

August 1, 2007

**Larimer County Engineering Dept.  
Procedural Guide for**

**Floodplain Special  
Review**



**Floodplain Special Review Process**

The floodplain special review process contains the following steps:

**1. Pre-Application Meeting Between Applicant and County Staff.** An initial meeting between the applicant and Larimer County Engineering Department staff is **mandatory** prior to beginning either a hydrologic or hydraulic study in support of a Floodplain Special Review. This provides an opportunity for the applicant and County staff members to discuss the project and the planned modeling effort. It also provides an opportunity for the applicant and staff to agree on assumptions and parameters that are appropriate for the particular modeling effort.

Please note that actions requiring a Conditional Letter of Map Revision (CLOMR) or a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (FEMA) may need to be scheduled to go before the Flood Review Board and Board of County Commissioners before they are sent to FEMA to be processed and reviewed.

**2. Initial Project Submittal and Staff Review Period.** In order for the submittal to be accepted, the applicant must submit a completed application form and two copies of the hydraulic or hydrologic modeling report. The report shall be signed and stamped by the State of Colorado registered professional engineer who prepared or directed preparation of the report. A fee of \$ 400.00 must accompany the application to partially pay for administrative and advertising costs. The check should be made payable to Larimer County. Additionally, if the submittal involves a Conditional Letter of Map Revision (CLOMR) or a Letter of Map Revision (LOMR), the applicant will also be liable for applicable fees for the FEMA process.

County Engineering staff will review the submitted hydraulic and/or hydrologic modeling report to confirm compliance with Larimer County Hydraulic and Hydrologic Modeling Report Submittal Requirements. Staff will provide review comments and express staff's recommendation in regards to the submitted report in a memo by the end of a two<sup>1</sup> week period following receipt of the initial submittal.

**3. Applicant Revision Periods Followed by Additional Staff Review Periods as Required.** The applicant's professional engineer can revise the Hydraulic or Hydrologic Modeling Report to address staff concerns. Staff will review the revised report, provide

review comments, and express a staff recommendation in regards to the report in a memo by the end of a two<sup>1</sup> week staff review period. The applicant can request to proceed to the public hearing stage at any time subject to staff's current recommendation on the application.

**4. Submittal to Flood Review Board (deadline on 4<sup>th</sup> Thursday of month for the next month's meeting).** The applicant must submit a minimum of eight copies of the hydraulic or hydrologic modeling report. The report shall be signed and stamped by the State of Colorado registered professional engineer who prepared or directed preparation of the report. Filing deadlines are the fourth Thursday of each month for the following month's meeting.

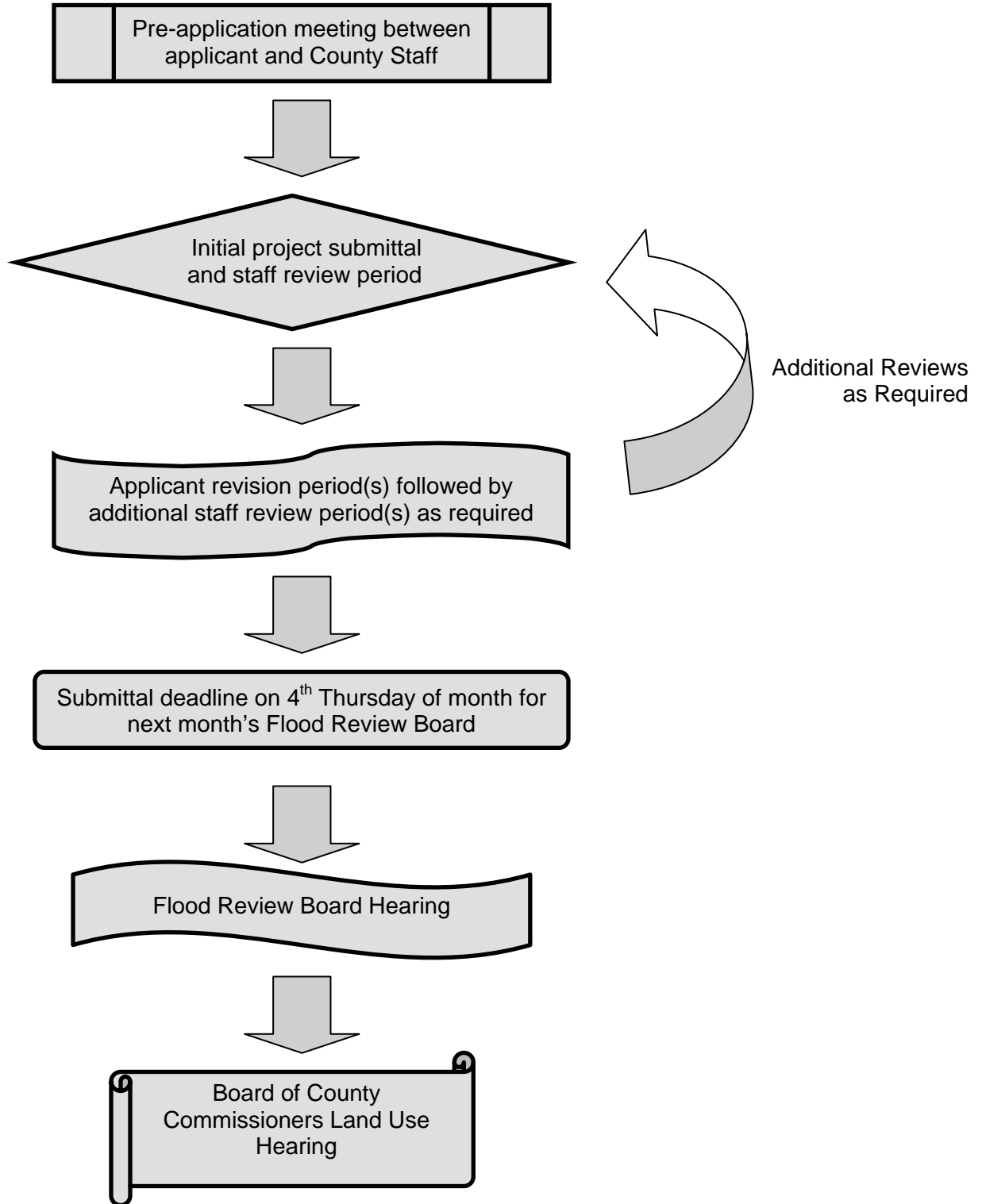
**5. Flood Review Board Hearing.** The registered professional engineer who prepared or directed preparation of the hydraulic or hydrologic modeling report must be present at the Flood Review Board Meeting. Hearings for the Flood Review Board are held on the 4<sup>th</sup> Thursday of the month at 8:00 AM in an Engineering Department conference room. At this meeting, the Flood Review Board will either table the application or make a recommendation to the Board of County Commissioners to approve; approve with conditions; or deny the application.

**6. Board of County Commissioners Land Use Hearing.** A hearing before the Board of County Commissioners will be scheduled a minimum of three weeks following the Flood Review Board Hearing. Land Use Hearings are held on Mondays (or on Tuesday if Monday is a Holiday) at 3:00 PM in the Commissioners' Hearing Room. At this meeting the Board of County Commissioners will either approve; approve with conditions; table; or deny the application.

Page three shows a graphic depiction of the floodplain special review process.

<sup>1</sup> Under rare and extenuating circumstances the two week staff review period may be extended to accommodate staff scheduling demands. If this event occurs the applicant will be notified by email of the expected completion date.

## Floodplain Special Review Process



## **Review Criteria for Floodplain Special Review**

For a favorable review and recommendation from the Larimer County Flood Review Board, the provisions of Section 4.2.2.1.2 of the Larimer County Land Use Code, listed below, must be met.

To approve a floodplain special review, the Board of County Commissioners must find that the following conditions exist.

- a. There is no danger to life and property due to increased flood heights or velocities caused by encroachments upstream or downstream within the floodplain.
- b. No danger to life or property may reasonably be expected to result from substantial solid debris being carried down the stream by floodwaters.
- c. There is no danger of materials being swept away onto other lands or downstream to the injury of others in the event of a flood.
- d. Proposed water supply and sanitation systems have been designed to prevent disease, contamination and unsanitary conditions in the event of a flood.
- e. The proposed use is consistent with the flood management program for the area in question.
- f. Access to the property is safe in times of a 100-year flood.
- g. The expected heights, velocity, duration, rate of the rise and sediment transport of flood waters at the proposed location are consistent with the proposed use.
- h. Any modification of the terrain within the FW-Floodway Zoning District will not result in a rise in overall flood heights at any location.
- i. Any modification of the terrain within the FW-Floodway Zoning District will not reduce available flood storage volume.
- j. Any modification of the terrain within the FW-Floodway Zoning District is environmentally sound and will not result in a net loss of vegetation nor wildlife habitat.
- k. Any modification of the terrain within the FW-Floodway Zoning District will not result in reduced stability of the river channel or floodplain.

# Larimer County Hydraulic and Hydrologic Modeling Report Submittal Requirements

These guidelines, where applicable, are to be used to assist in the preparation and review of hydraulic and hydrologic modeling reports. The County wishes to streamline the review process and give consultants a framework of expectations to be met in order to gain approval of a modeling report.

## Hydraulic Modeling Reports

Hydraulic Modeling Reports will be required in the following circumstances:

- A. There is a need to document hydraulic conditions in a **designated floodway**;
- B. when a development falls within a floodplain that has a **no-rise criteria**;
- C. when a development falls within a known hazard area for which detailed floodplain mapping is not available
- D. when the Larimer County Floodplain Administrator (while authorizing **CLOMR or LOMR** submittals) determines a need for a more detailed review;
- E. other **unique special hazard projects** in flood prone areas, such as channel restoration following a flood, at the direction of the County Engineer.

### Hydraulic Modeling Report Submittal Requirements:

**Report Organization.** The following information must be included in a hydraulic modeling report organized as follows:

1. a **project description**;
2. a **summary of previous hydraulic studies**;
3. **compensatory storage** information if identified in pre-application meeting;
4. **discharges and modeled flood recurrence intervals**;
5. a summary of **methods and approaches** used;
6. a description of the **hydraulic models**;
7. a response to the **review criteria for Floodplain Special Review** (see review criteria for floodplain special review in prior section);
8. an **Appendix**.

**1. Project Description.** The following information must be included in the project description:

- a. floodplain information (name, description, Flood Insurance Study (FIS) panel No., date of the Flood Insurance Rate Map (FIRM));
- b. a description of the purpose of the hydraulic study;
- c. a description of the intended land use for the area of the study;
- d. a description of any changes which may have occurred since earlier studies such as gravel mining, or road construction;
- e. information on the adopted basin master plan and this project's effects on the master plan;
- f. information on the study location, including vicinity maps and site plans, that show streams, roads, lakes, topography, etc. which may effect floodplain issues;

g. a description of any proposed project phasing.

**2. Summary of Previous Hydraulic Studies.** The following information must be identified in the summary of previous hydraulic studies:

- a. all previous adopted master plans, master plan updates, flood insurance studies, and/or U.S. Army Corps of Engineers studies;
- b. the effective flood insurance study;
- c. information on the source of hydraulic data
- d. any previous map revisions in the vicinity of the project;
- e. any other pertinent reports;
- f. information on the source of historic water surface elevations and discharges.

**3. Compensatory Storage.** This section must be addressed if required in the pre-application meeting. In non-conveyance zones and storage areas for floodplains, which are identified by Engineering Department staff, compensatory storage shall be computed. Modelers will be expected to demonstrate that floodwater displaced by the project is offset by storage at another location so as not to impact neighboring properties.

**4. Discharges and Modeled Flood Recurrence Intervals.** The following information must be included with the discharges and modeled frequencies:

- a. a table showing the discharges used for the computations and the recurrence intervals represented by the discharges.

**5. Methods and Approaches Summary.** The following information must be included in a hydraulic modeling report:

- a. a description of the model used (state the model version, date of model);
- b. a discussion of the modeling parameters and an explanation of any changes in parameters between studies (parameters to be addressed include n-values, expansion and contraction coefficients, encroachments, channel and overbank lengths, bank stations, bridge data, culvert data and ineffective and obstructed flow areas);
- c. a discussion of channel, bank, and structural stability for the pre and post project condition models including an analysis of the channel stability;
- d. in the case of any proposed physical encroachment in the stream/river channel (such as pipelines, bridge abutments, or piers), a scour analysis shall be conducted to characterize the potential depth and lateral extent of scour during the maximum scour event up to the 100 year event by all applicable mechanisms;
- e. a discussion of any scour countermeasures designed using appropriate and widely accepted technical engineering methods to protect the channel and proposed facilities from damage due to scour during the maximum scour event up to the 100 year event and supporting construction drawings/details;
- f. a description of any changes in the proposed project or base flood elevations that came about as a result of the modeling;
- g. a discussion of how changes in the floodplain and/or floodway represented by the proposed project were incorporated into the post-project conditions model (describe any changes in the planned activity proposed to accommodate these changes).

**6. Hydraulic Models.** The following information must be included in a hydraulic modeling report.

- a. **A discussion of the duplicate effective model.** Describe and use the exact parameters that are included in the effective model.

- b. **A discussion of the corrected effective model.** The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the current effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model. If no update to the duplicate effective model is required, the corrected effective model may be omitted.
- c. **A discussion of the pre-project conditions model.** Include documentation of any changes in the floodplain or basin hydraulic conditions since the previous study. Changes in hydraulic conditions might be the result of street or bridge construction, channel improvements or changes in land use. Documentation might consist of as-built plans, surveyed cross sections, or pictures of new land uses. If no update is needed the pre-project conditions model may be omitted.
- d. **A discussion of the post-project conditions model.** This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for a proposed project, this model must reflect proposed conditions. Describe how the proposed changes in the floodplain were modeled to effectively represent the changed conditions.
- e. A table of water surface elevations resulting from the hydraulic analyses as well as identification of any differences in water surface elevation between the previous applications of the hydraulic model.

**7. Review Criteria for Floodplain Special Review.** Provide a response to each of the 11 mandatory provisions of section 4.2.2.1.2, items a. through k. of the Larimer County Land Use Code (as noted on page 4 of this packet).

- 8. Appendix.** The following information must be included with the appendix:
- a. input data and detailed output data;
  - b. a flow conveyance table, summary output table, HEC-RAS (Hydrologic Engineering Centers River Analysis System) standard table 1, HEC-RAS standard table 2 with bed shear information, hydraulic depth information, and error message output;
  - c. include the duplicate effective, corrected effective, pre-project conditions, and post-project conditions model's tabular and graphical profiles and cross-section plots;
  - d. copies of any correspondence with FEMA or the U.S. Army Corp of Engineers;
  - e. include CHECK-RAS output with an explanation of any unresolved error messages, if a HEC-RAS model was used;
  - f. a topographic map showing the boundaries of the effective, pre-project, and post-project conditions 100-year floodplain (for approximate Zone A revisions) or the boundaries of the 100-year and 500-year floodplains for both the Larimer County's 0.5 foot regulated floodway (for detailed Zone AE, AO, and AH revisions) and FEMA's 1 foot regulated floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g. dams, levees, etc.); current community easements and boundaries; boundaries of the requester's and neighboring property; stamp and signature of a registered professional engineer registered in the State of Colorado; location and description of National Geodetic Survey, County, and or municipality benchmarks; existing and proposed contours, and the referenced vertical datum (National Geodetic Vertical Datum, North American Vertical Datum, etc.)

(Note that the boundaries of the existing or proposed condition floodplain and both Larimer County's 0.5 foot regulated floodway and FEMA's 1 foot regulated floodway to be shown on the revised FIRM must tie-in with the effective floodplain and the respective regulated floodway boundaries. Please include a copy of the effective FIRM, annotated to show the boundaries of the revised 100-year and 500-year floodplains and both Larimer County's 0.5 foot regulated floodway and FEMA's 1 foot regulated floodway. The revised floodplain and floodway limits need to tie-in with the boundaries of the effective 100-year and 500-year floodplains and the respective regulated floodway boundaries at the upstream and downstream limits of the area of revision);

- g. input and output files on CD.

# Hydrologic Modeling Reports

Hydrologic modeling reports will be required in the following circumstances:

- A. When the area of the tributary basin or any subbasin **exceeds 160 acres** and flow data are not available. In this case, the engineering concern is the complexity of the basin being modeled, and the validity of the assumptions implicit in rational formula computations. The rational formula assumes a uniform velocity of flow of runoff through the basin and it does not differentiate between different basin shapes, varying slopes or varying infiltration rates;
- B. when a development falls within a basin for which **no master plan** or accepted hydrologic modeling report exists;
- C. when there is a diversion of stormwater from one subbasin to another which might affect downstream properties or which was not modeled in the original basin study.

**Report Organization.** The following information must be included in a hydrologic modeling report organized as follows:

1. a **project area description**;
2. a **summary of previous hydrologic studies**;
3. a discussion of **modeling parameters**;
4. a summary of **methods and approaches to hydrologic modeling**;
5. a summary of **discharges and modeled frequencies** and modeling results.

**1. Project Area Description.** The following information must be included in the project area description:

- a. a description of the purpose of the hydrologic study;
- b. a description of the intended land use for the area of the study
- c. a description of the site location and the location of nearby streets, a basin map with project area and all sub-basins delineated, the hydrologic basin name if applicable, flood insurance rate map (FIRM) panel number if applicable, date of flood insurance study (FIS) if applicable;
- d. a description and documentation of any changes in the basin since earlier studies such as basin development, road construction, or the construction of stormwater diversions and/or stormwater detention which would affect the basin hydrology.

**2. Summary of Previous Hydrologic Studies.** The following information must be identified in the summary of previous hydrologic studies:

- a. any previous adopted master plans, masterplan updates, flood insurance studies, and/or U.S. Army Corps of Engineers studies;
- b. any map revisions;
- c. any other pertinent reports.

**3. Modeling Parameters.** The following information must be included in the modeling parameters section:

- a. a discussion of all hydrologic parameters (parameters to be addressed shall at least include initial storage and abstraction, antecedent moisture conditions, infiltration rate, channel n-values and conditions, overland flow lengths, basin slope, channel slope, basin width and depression storage). See the runoff section of the Larimer County

Stormwater Design Standards an addendum of the Urban Storm Drainage Criteria Manual for more information.

**4. Methods and Approaches to Hydrologic Modeling.** The following information must be included in the hydrologic modeling report:

- a. a description of what hydrologic model was used (state the model version, date of model, and whether the model was a developed flow or existing flow model);
- b. a duplicate effective model if a previous hydrologic model exists (describe and use the exact parameters that were included in the existing model);
- c. a proposed conditions hydrologic model, describe how the model data were revised to accurately reflect the proposed conditions, include any changes in basin hydrologic conditions since the previous study;
- d. a description of any changes in the proposed project that were made as a result of the modeling;
- e. a description of any on-site detention or regional detention facilities;
- f. a description of any existing or proposed levees;
- g. a narrative discussion of the results as they apply to the property in the basin.

**5. Discharges and Modeled Frequencies.** The following information must be included in the discharges and modeled frequencies summary:

- a. a table showing the locations, computed discharges and the frequencies represented by the discharges;
- b. unedited computer printouts of both input and output data;
- c. data input and output files on CD.

## Definitions

*Base flood.* A flood having a one percent chance of being equaled or exceeded in any given year. This is also commonly referred to as the 100-year flood.

*Channel.* A natural or artificial watercourse or drainway of perceptible extent with definite bed and banks to confine and conduct continuously or periodically flowing water.

*CHECK-RAS.* A U.S. Army Corps of Engineers software package that uses a series of checking routines to check the reasonableness of data from HEC-RAS files.

*Corrected effective model.* The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the current effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

*Critical Facility.* Critical facilities shall include hospitals, nursing homes, group homes, residential care facilities, congregate care facilities and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood; schools; daycare facilities; cemeteries; police stations, fire stations, vehicle and equipment storage facilities and emergency operations centers that are needed for flood response activities before, during and after a flood; and public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during and after a flood.

*Drainway.* A natural or artificial land surface depression with or without perceptibly defined beds and banks to which surface runoff gravitates and collectively forms a flow of water continuously or intermittently in a definite direction.

*Duplicate effective model.* The duplicate effective model is a copy of the hydraulic analysis used in the effective flood insurance study (FIS), referred to as the effective model. The effective model should be obtained and then reproduced on the requester's equipment to produce the duplicate effective model. This is required to ensure that the effective model's input data has been transferred correctly to the requester's equipment and to ensure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.

*Existing manufactured home park or subdivision.* The preparation of additional sites by the construction of facilities for servicing lots on which manufactured homes are to be affixed (including the installation of utilities, the construction of streets and either final site grading or the pouring of concrete pads.)

*Fill.* A deposit of materials of any kind placed by artificial means.

*Flood or flooding.* A general and temporary condition of partial or complete inundation of normally-dry land areas from:

1. The overflow of inland or tidal waters; and/or
2. The unusual and rapid accumulation or runoff of surface waters from any source.

*Flood hazard area.* The area delineated as Zones A, Zone AH, Zone AO and Zones A1 to A30 in those detailed studies which do not have a regulatory floodway defined. Also including areas determined to be subject to 100-year flood hazard on adopted Larimer County drainage master plans.

*Flood insurance rate map (FIRM).* The official map on which the Federal Emergency Management Agency has delineated both areas of special flood hazards and risk-premium zones applicable to the community.

*Flood insurance study.* The official report provided by the Federal Emergency Management Agency that includes flood profiles, the Flood Boundary-Floodway Map and the water surface elevation of the base flood.

*Floodproofing.* A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the purpose of reducing and eliminating flood damage to properties, water and sanitation facilities, structures and contents of buildings in a flood hazard area.

*Floodway.* The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than **0.5 foot** (the Larimer County 0.5 foot regulated floodway).

*Flood fringe.* That portion of the floodplain inundated by the 100-year return frequency flood not within the floodway.

*Floodplain.* The land adjacent to a body of water that has been or may hereafter be covered by floodwater.

*HEC-RAS (Hydrologic Engineering Centers River Analysis System).* A US Army Corp of Engineers software package that computes one-dimensional steady and unsteady flow calculations as well as sediment transport computations.

*Lowest floor.* The lowest floor of the lowest enclosed area (including basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access or storage, in an area other than a basement area, is not considered a building's lowest floor, provided the enclosure is not built in a way that results in the structure violating the applicable nonelevation design requirements of the Larimer County Land Use Code.

*New construction.* Structures for which "start of construction" commenced on or after the effective date of the Larimer County Land Use Code.

*Obstruction.* Any dam, wall, wharf, embankment, levee, dike, pile abutment, projection, excavation, channel rectification, bridge structure or matter located in, along, across or projecting into any channel, watercourse or regulatory flood hazard area that may impede, retard or change the direction of water flow, either in itself or by catching or collecting debris carried by such water, or that is located where the flow of water might carry debris downstream to the damage of life and property elsewhere.

*Pre-project conditions model.* The duplicate effective model or corrected effective model is modified to produce the pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective model or duplicate effective model. The existing or pre-project model may be required to support conclusions about the actual impacts of the project associated with the revised or post-project model or to establish more up-to-date models on which to base the revised or post-project conditions model.

*Post-project conditions model.* The pre-project conditions model (or duplicate effective model or corrected effective model, as appropriate) is modified to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for a proposed project, this model must reflect proposed conditions.

*Regulatory flood datum.* The reference elevation above mean sea level that represents the peak elevation of the 100-year return-frequency flood.

*Regulatory flood protection elevation.* The elevation **one and one-half feet** above the regulatory flood datum.

*Start of construction.* Includes substantial improvement and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement or other improvement was within 180 days of the building permit date. The actual start means the first placement for permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles or foundations. Permanent construction does not include:

1. Land preparation, such as clearing, grading and filling;
2. Installation of streets and/or walkways;
3. Excavation for a basement, footings, piers or foundations or the erection of temporary forms;
4. Installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure.

*500 year floodplain of the Cache La Poudre River.* The **geographical area** of the Cache La Poudre River that has a 0.2 percent chance of flooding in a given year.