A P P E N D I X A

References

Required Publications

These documents define policy and basic methods directly related to hydrologic engineering for flood-damage reduction planning by the Corps of Engineers. They are cited in the text and in this list by number only. All are promulgated by the Headquarters, U.S. Army Corps of Engineers (HQUSACE), Washington, DC.

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EM 1110-2-1416
Engineering and Design: River Hydraulics

EM 1110-2-1417
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EM 1110-2-1419
Hydrologic Engineering Requirements for Flood Damage Reduction Studies

EM 1110-2-1619
Engineering and Design: Risk-based Analysis for Flood Damage Reduction Studies

EM 1110-2-9039
Engineering and Design: Hydrologic Engineering Requirements for Flood-damage Reduction Studies

ER 1105-2-100
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ER 1105-2-101
Risk-based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies

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ETL 1110-2-547
Introduction to Probability and Reliability Methods for Use in Geotechnical Information

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A P P E N D I X B

Glossary

Aggregated Stage-Damage Function with Uncertainty: A composite median stage-damage function for a damage reach. The function is developed by damage categories at the damage reach index location. The stage-damage functions of individual structures are aggregated using a series of water surface profiles to account for the slope in the profiles throughout the reach. Uncertainty, the errors in the damage estimates, may also be computed.

Analysis Years: Analysis years are for determining damage and project performance information for specific time periods, such as the base year or most likely future year. The analysis years results for a plan are also used to perform equivalent annual damage computations. The same analysis years are used for all study evaluations. An analysis year represents a static time period or year that the HydEng and Economic analysis data represent. Base year is the first year of the plan operation. The "Most Likely Future" condition is a development projection for a specific future year, say twenty years out from the base year. It usually is based on the projections of local future development plans.

Analytical Discharge-Probability Function: A discharge-probability function that is fit with an analytical (statistical) distribution. The distribution is defined by statistics which are the mean, standard deviation, and skew for the Log Pearson Type III distribution. The function is developed by site specific, hydrologic engineering analysis procedures. A "synthetic" approach defined by discharges associated with the .50, .10, and .01 probability events yields Log Pearson Type III distribution statistics and frequency function that fits the 3 points specified.

Bank: Stream bank (looking downstream) where the damage reach or structure is located. The delineation of the bank should consider potential local protection flood damage reduction measures and jurisdictional boundaries. Some measures are typically implemented on only one bank, which include levees and walls, and various nonstructural actions. Channels and upstream storage projects reduce flooding for both banks. There are three hardwired choices (Left, Right, Both), with Both being the default.

Base Year: First year the plan is implemented and operational.

Beginning Damage Depth: Optional depth in feet (meters) where damage begins. Normally used in analysis of structures with basements where flood waters enter above basement floor. Truncates damage function at below specified depth (stage).

Beginning Station: Beginning station number for downstream end of damage reach. The range of allowable values is from 0.00 to 999,999.99. Value must be less than the Ending Station.

Both Banks: Indicator that the damage reach is delineated spatially over both banks of the stream. The stream cuts through the damage reach. Normally used for ponding or storage area reaches.

Bulletin 17B: A U. S. Geological Survey publication entitled, "Guidelines for Determining Flood Flow Frequency," by the Hydrology Subcommittee, Interagency Advisory Committee on Water Data, revised September 1981. The publication describes procedures for developing discharge-frequency functions using stream flow records. These procedures are recommended for all Federal agencies applications.

Compute Synthetic Statistics: The Log Pearson Type III statistics are computed based on the discharges associated with the .50, .10, and .01 probabilities of an adopted probability function. The synthetic statistics are based on equations given in Guidelines for Determining Flood Flow Frequency, Bulletin 17B, USGS, September 1981.

Confidence Limit Curves: *Error limit curves* about a Log Pearson Type III discharge-probability function developed using the non-central t distribution. Confidence limit curves are used to define the discharge-exceedance probability function's uncertainty.

Content/Structure Value Ratio Survey Error: The standard deviation as a percent associated with the uncertainty in estimating the content to structure value ratio. For example, for a content to structure value ratio of fifty percent, an entered standard deviation of ten (10) percent would mean that the ±1 standard deviation range is 45 to 55 percent.

Content to Structure Value Ratio: The numeric value in percent that represents the maximum content value divided by the maximum structure value for a particular structure occupancy type. Used to proportion the contents depth-percent damage function from the structure function.

Content Value: The value of the contents associated with the structure. Does not include the structure (building) value. Numeric value ranging from 0 to 999,999,999.

Damage: Economic loss associated with specific flood events. Value may be at a structure, damage reach, or entire study area.

Damage Category: Used to consolidate large number of structures into specific groups of similar characteristics for analysis and reporting purposes. Damage categories are defined for the study.

Damage Reaches: Damage reaches are spatial floodplain areas. You use damage reaches to define consistent data for plan *evaluations* and to aggregate structure and other potential inundation damage information by stage of flooding. You define a damage reach by the beginning and ending stations (river mile, kilometer, etc.) along the *stream* and extend it in the floodplain to include the largest flood deemed possible. Damage reaches are unique to a *stream* for the entire study. They are integral to both the *hydrology* and *economic* analyses. You may specify a damage reach for the *right* or *left bank* (as looking downstream) or both. You must delineate the damage reach consistent with flood damage reduction measures, i.e., a channel may be analyzed with a damage reach covering both banks, but a levee only one.

Depth: Distance of the water surface straight down to the point of interest. Normally, refers to a value associated with corresponding damage from the depth of water.

Depth-Damage Functions: Relationship of depth of water to damage at a structure. Damage is normally as a percent of the structure or content value. The functions are generic for similar structures and are not tied to the structure location.

Depth-Direct Dollar Content Damage: Relationship of depth and direct (actual) content dollar damage values at the structure location.

Depth-Direct Dollar Structure Damage: Relationship of depth and direct (actual) structure dollar damage values at the structure location.

Depth-Percent Damage: Defines the percent of the maximum structure damage for a range of flood stages at a structure. The percent-damage is multiplied by the structure value to get a unique depth-damage function at the structure.

Discharge: The volume of water passing a specific point for a given time interval. For example, 2,000 cubic feet per second or 1,000 cubic meters per second.

Discharge-Exceedance Probability: The relationship of peak discharge to the probability of that discharge being exceeded in any given year.

Economic Analysis: The flood damage computational part of a study involving specification of damage categories depth-damage functions, structure inventory, development of aggregated stage-damage-uncertainty functions and analysis of expected and equivalent annual damage.

Effective Wave Height: The vertical distance between the crest of a wave and the preceding wave trough.

Ending Station: Ending station number for upstream end of damage reach. The range of allowable values is from 0.00 to 999,999.99. Value must be greater than the Beginning Station.

English Units: Data entry and output reports are English Units and not SI Units. Indicator is for labeling purposes only. No conversions are performed in this program version.

Equivalent Annual Damage: The damage value associated with the without-or-with project condition over the analysis period (project life) considering changes in hydrology, hydraulics, and flood damage conditions over the life. Expected annual damage is computed for each analysis year and discounted to present worth which is then annualized to obtain the equivalent annual damage value. Rather than compute the expected annual damage for each year, it is computed for the base year and most likely future years and interpolated for subsequent years. The expected annual damage for years beyond the most likely future conditions year is assumed equal to that year.

Equivalent Record Length: Number of years of a systematic record of recorded peak discharges at a stream gage. For probability functions derived at ungaged locations using model or other data, the equivalent record length is estimated based on the overall "worth" or "quality" of the frequency function expressed as the number of years-of-record. This parameter is important in risk-based analysis because it relates directly to the uncertainty of the probability function.

Error Distribution: A statistical relationship of possible outcomes that defines the dispersion or variation of errors about the median or "best estimate" of values along a function. Error or uncertainty distributions are used to quantify errors probabilistically when using risk-based analysis. The magnitude and range of the distribution can be defined using error limit or confidence limit curves above and below the median curve.

Error Distribution Parameters: Statistics or other values that define error probability or uncertainty distributions about stage-discharge or other functions. The parameters are dependent on the type of distribution. The magnitude and range of the distribution can be defined using error limit or confidence limit curves above and below the median curve.

Error Limit Curves: Curves above and below the median or "best estimate" curve that define the distribution of errors about the best estimate values. Error limit curves define the uncertainty of functions and are developed by fitting a statistical distribution to known data or the results of model sensitivity analyses.

Exceedance Probability Event: The probability that a specific event will occur in any given year. For example, the .01 exceedance probability event has one chance in a hundred or a one percent chance of occurring in any given year.

Expected Annual Damage: The integral of the damage-probability function. In risk-based analysis it is equal to the average or mean of all possible values of damage determined by exhaustive Monte Carlo sampling of discharge-exceedance probability, stage-discharge, and stage-damage relationships and their associated uncertainties.

Expected Value: The mean or average value. For normal probability density functions the expected, median, and mode are the same.

Exterior: The "exterior" side of the levee or flood wall is the river side where the stage-discharge function applies.

First Floor: The normal entry floor of a building.

First Floor Stage: The stage or elevation of the first floor of the structure. Numeric value ranging from -300 to 30,000.

First Floor Stage Uncertainty: The error of uncertainty in the first floor stage estimate of a particular structure occupancy type. Based on the procedures/type of surveys used to estimate the first floor stage. A normal, triangular, or log normal error distribution may be used.

Flood Damage Reduction: Measures and actions taken to reduce flood damage. These may include implementation of reservoirs, detention storage, channel, diversions, levees and floodwalls, interior systems, floodproofing, raising, relocation, and flood warning-preparedness actions.

Flood Inundation Damage: The damage that results to structures, contents, automobiles, traffic, infrastructure, etc. when flood waters covers or inundates them.

Flood Risk: The risk associated with being flooded. Risk performance indicators used in the analysis are 1) the expected annual stage exceedance probability; 2) long-term risk (a .26 probability of the .01 exceedance probability event occurring over a thirty year period); and 3) conditional probability of non-exceedance (the project has a .95 probability of containing the .01 exceedance probability event should it occur).

Flow Transform Relationship: A relationship that defines the outflow at a specific point on a stream or river based on the inflow at that point. These functions are used to modify the discharge during at a specific step in the risk-based analysis. An example would be a regulated versus unregulated function for a reservoir that could be used instead of a regulated discharge-probability function to represent the effect of a reservoir.

Foundation Height: The vertical distance between the ground stage and first floor stage at the structure.

Geotechnical Failure Analysis: Analysis of a non-standard levee that has the potential to fail geotechnically before overtopping. Geotechnical failure causes include seepage, piping, and stuffing. A single relationship of exterior levee stage versus probability of geotechnical failure (all combinations) are developed external to the program and entered for analysis.

Graphical Discharge (or Stage) Probability Function: A graphical or non-analytical discharge- or stage-probability function is one drawn graphically by an eye-fit curve. The function is assumed not fitted by an analytical distribution. For HEC-FDA, graphical functions should use Wiebull's plotting positions (not median) since the normal distribution is used to represent expected values in the order statistics approach to define the error bands.

Ground Stage: The stage or elevation of the ground at the structure. Numeric value ranging from -300 to 30,000.

HEC-2: The Hydrologic Engineering Center's Water Surface Profile Computations computer program. The program output may be designed to enable ready import of water surface profiles data sets into the HEC-FDA program.

HEC-RAS: The Hydrologic Engineering Center's River Analysis System computer program for computing water surface profiles for a series of flood events. The program output may be designed to enable ready import of water surface profile data sets into the HEC-FDA program.

HEC-SID: The Hydrologic Engineering Center's Structure Inventory for Damage computer program. The structure inventory and depth-percent damage functions may be imported into the HEC-FDA program.

Historic Events: Observed and sometimes recorded flood events such as the 1973 Flood or 1993 Flood.

Hydrologic Engineering: Hydrology and hydraulic technical studies necessary for performing flood damage reduction studies.

Hydrology & Hydraulics: Hydrology involves the estimation of the amount and shape of the runoff response throughout the study area. It also includes the frequency of the events. Hydraulics involve analysis of stream water surface profiles, flood inundation boundaries, and other technical studies of stream flow characteristics.

Hypothetical Probability Events: A series of hydrographs derived from rainfall-runoff analysis using hypothetical frequency based rainfall patterns. Rainfall values are normally derived from National Weather Service Publications eg., Technical Papers TP 40 and TP 49.

Image: Picture stored in digital format for display. Normally used for important structures.

Index Location Station: A stream station location within a damage reach used to specify discharge-probability, stage-discharge, and stage-damage functions with uncertainty data for plan evaluations for that damage reach . Also, the index location station (corresponding stream station) is used for aggregation of stage-damage functions with uncertainty by damage category under economic analysis. The index location station is defined between the beginning and ending station values and normally where data is deemed most reliable, such as a streamgage location. The range of allowable values is from 0.00 to 999,999.99. Value must be greater than the Beginning Station and less than or equal to the Ending Station.

Interior: The "interior" side of the levee or flood wall is the floodplain or protected side where the stage-damage function applies.

Invert: Stage associated with zero discharge or bottom of channel. The range of allowable values is from -300.00 to 30,000.00.

Left Bank: Indicates that the damage reach is only along the left bank of the stream. The left bank is defined looking downstream or with the current of the stream.

Levee Overtopping: Analysis of levee overtopping.

Log Normal Distribution: A two-parameter probability distribution defined by the mean and standard deviation. A non-symmetrical distribution applicable to many kinds of data sets where the majority (more than half) of values are less than the mean but values greater than the mean can be extreme, such as with stream flow data. The distribution is truncated at three standard deviations.

Log Pearson Type III Distribution: Analytical discharge-probability functions can be defined (fit) with a statistical distribution such as Log Pearson Type III. The distribution has statistical parameters that define the moments of the data about the analytical curve. For a Log Pearson Type III distribution, these statistical parameters are mean (first moment), standard deviation (second moment), and weighted skew (third moment). Also, an there is an additional parameter, equivalent record length.

Mean: The average value of a set of numbers, such as the annual peak discharges that have occurred over a period of time. The first moment statistic of a Log Pearson Type III analytical discharge-probability function, representing the average of the logarithms of peak discharge values.

Median: Value where there is a .5 probability that the actual value is less than that value. The middle value of an ordered list.

Mode: The most frequently occurring value in a data set.

Monetary Units: Monetary units used for all study data and output reports. There are three hardwired choices ($'s, $1,000's, and $1,000,000's), with $1,000's being the default. Monetary units are used only as labels.

Most Likely Future: The most likely future condition development projection for a specific future year. Used in equivalent analysis of project over it's life. Normally 25-30 years out from Base Year. Must be greater than Base Year.

Nonstructural: Nonstructural measures include raising, relocating, flood proofing, and regulatory and emergency actions associated with structures and damageable property that modify the existing and/or future damage susceptibility.

Normal Distribution: A two-parameter probability distribution defined by the mean and standard deviation. A symmetrical “bell shaped” curve applicable to many kinds of data sets where values are equally likely to be greater than or less than the mean. Also called a Gaussian distribution. The distribution is truncated at three standard deviations.

Ordered Events: Ranked events or plotting positions that define a graphical discharge- or stage-probability function. Ordered events are used to determine the uncertainty about the discharge- or stage-probability function using order statistics. The Wiebull's plotting positions, which represent expected values should be used.

Order Statistics: Statistical procedure for defining the sample errors of events that define a graphical frequency function. Order statistics are used to define the uncertainty (error limit curves) about a graphical frequency function defined by Weibull plotting positions (ordered events) for a specified equivalent record length. A normal distribution is used to define the errors.

Plan Evaluation: The assessment of economic and plan performance to determine the impact of one or more plans versus the without-project condition. Results may be viewed by specific analysis years or as equivalent annual values for the project life.

Plan Formulation: The development and evaluation of one or more measures and actions into a plan designed to reduce flood damage for one or more damage reaches.

Plan Performance: A measure of the hydrologic and/or economic efficiency of a flood damage reduction plan. Performance is measured in terms of risk of flooding in a year and over a specified number of years and an expected annual flood damage. Risk-based analysis is used to determine plan performance.

Plans: A set of one or more flood damage reduction measures or actions designed to operate over a period of time (project life). The plan is inclusive of the entire study area although it may have a flood damage reduction measure for a single damage reach.

Ponding Area: Storage area usually a lake or pond normally requiring stage-frequency functions instead of discharge-frequency functions for analyses.

Price Index: The economic index value associated with the present value. Used to globally update the economic (flood damage) values over the base price index value. Numeric, up to 10 digit fixed point value. If blank, the base price index is used and no adjustments are made to the economic data.

Price Year: The price year associated with present updated economic (flood damage) values over the base price index. Numeric four digit value. If blank, the base price year is used. Global price indices may be overwritten for specific damage categories on the Economics/Damage Categories data entry screen.

Probability: The values ranging from zero to one of the number of outcomes in an exhaustive set of equally likely outcomes that produce the event divided by the total number of outcomes (Frequency divided by 100).

Probability Function: A discharge- or stage-exceedance probability relationship for a reach developed by traditional, site specific, hydrologic engineering analysis procedures.

Probability Function Statistics: Reports the statistics entered or computed for an exceedance probability function. For the Log Person Type III distribution, the statistical parameters are mean log (first moment), standard deviation (second moment), skew (third moment), and equivalent record length. For synthetic or parameter fitting (Compute Synthetic Statistics), the computed statistical parameters are mean, standard deviation, skew, and equivalent record length. Also, the mean discharge is computed and is equal to the anti-log of the mean log. The statistics reported for a non-analytical probability function is the equivalent record length.

Probability Function Type: Probability function type is either graphical (discharge- or stage-probability). An analytical discharge-exceedance probability function is one that can be fit with an analytical (statistical) distribution such as Log Person Type III. A graphical discharge- or stage-exceedance probability function is one that is best fit by a graphical, eye-fit curve.

Probability Ordinates: The discharge or stage values corresponding to specific probabilities from a discharge- or stage-exceedance probability function.

Project Life: The period of time the plan is assumed in place and operational. Normally fifty years. The base year is the first year of the plan being operational.

Right Bank: Indicator that the damage reach is only along the right bank of the stream. The right bank is defined looking downstream or with the current of the stream.

Risk-Based Analysis: The analysis of flood damage reduction measures and plans considering the uncertainty of the various key functions such as discharge-probabilities, stage-probabilities, and damage. Includes the uncertainty in the annual damage reduction values and plan performance indicators for flood risk.

SI Units: Metric units such as meters (stage, heights, etc.) and kilometers (distances).

Skew: A statistic used as a measure of the dispersion of the data about the mean equal to the number of values times the sum of the cubes of the deviations from the mean divided by the number of values minus one, times the number of values times two, times the standard deviation cubed. The third moment statistic of a Log Person Type III distribution, calculated using the mean logarithm, the standard deviation of the logs, and the logarithms or peak discharge values.

Stage: The vertical distance in feet (meters) above or below a local or national datum (N.G.V.D. for elevations).

Stage Associated with the Median One-Percent Chance Flood Discharge: The stage where the discharge, taken from the stage-discharge curve, has a probability (percent chance occurrence), taken from the discharge-probability curve, of one-percent.

Stage-Damage: The relationship of damage to a range of flood stages at a structure or the aggregated values of the structure damage by damage categories for a range of stages at the damage reach index location station.

Stage-Damage Functions with Uncertainty: Stage-damage functions with uncertainty are computed at each structure and aggregated by damage category to damage reach index locations. Stage is elevation or locally referenced stage associated with the structure and index location. Damage is the median estimate of structure, content, or other inundation reduction damage associated with the stage of flood waters at the location. Uncertainty in the stage-damage function is due to errors in estimating the depth-damage function, first floor stage, structure value, and content to structure value ratio.

Stage-Damage Uncertainty: Error (uncertainty) in estimating the stage-damage values. The error probability density functions available are normal, log normal, and triangular.

Stage-Direct Dollar Content Damage: Relationship of depth and direct (actual) content damage values at the structure location.

Stage-Direct Dollar Structure Damage: Relationship of depth and direct (actual) structure dollar damage values at the structure location.

Stage-Discharge: The relationship of stage to a range of discharge values at a specific location.

Stage-Discharge Function: A graphical relationship that yields the stage for a given discharge at a specific location on a stream or river. Referred to as a rating function or curve. These relationships are usually developed by computing water surface profiles for several discharges and plotting the stages vs. discharge relationship at a specific stream location.

Stage-Discharge Functions with Uncertainty: Relationship of the water surface stage and discharge. Uncertainty is the distribution of the errors of stage estimates about a specific discharge. The error probability density functions available are normal, log normal, and triangular.

Stage-Probability Water Surface Profiles: Water surface profiles are stage based. The stage values are required for each station and water surface profile analyzed.

Stage-Probability Functions with Uncertainty: Relationship of water surface stage and exceedance probability of occurrence. Uncertainty is the distribution of the errors of stage estimates about a specific ordinate. The ordered statistics approach is used to define the errors of the graphical relationship.

Standard Deviation: A statistic used as a measure of the variation in a distribution, equal to the square root of the sum of the squares of the deviations from the arithmetic mean divided by the number of values minus one. The second moment statistic of a Log Pearson Type III analytical discharge-probability function calculated using the mean logarithm and the logarithms of peak discharge values.

Steady Flow: State where depth in flow is open channel does not change during the time interval under consideration, (Chow, Open Channel Hydraulics, 1959).

Still Water Stage: Stage that the water surface assumes if all wave action is absent.

Storage Area: Storage area is a water body such as a lake or pond that normally requires a stage-frequency instead of discharge-frequency function analysis.

Streams: Streams are defined for the study and are therefore common for all plans and analyses. They include one or more damage reaches. They are used to aggregate data entry and output report information by the stream title. Streams are generalized to include rivers, creeks, bayous, channels, ditches, canals and even ponding areas. One or more streams may be specified as part of the study area. Several hydraulic routing reaches along the stream are normally combined by stream name for analysis and reporting purposes. Water surface profile data are entered by streams.

Stream Station: Study adopted stations along the stream normally denoted as miles (kilometers) above the mouth of the stream. Must be consistent between damage reach boundaries, damage reach index location, water surface profiles, and structure location. The range of allowable values is from -9,999,999.99 to 9,999,999.99.

Structure Coordinates: The x, y spatial coordinates of the location of the structure.

Structure Occupancy Type: The name given to a similar set of structures that is used to define the depth-percent damage function and first floor, structure value, and content/structure value ratio uncertainty of the type of structures. Each structure is assigned to a structure occupancy type. Several structure occupancy types may be assigned to the specified study damage category. For example: single-story no basement, single-story with basement, duplexes, mobile homes are structure occupancy types assigned to a residential damage category. An existing structure occupancy type can be selected, updated, and deleted. The length is 16 characters.

Structure Value: The standard deviation in percent of structure value associated with the uncertainty in the structure value estimate for a particular structure occupancy type. A normal distribution is used.

Structure Year: The year the structure is built. Used for economic evaluations. Important for analysis of base and future analysis years in that only structures specified with those or previous years are included in the analysis.

Study: The investigation of with- and without-project conditions involving hydrology, hydraulics, economics, plan formulation and evaluation. All the above information is stored under the study directory.

Study Configuration: The information that is multiple discipline used throughout the study. Includes definition of streams, damage reaches, plans and analysis years. These data are commonly used during H&H (hydrology and hydraulics) and Economic analysis. Definition of the study configuration should be a multi-disciplinary activity.

Surveyed Year: The year associated with the structure survey flood damage values used in the structure inventory.

System of Units: Units of measure for study data and output reports. There are two hardwired choices (SI (metric) and English), with English being the default. The units are used only as labels.

Top of Levee Stage: The stage of the top of the levee, flood wall, or tidal barrier that exists at the site or is being evaluated.

Total Overtopping Height (HW): The difference between the levee or flood wall stage and the sum of the still water stage and the wave runup. Wave runup is assumed equal to wave height if the still water stage is below the levee or flood wall and two-thirds wave height if the still water elevation is above the levee or flood wall. These assumptions for wave runup are appropriate for non-coastal applications where waves are relatively small.

Triangular Distribution: A three-parameter bounded probability distribution defined by the minimum, most likely (mode), and maximum.

Uncertainty: The estimated amount or percentage by which an observed or calculated value may differ from the true value. Uncertainty of estimated parameters is included when determining economic and hydrologic performance using risk-based analysis.

Uncertainty Distribution: A statistical relationship of possible outcomes that defines the dispersion or variation of errors about the median or "best estimate" of values along a function. Uncertainty distributions are used to quantify errors probabilistically when using risk-based analysis. The magnitude and range of the distribution can be defined using error limit or confidence limit curves above and below the median curve.

Uniform Distribution: A two-parameter bounded probability distribution defined by the minimum and maximum that is used for data that varies uniformly between the minimum and maximum values.

Unsteady Flow: The flow condition where depth changes with time (Chow, Open-channel Hydraulics, 1959).

Updated Price Index: A value used to update all economic (structure damage) values to present (or other) values. The range of allowable values is from 0.00 to 100.00. If left blank, the default will be 1.00 and no adjustments are made to the economic data.

Updated Year: The price year associated with the updated price index. Must be greater than or equal to the Surveyed Year. If left blank, the default will be the Surveyed Year.

Water Surface Profiles: Water surface profiles are used to develop without- and with-project condition stage-discharge (rating) functions at a index location station within a damage reach. Also, water surface profiles are used to aggregate stage-damage functions with uncertainty at a index location station within a damage reach. If provided, the profiles are used in the development of discharge- and stage-probability functions, if not, the stage-discharge (rating) and discharge- or stage-probability functions must be entered directly. Discharge values used in the water surface profile analyses should be median values. A set of *water surface profiles* is specified for each *plan*, *analysis year*, and *stream* to be analyzed.

Wave Height: The vertical distance between the crest of a wave and the preceding wave trough. Wave height is dependent on still water level.

Wave Overtopping: The effects of water overtopping a levee or flood wall and the associated contribution to flood depth on the interior.

Weighted Skew: A statistic used as a measure of the dispersion of the data about the mean equal to the number of values times the sum of the cubes of the deviations from the mean divided by the number of values minus one, times the number of values minus two, times the standard deviation cubed. The third moment statistic of a Log Pearson Type III analytical discharge-probability function calculated using the mean logarithm, the standard deviation of the logs, and the logarithms of peak discharge values.

With-Project Condition: The economic, performance, and other conditions associated with implementing a flood damage reduction plan. It is compared to the without-project condition. It includes the base-year and static future analysis year periods to determine the equivalent values.

Without-Project Condition: The condition of the study area for the project life analysis period that is anticipated to most likely occur if the flood damage reduction measures and actions are not implemented. It includes the base year and static future analysis year periods to determine the equivalent values. It is the basis or baseline condition for evaluating the benefits and performance of potential flood damage reduction plans. Emphasis is initially placed on defining the without-project base-year conditions.

Year in Service: Year that a particular structure was built or a future year when the structure is assumed to be in place. Used to designate which structures are to be used for the specified analysis years. Only structures with year in service dates equal or less than the designated analysis years are used.