, as described below.

Where a later floodflow-frequency analysis provides discharges that differ from those established previously in studies on the same stream, the latest discharges shall be adopted if the previously established discharge do not fall within the 95 and 5 percent confidence limits (90 percent confidence interval) of the most recent estimates. The previously established discharges shall be adopted if they fall within the 75 and 25 percent confidence limits (50 percent confidence interval) of the most recent estimates. Where the previously established discharges fall between 50 and 90 percent confidence intervals of the most recent estimates, the situation shall be presented to the Board for resolution.

C. Hydraulic Analysis

1. Water Surface Profiles. Hydraulic calcula- tions shall be performed to define, at a minimum, the water surface profiles for the 10-, 50-, and 100-year flood frequencies as developed in the hydrologic analysis. The hydraulic calculations for each frequency flood shall be summarized in a frequency- elevation table or, in lieu of the table, may be shown on the graph of water surface profiles. The table shall include, at a minimum, the stream station for each cross section, cross section identification, peak discharges, and water surface elevations. The water surface profiles shall show, at a minimum, the elevations for the 10- and 100-year flood. The Board recommends the 50- and 500-year water surface profiles be shown in addition to other profiles.

2. Floodplain Boundaries. Flooded area maps shall show, at a minimum, the floodplain boundary of the 100-year flood. Where more than one floodplain may be delineated on the maps, the Board recommends the 500-year floodplain be shown in addition to the 100-year floodplain. The floodplain boundaries shown on the flooded area maps shall be consistent with the flood water surface profiles.

3. Methodology. The hydraulic analysis for detailed floodplain information shall be based on the following methods, or any other method approved by the Board, as appropriate:

a. Step-Backwater Method. Flood water surface profiles may be calculated by the standard step method employing the Bernoulli energy equation with energy losses due to friction evaluated with the Manning equation and other losses evaluated by shock loss equations.

b. Alternative Methods. An alternative hydraulic methodology may be accepted by the Board provided it has been recommended for general use by a governmental agency or notable scientific body, is well documented and is available to the general user. In the case of a computer program, documentation shall include a published user's manual and a programmer's manual.

4. Floodplain Delineation Procedures. The floodplain boundaries shall be delineated by one of the following methods:

a. Flood Contour Method. A reference line shall be shown down the center of the low flow channel on the work maps for all streams studied by detailed methods. Flood contours, derived from the water surface profile and corresponding to the map contours, shall be used to define the boundaries of the 100-year floodplain on the work maps. The flood contours shall have a vertical interval equal to the contour interval of the work map if a) the average slope of the water surface profile between cross sections is flatter than one to one-hundred, or b) the width of the floodplain is greater than 200 feet, or c) there are, in the judgment of the engineer, unusual topographic features. Alternate flood contours or index flood contours may be used in lieu of the above flood contour interval if the slope of the water surface profile, in combination with the work map contour interval and scale, would result in an average horizontal spacing between flood contours of less than 1 inch. A copy of the work map shall be provided to the Board for review by the staff prior to designation and approval under this rule.

b. Map Contour Method. A reference line shall be shown down the center of the low flow channel on the base map for all streams studied by detailed methods. For the selected channel and floodplain cross sections, the 100-year flood water surface elevations and floodplain

horizontal widths shall be computed. The 100-year flood boundaries shall be delineated between these cross sectional locations by transposing the water surface elevations to a one or two foot contour topographic base map. These intermediate locations must be correlated to the reference line and the 100-year flood profile as to their specific location and elevation.

5. Blockage. All culverts and bridges shall be considered for the potential to become blocked by floating debris. In determining if there is a potential for blockage, and subsequent reduction in conveyance, old photographs, the history of maintenance during high flows, watershed characteristics such as erodibility of channel banks, amount and type of vegetation along stream, and size and character of the waterway shall be evaluated. Blockage may be accounted for in computer runs by increasing width of piers, raising streambed elevation or reducing waterway opening by a percentage. Where the potential for blockage can be shown, human intervention (e.g., snagging) shall be considered only if such flood fighting activities are specifically included in the community's adopted emergency response plan.

6. Roughness Coefficients. Values for the roughness coefficient at valley cross sections shall be based on assumed worst case vegetation conditions along the stream and floodplain. Past flood data, if available, shall be used to verify the adopted roughness coefficients, taking into consideration any alteration in the channel subsequent to the floods. Photographs shall be taken of the study reaches of the stream channel and floodplain to support roughness coefficients used for hydraulic computations.

7. Consistency. A comparison of any proposed 100-year flood profile with all previously designated and approved information shall be provided to the Board. Except where a clearly identified change in flooding characteristics or error in the existing data can be shown, the proposed 100-year flood elevations shall agree with those of other contiguous studies on the same stream. Elevations of cross sections shall be computed to match within ±0.5 foot of an existing valid elevation; however, the final published 100-year flood water surface profile shall be shown to

match the contiguous study exactly. Where elevations cannot be reconciled to within ±0.5 foot because of changed flooding conditions or an error in the previous analysis, a full explanation and justification for the difference shall be provided to the Board.

D. Published Report and Map

1. Reports. The results of the hydrologic and hydraulic analyses, as developed in accordance with rules 5B and 5C, shall be summarized in a published report. All detailed floodplain information which is presented to the Board for designation and approval shall be entitled, dated, and bound in an individual document.

2. Flooded Area Maps

a. The published flooded area maps shall show, at a minimum, the flood boundaries in accordance with rule 5C2, the location of all cross sections used in the hydraulic analysis and/or a reference line drawn down the center of the low flow channel, and a sufficient number of flood contours in order to reconstruct the flood water surface profiles to an accuracy of ±0.5 foot. Flood contours shall be shown as wavy lines drawn normal to the direction of flow of floodwater and shall extend completely across the area of the 100-year floodplain. Each flood contour shall indicate its elevation to the nearest whole foot.

b. Published Map Scale. The published flooded area map scale shall be 1 inch equals 1000 feet or such map scale showing greater detail. The Board recommends a published map scale of 1 inch equals 400 feet.

3. Discrepancies. Where discrepancies appear between flooded area maps and water surface profiles, any 100-year water surface profile designated by the Board shall take precedence over any corresponding flooded area map for the same stream reach.

E. Qualifications. All detailed floodplain information shall be developed by a qualified hydrologist or hydraulic engineer under the direct supervision of a professional engineer registered in the State of Colorado, or by an employee of a state or federal government agency that has executed a memorandum of understanding or other written agreement with the Board based on a written statement which demonstrates to the satisfaction of the Board their equivalent qualifications to perform such work in Colorado.

Rule 6. Standards for Delineation of Approximate Floodplain Information: To qualify as approximate floodplain information, the standards of this rule with consideration of the effects of dams and levees being subject to the criteria of rules 7 and 8, respectively, must be met.

A. Topographic Base Mapping.

1. Work Map. The best available topographic base map shall be used to develop approximate floodplain information. Such work map shall, at a minimum, be the most recent edition of a 7.5 minute quadrangle as published by the U.S. Geological Survey (USGS).

B. Hydrologic Analysis

1. Frequency. The hydrologic analysis for the preparation of approximate floodplain information shall include, at a minimum, calculation of the 100-year frequency flood peak discharge.

2. Other Requirements. The hydrology for approximate floodplain information shall, at a minimum, meet the hydrology standards in rule 5.B.2 through 5.B.6. for detailed floodplain information.

C. Hydraulic Analysis

1. Floodplain Boundaries. Approximate flooded area maps shall show, at a minimum, the floodplain boundary for the 100-year flood.

2. Methodology. Approximate flooded area maps shall be based on the following simplified methods, or any other method approved by the Board, either individually or in combination, as appropriate:

a. Assumed Depth Method. An assumed flood depth above the channel may be used in conjunction with the best available topographic map. The assumed depth may be determined from a regional regression analysis of depth-frequency relations or from the slope-area-conveyance calculation at representative cross sections. Where approximate floodplain boundaries have been developed based on an assumed or representative

100-year flood depth, the assumed depth shall be so stated on the maps.

b. Geomorphic Features Methods. Approxi- mate 100-year flood boundaries may be determined from a study of geomorphic features on the best available topographic map.

c. Historic Flood Method. Historical flood information may be used directly if the peak discharge can be shown to approximate a 100-year flood and is applicable to the present conditions. Historical flood information may be available in government reports on maps that have been prepared for major floods, from high-water marks, from gaging station data, or from miscellaneous discharge measurements made in the study area.

D. Published Report and Maps

1. Reports. All approximate floodplain information which is presented to the Board for designation and approval shall be entitled, dated, and bound in an individual document.

2. Published Map Scale. The published flooded area map scale shall be 1 inch equals 2000 feet or such map scale showing greater detail.

E. Qualifications. All approximate floodplain information shall be developed by a qualified hydrologist or hydraulic engineer under the direct supervision of a professional engineer registered in the State of Colorado, or by an employee of a state or federal government agency that has executed a memorandum of understanding or other written agreement with the Board based on a written statement which demonstrates to the satisfaction of the Board their equivalent qualifications to perform such work in Colorado.

Rule 7. Criteria for Determining When the Effects of Dams on Floods May Be Taken Into Account:

A. Flood Control Dams. If a publicly owned, operated and maintained dam is specifically designed and operated, either in whole or in part, for flood control purposes, then its effects shall be taken into consideration when delineating the floodplain below such a dam. The effects of the dam shall be based upon the 100-year flood under foreseeable development, with full credit to be given to the diminution of peak flood discharges which would result from normal dam operating procedures.

B. Non-Flood Control Dams. If a dam is not specifically designed and operated, either in whole or in part, for flood control purposes, then its effects, even if it provides inadvertent flood routing capabilities which reduce the 100-year flood downstream, shall not be taken into account and the delineation of the floodplain below such a dam shall be based upon the 100-year flood that would occur absent the dam. However, if adequate assurances have been obtained to preserve the flood routing capabilities of such a dam, then the delineation of the floodplain below the dam may, but need not, be based on the assumption that the reservoir formed by the dam will be filled to the elevation of the dam's emergency spillway.

C. Adequate Assurances. For the purposes of rule 7.B, "adequate assurances" shall, at a minimum, include appropriate recognition in the community's adopted master plan of: (1) the flood routing capability of the reservoir, as shown by a comparison of the 100-year floodplain in plan and profile with and without the dam in place in order that the public may be made aware of the potential change in level of flood protection should the reservoir flood routing capability be lost and (2) the need to preserve that flood routing capability by whatever means available should the reservoir owners attempt to make changes which would decrease the flood routing capability.

In addition, an agreement must be executed between the Board (or the Urban Drainage and Flood Control District on behalf of the Board if the floodplain below the dam is in their jurisdiction), and the affected local governments which expresses the intent of the parties to assure that the flood routing capabilities of the reservoir will be maintained by

whatever means are available when and if the reservoir owners attempt to make changes which would reduce the flood routing capability.

Rule 8. Criteria for Determining When the Effects of Levees on Floods May Be Taken Into Account:

A. Ownership. Privately owned, operated, or maintained levee systems will not be considered in the hydraulic analysis to be performed pursuant to rule 5 or rule 6 unless a local ordinance mandates operation and maintenance of the levee system and the criteria set forth below are met. Levees for which the community, State, or Federal government has responsibility for operation and maintenance will be considered provided that the criteria set forth below are met.

B. Freeboard. A minimum levee freeboard of 3 feet shall be necessary, with an additional 1 foot of freeboard within 100 feet of either side of structures within the levee or wherever the flow is constricted, such as at bridges. An additional 0.5 foot above this minimum is also required at the upstream end, tapering to the minimum at the downstream end of the levee.

C. Field Inspection and Maintenance. The levee shall be structurally sound and adequately maintained. Certification from a Federal agency, State Agency, or a registered professional engineer that the levee meets the minimum freeboard criteria above and that it appears, on visual inspection, to be structurally sound and adequately maintained shall be required. Levees that have obvious structural defects, or that are obviously lacking in proper maintenance, shall not be considered in the hydraulic analysis.

D. Internal Drainage. Where credit will be given to levees providing 100-year protection, the adequacy of interior drainage systems shall be evaluated. Areas subject to flooding from inadequate interior drainage behind levees will be mapped using standard procedures.

E. Human Intervention and Operation. In general, evaluation of levees shall not consider human intervention (e.g., capping of levees by sandbagging, earthfill, or flashboards) for the purpose of increasing a levee's design level of protection during an imminent flood. Human intervention shall only be

considered for the operation of closure structures (e.g., gates or stoplogs) in a levee system designed to provide at least 100-year flood protection, including adequate freeboard as described above, provided such operation is specifically included in the community's adopted emergency response plan.

F. Analysis. For the area protected by a levee providing less than 100-year protection, 100-year flood elevations shall be computed as if the levee did not exist. For the unprotected area between the levee and the source of flooding, the elevations to be shown shall be obtained from either the flood profile that would exist at the time levee overtopping begins or the profile computed as if the levee did not exist, whichever is higher.

This procedure recognizes the increase in flood elevation in the unprotected area that is caused by the levee itself. This procedure may result in flood elevations being shown as several feet higher on one side of the levee than on the other. Both profiles should be shown in the final report and labeled as "before levee overtopping" and "after levee overtopping," respectively.

Rule 9. Designation and Approval of Floodplain Information:

A. Designation and Approval Requirements. The Board will designate and approve floodplains and storm or floodwater runoff channels by the adoption of written resolutions based only upon such floodplain information as the Board determines meets the standards set forth in rule 5 or rule 6, as applicable, with consideration of the effects of dams and levees being subject to the criteria of rules 7 and 8, respectively.

B. Base Flood. The 100-year flood shall be the basis for all designations and approvals by the Board, for zoning purposes, of floodplains and of storm or floodwater runoff channels in Colorado.

C. Conditions. All designations and approvals of approximate floodplain information by the Board shall specify that the community may not exercise its zoning powers based on the Board's designation unless it includes in its zoning ordinances or regulations the requirement that there be a case-by-case review with a detailed hydrologic and hydraulic investigation for rezoning and development activities within the approximate 100-year floodplain.

D. Process for Taking Designation and Approval Actions. The Board may consider the designation and approval of floodplain information either by request of a community or by acting on its own initiative.

1. Consideration at a Community's Request. The Board shall consider designation and approval of floodplain information upon written request from the governing body of any community having jurisdiction in the area where the floodplain information is applicable. The letter of request shall identify the report title, date, author or agency which prepared the report, stream name(s), upstream and downstream limits of the stream reach(es) to be designated, stream length(s) in miles, type of designation requested (detailed or approximate), and any other relevant information. Such request must be received by the Board at least 30 days prior to the Board meeting at which consideration of designation and approval is requested.

2. Consideration at the Board's Initiative. If designation and approval of a floodplain would be in the best interests of the health, safety, and welfare of the citizens of the State of Colorado, then the Board may take action at its own initiative to consider the designation and approval of floodplain information. In such cases, the Board shall notify the affected communities in writing at least 45-days prior to the Board meeting at which it will consider the designation and approval of floodplain information within their jurisdiction.

E. Notification of Adopted Resolutions. The Secretary of the Board shall send certified copies of each adopted resolution of designation and approval to the legislative bodies of each community having jurisdiction in the study area; to the state emergency preparedness agency; and to the agency that was responsible for preparing the floodplain information.

Rule 10. Changes in Designations and Approvals of Floodplain Information: Any community wishing to request changes to and/or rescission of previously designated and approved floodplain information, or any part thereof, may request an amendment of the designation. A written request for amendment shall be filed: (1) with the entity which sponsored the development of the floodplain information proposed to be amended if different than the the community requesting the change, and (2) with the Board at least 30 days prior to the Board meeting at which consideration of an amendment is requested.

All requests for amendments shall include such engineering and technical data as may be required by the Board to support the request. Supporting information to be furnished by the requester shall include, at a minimum, a comparison in both plan and profile showing all changes with the previously designated information. If the supporting information is found to cause significant change in flood water surface profiles or velocities and is complete and acceptable to the Board, the original designation or portion thereof shall be rescinded and/or amended to reflect the new information provided.

Rule 11. Variances

A. Consideration by the Board. Requests for a variance to any of these rules may be considered by the Board provided the entity requesting the variance has submitted a written request to the Director of the Board and notice of the request is given to the community, if different from the entity requesting the variance, that would be affected by the variance, if granted.

B. Contents of a Request for Variance. The request for a variance shall identify:

1. the rule from which the variance is requested,

2. the communities that would be affected by the variance,

3. the reasons why the rule cannot or should not be complied with,

4. the estimated difference in water surface elevations, flood velocities and flood boundaries that will result if the requested variance is granted than if the calculations are made through strict compliance with the rule,

5. the estimated number of people and structures that will be impacted by granting of the variance, and

6. any other evidence submitted by the community, the Colorado Water Conservation Board staff, or other party at interest.

C. Factors to be Considered. Variances may be issued by the Board if it can be determined that:

1. there is good and sufficient cause, and

2. the variance is the minimum necessary, considering the flood hazard, to afford relief, and

3. failure to grant the variance would result in exceptional hardship to the community and that the hardship is not in the community's own making, and

4. the granting of a variance will not result in increased vulnerability to flood losses, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud or victimization of the public, hide information of significant interest to the public or conflict with existing local laws or regulations.

Rule 12. Incorporation by Reference: The Statement of Basis and Purpose for the adoption of these Floodplain Designation and Approval Rules is incorporated by reference as part of these rules.

Rule 13. Severability: If any portion of these Floodplain Designation and Approval Rules is found to be invalid, the remaining portion of the rules shall remain in force and in effect.

Rule 14. Revision of Rules: The Colorado Water Conservation Board may revise these rules in accordance with Section 24-4-103 C.R.S. Such revisions may be the result of new information and/or the submittal of a petition by an interested person pursuant to Section 24-4-103(7) C.R.S. and 2 C.C.R. 402-5 1.1.3.B.2.

Rule 15. Effective Date: These rules shall apply to the designation and approval of all floodplain information made by the Board on or after January 1, 1988, and are, therefore, not retroactive to any floodplain information designated and approved by the Board prior to the effective date.