GLOSSARY

HIGHWAY-RELATED DRAINAGE TERMS

Revised July 2003

Introduction

This Glossary is divided into three parts:

- Introduction
- Glossary
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Definitions contained in this Glossary are for the general use of the term in the context of the *MDOT Drainage Manual*. Not every definition of each term is included. Depending on the circumstance, a particular term may have several meanings.

The primary purpose of this Glossary is to define the terms found in the Drainage Manual in a manner that makes them easier to interpret and understand.

Where readily available, the source of a definition has been referenced. If the definition was taken from the chapters within this Drainage Manual, the chapter is sited as the reference. As might be expected, different sources were found to use different hyphenation and terminology practices for the same words. Insignificant changes in this regard were made to some cited references to maintain uniformity in this Glossary; as an example, groundwater, ground-water, or ground water.

Cited definitions were taken primarily from two sources: W.B. Langbein and K.T. Iseris, *General Introduction and Hydrologic Definitions (30)*, a draft of a Glossary being developed by the Interagency Hydrology Committee, and the MDOT *Road Design Manual*.

Glossary

AASHTO - Acronym for American Association of State Highway Transportation Officials.

ABSORPTION - The assimilation or taking up of water or other solutions by soil or other material, i.e., the entrance of water into the soil or rocks by all natural processes. It includes the infiltration of precipitation or snowmelt, gravity flow of streams into the valley alluvium (see Storage), sinks, or other large openings, and the movement of atmospheric moisture. The process by which substances in gaseous, liquid, or solid form dissolve or mix with other substances. Compare with Adsorption.

ABSTRACTION - That portion of rainfall which does not become runoff. It includes interception, infiltration, and storage in depressions. It is affected by land use, land treatment and condition, and antecedent soil moisture.

ACRE-FOOT - The quantity of water required to cover 1 acre to a depth of 1 foot and equal to 43,560 cubic feet or about 326,000 gallons. Abbreviated as ac-ft.

ADSORPTION - The adhesion in an extremely thin layer of molecules (such as gases, solutions, or liquids) to the surface of solid bodies or liquids with which they are in contact. Compare with Absorption.

AGGRADATION - General and progressive up-building of the longitudinal profile of a channel or within a drainage facility by the deposition of sediment. Compare with Sedimentation. Permanent or continuous aggradation is an indicator that a change in the stream's discharge and sediment load characteristics is taking place.

AIR/VACUUM VALVE – An Air/Vacuum valve is used to allow air to escape the discharge piping when pumping begins, and to prevent vacuum damage to the discharge piping when pumping stops. If the pump discharge is open to the atmosphere, an air/vacuum release valve may not be necessary. Combination air release valves are frequently used at high points in force mains to evacuate trapped air. (Chapter 10)

ALLUVIAL - Refers to deposits of silts, sands, gravels, or similar detrital material which has been transported by running water. (Chapter 4)

ALLUVIAL CHANNELS - Are formed wholly in alluvium with no bedrock exposed in the channel at low flow or likely to be exposed by erosion. A channel whose processes are controlled by flow and boundary interactions. (Chapter 4)

ANCHOR ICE - Ice in the bed of a stream or upon a submerged body or structure. *(38)*

ANNUAL FLOOD - The maximum momentary peak discharge in each year of record. May be maximum daily discharge or instantaneous discharge. The highest peak discharge in a water year. The maximum flow in one year. *(28)*

ANSI - Acronym for American National Standards Institute.

ANTECEDENT MOISTURE CONDITIONS (AMC) - Soil moisture conditions of the watershed at the beginning of a storm. These conditions affect the volume of runoff generated by a particular storm event. (Chapter 3)

ANTI RATCHET DEVICE - A device used to stop backflow from reversing the direction of pump and motor rotation in vertical shaft pumps. Installation of this type of device is mandatory in all vertical shaft pump equipped stations.

APA - Acronym for Authorized Public Agency

AQUIFER - A porous, water-bearing, subsurface geologic formation. Generally restricted to materials capable of yielding an appreciable supply of water.

AREA RAINFALL - The average rainfall over an area, usually as derived from or discussed in contrast with point rainfall. *(36)*

ARMORING - A natural process whereby an erosion-resistant layer of relatively large particles is formed on a channel bank and/or channel bed due to the removal of finer particles by stream flow, i.e., the concentration of a layer of stones on the bed of the stream which are of a size larger than the transport capability of the recently experienced flow - the winnowing out of smaller material capable of being transported while leaving the larger sizes as armor that, for discharges up to that point in time, cannot be transported. Armoring may also refer to the placement of a covering on a channel bank and/or channel bed to prevent erosion.

ARTESIAN - Pertains to groundwater that is under pressure and will rise to a higher elevation if unconstrained.

ARTIFICAL CHANNELS - Includes roadside channels, irrigation channels, and county or agricultural drains which are:

- Constructed channels with regular geometric cross-sections.
- Unlined, or lined with artificial or natural material to protect against erosion. (Chapter 4)

ASTM - Acronym for American Society for Testing and Materials.

AUXILIARY SPILLWAY - A waterway around a dam, used to supplement the principal spillway in conveying extreme amounts of runoff. (Chapter 8)

AVERAGE RAINFALL INTENSITY - The average rate of rainfall upon a watershed, usually expressed in inches per hour.

AWG - Acronym for American Wire Gage.

BACKWATER - The increase in water surface elevation induced upstream from such things as a bridge, culvert, dike, dam, another stream at a higher stage, or other similar structures or conditions that obstruct or constrict a channel relative to the elevation occurring under natural channel and floodplain conditions. (Chapter 6)

BAFFLE - A structure built on the bed of a stream to deflect or disturb the flow. Also a device used in a culvert to facilitate fish passage.

BANK - The side slopes or margins of a channel between which the stream or river is normally confined. More formally, the lateral boundaries of a channel or stream, as indicated by a scarp, or on the inside of bends, by the streamward edge of permanent vegetal growth.

The margins of a channel. Banks are called right or left as viewed facing in the direction of the flow [commonly downstream]. *(30)*

BANKFULL DISCHARGE - Discharge that, on the average, fills a channel to the point of overflowing. Commonly considered as the mean annual discharge ($Q_{2.33}$) or 2- to 3-year discharge (Q_2, Q_3) in a channel that has been relatively stable for a number of years without the occurrence of a large, bank-destroying flood.

BASE FLOOD - One (1) percent chance (100-year) flood frequency.

BASE FLOODPLAIN - Surface area flooded by the base flood.

BASE FLOW - Normal or dry weather flow in a stormwater system. (Chapter 3)

BED - The bottom of a channel. The part of a channel not permanently vegetated which is bounded by banks and over which water normally flows.

BED LOAD - Sediment that is transported in a stream by rolling, sliding, or skipping (saltating) along the bed or very close to it; considered to be within the bed layer. The quantity of silt, sand, gravel, or other detritus rolled along the bed of a stream, often expressed as weight or volume per time.

BERM - A narrow shelf or ledge; also a form of dike. A more detailed description might be: 1.) The space left between the upper edge of a cut and the toe of an embankment. 2.) A horizontal strip or shelf built into an embankment to break the continuity of an otherwise long slope.

Also may be the top surface or plane of a shoulder, ledge, or bank constructed in connection with the roadway embankment at bridge abutments, waste along fill slopes, and canal or ditch banks. Compare with Dike.

BERNOULLI'S THEOREM - A proposition advanced by Daniel Bernoulli that the energy head at any section in a flowing stream is equal to the energy head at any other downstream section plus the intervening losses.

BEST MANAGEMENT PRACTICE (BMP) - Structural devices or nonstructural practices (both temporary and permanent) that are designed to prevent pollutants from entering into stormwater flows, to direct the flow of stormwater, or to treat polluted stormwater flows. (Chapters 8 and 9)

BLM - Acronym for Bureau of Land Management.

BMP - Acronym for Best Management Practice.

BRIDGES - are defined as:

- Structures that transport traffic over waterways or other obstructions.
- Part of a stream-crossing system that includes the approach roadway over the floodplain, relief openings, and the bridge structure.
- Structures with a centerline span of 20 feet or more. However, structures designed hydraulically as bridges, as described above, are treated in this chapter regardless of length. Generally, structures less than 20 feet are considered culverts. (Chapter 6)

BULKHEAD - Plug installed in a sewer pipe constructed of concrete, brick, or masonry block to prevent flow into or out of a conveyance system.

CALIBRATION - The process of fitting a [computational] model to a set of observed data by changing unknown or uncertain model parameters systematically within their allowable ranges until a “best fit” of the model to the observed data is achieved. *(1)*

CATCH BASIN - A structure, sometimes with a sump, for inletting drainage from such places as a gutter or median and discharging the water through a conduit. In common usage it is a grated inlet, curb opening, or combination inlet with or without a sump. (Chapter 7)

CAVITATION - A phenomenon associated with the vaporization of a flowing liquid in a zone of low pressure, wherein cavities filled with liquid vapor (vapor bubbles) alternately develop and collapse. Significant cavitation is unusual in highway drainage structures but, if present, may cause structural deterioration. Put another way, a condition wherein a vacuum, to any degree, exists as a result of flowing water. Complete cavitation occurs when the pressure within the affected part is reduced to that of the vapor pressure of the water.

CE - Acronym for Categorical Exclusions.

CEA - Acronym for County Enforcing Agencies.

CFR - Acronym of Code of Federal Regulations.

CELERITY, WAVE - The velocity of a wave measured relative to the liquid, known as celerity C, is equal to the wave length divided by the period [of the wave], or C = L/t. *(8)*

CFS-DAY (cfs-day) - Often [erroneously] called a “second-foot-day.” The volume of water represented by a flow of 1 cubic foot/s for one day. *(35)*

CHANNEL - The term “channel” has been defined numerous ways: 1.) The bed and banks that confine the flow of surface water in a natural stream or artificial channel; 2.) The course where a stream of water runs or the closed course or conduit through which water runs, such as a pipe; 3.) An open conduit either naturally or artificially created which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. River, creek, run, branch, anabranch, [arroyo, draw, wash], and tributary

are some of the terms used to describe natural channels. Natural channels may be single or braided. Canal and ditch are some of the terms used to describe artificial channels. *(30)*

Channel has also been defined as an elongated, open depression in which water may, or does, flow. An elongated depression, either naturally or artificially created and of appreciable size, which periodically or continuously contains moving water or which forms a connecting link between two bodies of water. It must have a definite bed and bank, which serve to confine the water up to some bankfull discharge amount.

Local convention may use river, stream, arroyo, or branch. With constructed canals, the term ditch or lateral may be used. Compare with Swale and Waterway.

CHANNEL ROUTING - The process whereby a stream flow hydrograph is mathematically transposed to another site downstream taking into account the effect of channel storage.

CHANNELIZATION - Straightening and/or deepening of a channel by such things as artificial cutoffs, grading, flow control measures, river training, or diversion of flow into an artificial channel.

CHECK DAM - A low structure, dam, or weir across a channel for the control of water stage or velocity, or to control channel erosion. (Chapter 9)

CHECK VALVE - A watertight fitting used in pipes to prevent back flow to the pumps and subsequent re-circulation. MDOT prefers a check valve that is sealed with a rubber seated ball type fitting. (Chapter 10)

CHOKING (OF FLOW) - Severe backwater effect resulting from excessive constriction. This usually implies flow has been forced through critical depth.

CIVIL ACTION - Action presenting an issue to be resolved under civil law, as distinguished from criminal law, and/or brought to establish or recover private and civil rights or redress for damage; tort action.

CIVIL LAW - The system of jurisprudence established by a nation, state, or commonwealth peculiarly for itself; the division of law regulating ordinary private matters, as distinct from laws regulating criminal, political, or military matters. The civil laws regarding the management of naturally occurring waters established the rights or easements, both favorable and restrictive, of the riparian owners individually and with respect to others, and are directed toward equitable use and the preservation and continuation of natural drainage conditions. Compare with Common Law.

CIVIL LAW DOCTRINE OR RULE – A rule or law pertaining to the disposal of drainage waters, under which the owner of higher land has the right or easement to dispose of the surplus or excess waters from his lands to lower lands, unobstructed by the owners thereof. Compare with Common Enemy Doctrine or Rule and Reasonable Use Doctrine and Rule.

COAST LINE - The line or interface forming the boundary between the land and water.

COASTAL ZONE - The strip of land that extends inland from a coast (or shore) line to the first major change in terrain features.

CODE OF FEDERAL REGULATIONS (CFR) - Codifies and publishes, at least annually, Federal regulations currently in force. The CFR is kept up-to-date by individual issues of the *Federal Register.* The two publications must be used together to determine the latest version of any given rule. See *Federal Register.*

COEFFICIENT OF CONTRACTION - The ratio of the smallest cross-section area of the flow after passing the constriction to the nominal cross-section area of the constriction.

COEFFICIENT OF DISCHARGE - Ratio of observed to theoretical discharge. Also the coefficient used for orifice or other flow processes to estimate the discharge past a point or through a reach.

COFFERDAM - A barrier built in the water to form an enclosure from which the water is pumped to permit free access to the area within.

COLLECTION SYSTEM - Stormwater is conveyed from the drainage area of the highway to the pump station in a system of ditches, gutters, manhole inlets, and conduits that comprise a collection system. (Chapter 10)

COMBINED SEWER (CSO) - A sewer that conveys sanitary sewage and, at times, stormwater. See Sewer.

COMMON ENEMY DOCTRINE OR RULE - A common law rule recognized by some states pertaining to the disposal of surplus or excess surface waters, which holds that such waters are a “common enemy” and, therefore, the land owner has the right to protect his lands from such waters coming from higher lands. Under this rule, surface waters are regarded as a common enemy which each landowner may fight as he deems best and without regard to the harm that may be caused to others. Compare with Reasonable Use Doctrine and Rule.

COMMON LAW - As distinguished from “Roman” or “Civil” law, the body of unwritten law, especially of England, based on long-standing usages and customs and the court decisions and decrees recognizing, affirming, and enforcing such usages and customs. Compare with Civil Law.

CONDUIT - An artificial or natural channel; usually a closed structure such as a pipe or culvert. A general term for any channel intended for the conveyance of water, whether open or closed; any container for flowing water. With highways, conduits are often considered as being a pipe, culvert, flume, channel, chute, or similar drainage facility.

CONFLUENCE - The junction of two or more streams.

CONJUGATE DEPTH - The alternate depth of flow involved with the hydraulic jump, i.e., The depth d_1 and d_2 before and after a hydraulic jump. Unlike the alternate depths for a given specific head, the conjugate depths for a hydraulic jump reflect the energy loss from the hydraulic jump.

CONSTRICTION - A compressed or constricted section or reach of a channel may be a natural condition or one produced by raising the bottom (as a sill or dam), or contracting the width (as a highway embankment on a floodplain), or both. A control section, such as a bridge crossing, channel reach, sill or dam, with limited flow capacity in which the discharge is related to the upstream water surface elevation; a constriction may be either natural or artificial.

CONTIGUOUS - Touching, adjacent, adjoining, bordering on. Adjacent things may or may not be in actual contact, but they are not separated by like things. That which is adjoining something and touches it at some point or along a line. Things are contiguous when they touch along the whole or most of one side.

CONTINUITY EQUATION - Discharge equals velocity times cross section area (Q=VA). For steady flow there is a continuity of discharge through succeeding sections of channel, expressed as: $Q = (A_1)(V_1) = (A_2)(V_2) = (A_n)(V_n) =$ a constant.

CONTRACTED SECTION - A cross section within a constriction; for example, at the downstream side of a bridge opening or at a culvert entrance. Compare with Constriction.

CONTRACTION METHOD (OF FLOW MEASUREMENT) - A method of indirect measurement of peak discharge following a flood by field survey of high water marks and channel and bridge geometry at a constriction, such as at a bridge. Discharge is computed on the basis of an evaluation of energy changes between the approach section and the downstream side of the constriction by methods given in U.S. Geological Survey Circular 284.

CONTROL - A natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from a gaging station that determines the stage-discharge relation at the gage. A control may be complete or partial. A complete control exists where the stage-discharge relation at a gaging station is entirely independent of fluctuations in stage downstream from the control. A partial control exists where downstream fluctuations have some effect on the stage-discharge relation at a gaging station. A control, either partial or complete, may also be shifting. Most natural controls are shifting to a degree, but a shifting control exists where the stage-discharge relation experiences frequent changes owing to impermanent bed or banks. *(30)*

A feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, artificial structure, or a uniform cross section over a long reach of the channel. *(37)*

A control may relate to a drainage design exclusive of any gage considerations. A section or a reach of a conduit where conditions exist that make the water level about it a fairly stable index of discharge, i.e., a section or reach of an open conduit or stream channel which maintains a stable relationship between stage and discharge. A control may be partial or complete. A complete control is independent of downstream conditions and is effective at all stages. An overflow dam, a ledge of rock crossing a channel, a boulder-covered reach, and an indurated bed are examples. Controls may be either natural or artificial. See Control Section.

CONTROL SECTION - A control section, such as a bridge opening, reach of channel, or dam, with a definable flow capacity, in which the discharge is related to some measurable depth(s) such as the upstream water surface elevation, tailwater elevation, and/or contracted flow depth. See Control.

CONVEYANCE - Is a measure, K, of the ability of a stream, channel, or conduit to convey water. In Manning's formula, $K = (1.49/n) AR^{2/3}$. (Chapter 4)

CORROSION - The deterioration of pipe or structure by chemical action (oxidation).

COUNTERMEASURE - A measure, either incorporated into the design of a drainage facility or installed separately at or near the facility, that serves to prevent, minimize, or control hydraulic problems.

COUNTY DRAIN - May be an open ditch, stream, or underground pipe, retention pond, or swale that conveys stormwater. These drains become designated as county drains through a petition process where either property owners or a local city, village, or township petitions the Drain Commissioner to establish a county drain. (See Chapter 2, Legal Policy and Procedure, Appendix 2-B. (Chapter 4)

CRITICAL DEPTH - The depth at which the specific energy of a given flow rate is at a minimum. For a given discharge and cross-section geometry, there is only one critical depth. Chapter 5, Culverts, Appendix 5-C, contains critical depth charts for different shapes. (Chapter 5)

CRITICAL SHEAR STRESS - The minimum amount of shear stress (tractive force) exerted by passing stream currents required to initiate soil particle motion. Compare with Tractive Force.

CROSS DRAINAGE - The runoff from contributing drainage areas both inside and outside the highway right-of-way and the transmission thereof from the upstream side of the highway facility to the downstream side.

CROSS SECTION (STREAM OR VALLEY) - A diagram or drawing cut across a channel normal to the expected flow direction [for a particular flood magnitude] that illustrates the banks, bed, [vegetal cover, soils,] and water surface. The shape of a channel, stream, or valley viewed across the axis. In watershed investigations and channel analyses, it is determined by a line approximately perpendicular to the main path of water flow [for a particular flood magnitude], along which measurements of distance and elevation are taken to define the cross-sectional area [, conveyance properties] and shape. In hydraulic analyses, vegetal patterns, floodplain material, and bed material [as well as any other conveyance properties] are considered part of the cross section. *(36)*

CROWN - The highest interior elevation of a culvert, sewer, drain pipe, or tunnel. This may also be referred to as underclearance or low chord. (Chapters 5 and 7)

CUBIC FEET PER SECOND (cfs) - A unit measurement of water flow. Sometimes erroneously called "second feet," primarily in oral discussions.

A unit expressing rates of discharge. Cubic feet per second is equal to the discharge of a stream of rectangular cross section, a foot wide and one foot deep, flowing water at an average velocity of one foot per sec. Abbreviated cfs or cusec. *(30)*

The rate of discharge representing a volume of one cubic foot passing a given point during one second and equivalent to 7.48 gallons per second or 448.8 gallons per minute or 0.028 32 m^3/s. *(37)*

CUBIC FOOT PER SECOND-DAY - The volume of water represented by a flow of one cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, approximately 1.9835 acre-feet, about 646,000 gallons, or 2,445 m^3.

CULVERT - A structure that is usually designed hydraulically to convey surface runoff through an embankment. The span is less than 20 feet. (Chapters 5 and 7)

CONJUGATE DEPTH - The alternate depth of flow involved with the hydraulic jump, i.e., the depth d_1 and d_2 before and after a hydraulic jump. Unlike the alternate depths for a given specific head, the conjugate depths for a hydraulic jump reflect the energy loss from the hydraulic jump.

CURB OPENING - A drainage inlet consisting of an opening in the roadway curb. (Chapter 7)

CURRENT METER - An instrument for measuring the speed of flowing water. The U.S. Geological Survey uses a rotating cup meter. *(33)*

A device that is lowered into a stream in order to record the rate at which the current is moving. *(20)*

An instrument used to measure the flow velocity of a current. It is usually operated by a wheel equipped with vanes or cups which is rotated by the action of the impinging current. An indicating or recording device is provided to measure the speed of rotation which is correlated with the velocity of the current. A device or instrument for determining or measuring the velocity of flowing water by ascertaining the speed at which a stream of water rotates a vane or a wheel.

CUTOFF WALL - A wall, collar, or other structure intended to reduce percolation of water along otherwise smooth surfaces, or through porous strata. May also be a wall, usually constructed of such things as sheet piling or concrete, that extends from the end of a drainage structure and/or flowline downward to below the expected scour depth, or to scour-resistant material.

DAM - A barrier to confine or raise water for storage or diversion, or to create a hydraulic head. Part 315 of Act 451 requires permits for dams with a "height" of 6 feet or more and that have a surface area of 5 acres or more at the design flood elevation.

DEGRADATION (STREAMBED) - General and progressive lowering of the longitudinal profile of the channel bed due to long-term erosion. A progressive lowering of the channel bed due to scour. Permanent or continuing degradation is an indicator that a change in the stream's discharge and sediment load characteristics is taking place.

DEPRESSION STORAGE -The natural depressions within a watershed which store runoff. (Chapter 3)

DESIGN DISCHARGE - The maximum rate of flow (or discharge) for which a drainage facility is designed and thus expected to accommodate without exceeding the adopted design constraints. Maximum flow a bridge, culvert, or other drainage facility is expected to accommodate without contravention of the adopted design criteria. The peak discharge, volume, stage, or wave crest elevation, and its associated probability of exceedance selected for the design of a road culvert or bridge over a channel, floodplain, or along a shoreline. By definition, the design discharge, or wave, does not overtop the road. The design discharge headwater, or wave height, may be at an elevation lower than the road's profile grade in order to meet other design criteria such as the protection of property, accommodating land use needs, lowering of velocities, reducing scour, or complying with regulatory mandates. (Chapter 3)

DESIGN FLOOD - A flood that does not exceed the magnitude of the discharge for the design frequency.

DESIGN FLOOD FREQUENCY - The return interval or recurrence interval used as a basis for the design discharge.

DESIGN STORM - Selected storm of a given frequency (recurrence interval) used for designing a design storm system.

Hypothetical storm derived from intensity-duration-frequency curves by reading the rainfall intensity from these curves for various durations for the frequency of interest and rearranging these rainfall intensities to fit an assumed storm pattern and storm duration. *(36)*

A given rainfall amount, areal distribution, and time distribution used to estimate runoff. The rainfall amount is either a given frequency (25-, 50-year, etc.) or a special large [or specific frequency] value. *(36)*

DETENTION BASIN - A basin or reservoir incorporated into the watershed to temporarily store runoff, thus reducing the peak flow of the runoff hydrograph. Water is released and no permanent pool remains. (Chapter 8)

DIKE - An impermeable linear structure for the containment or control of overbank flow; such dikes trend parallel with a river bank and differ from a levee only in that such dikes extend for a much shorter distance along the bank. Relatively short dikes are also placed to contain and redirect flow such as into a culvert or down some other path. Compare with Levee.

DISCHARGE - The rate of flow of a stream or drain per unit of time, usually expressed in cfs. See cubic feet per second.

In its simplest concept, discharge means outflow; therefore, the use of this term is not restricted as to course or location and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal [, channel,] or of a river. It is also correct to speak of the discharge of a canal [, channel,] or stream into a lake, a stream, or an ocean (see Runoff). *(30)* The volume of water (or more broadly, volume of fluid plus suspended sediment) that passes a given point within a given period of time. *(37)*

DITCH - An artificial channel, usually distinguished from a canal by its smaller size. See Channel.

DRAIN - When used under Michigan's Drain Code, MCL 280.3, "…shall include the main stream or trunk and all tributaries or branches of any creek or river, any watercourse or ditch, either open or closed, any covered drain, any sanitary or any combined sanitary and storm sewer or storm sewer or conduit composed of tile, brick, concrete or other material, any structures or mechanical devices, …pumping equipment…any levee, dike, barrier, or a combination of any or all of the same …for the purpose of drainage…" Therefore, a "county drain" or "intercounty drain" can be a natural or artificially constructed water conveyance system. (Chapter 2)

DRAIN, COUNTY - As defined by the Drain Code, Act 40 of 1956: "Sec. 3. The word 'drain,' whenever used in this act, shall include the main stream or trunk and all tributaries or branches of any creek or river, any watercourse or ditch, either open or closed, any covered drain, any sanitary or any combined sanitary and storm sewer or storm sewer or conduit composed of tile, brick, concrete, or other material, any structures or mechanical devices, that will properly purify the flow of such drains, any pumping equipment necessary to assist or relieve the flow of such drains and any levee, dike, barrier, or a combination of any or all of same constructed, or proposed to be constructed, for the purpose of drainage or for the purification of the flow of such drains, but shall not include any dam and flowage rights used in connection therewith which is used for the generation of power by a public utility subject to regulation by the public service commission."

DRAINAGE - Four definitions are provided: 1.) The process of removing surplus groundwater or surface waters by artificial means; 2.) The manner in which the waters of an area are removed; 3.) The area from which waters are drained; 4.) A drainage basin. See Drainage Area.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is enclosed by a drainage divide. Over the years, use of the term to signify drainage basin or catchment area has come to predominate, although drainage basin is preferred. Used alone, the term "watershed" is ambiguous and should not be used unless the intended meaning is made clear. *(30)*

According to the *National Engineering Handbook (36)*: 1.) The area draining into a stream at a given point. The area may be of different sizes for surface runoff, subsurface flow, and base flow, but generally the surface runoff area is used as the drainage area; 2.) The area contributing direct runoff to a stream. Usually it is assumed that base flow in the stream also comes from the same area. However, the groundwater watershed may be larger or smaller.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified point. Figures of drainage area given in [WRD Data Reports] include all closed basins or non-contributing areas within the area unless otherwise noted. *(37)*

The area of land drained by a channel. An area confined by drainage divides, often having only one outlet for discharge; the total drainage area contributing runoff to a single point. The watershed area to include all other catchment physical characteristics. The term “catchment” is often used synonymously with other terms such as “drainage area: and implies all physical characteristics, including the contributing area.

An area surrounded by a continuous ridge [or drainage divide] within which all runoff is expected to join into a single flow stream and which extends to the point of junction of this flow stream (downstream) with the ridge. Natural boundaries, constructed boundaries, or minimum size of pipe are criteria which can be used to define the catchment. *(1)*

Three other definitions of interest are: 1.) The area drained by a stream or stream system; 2.) Synonymous with drainage area, drainage basins, or catchment area; 3.) For the sake of clarity, the use of the term "watershed" to mean catchment basin or drainage basin is avoided by the USGS and others.

DRAINAGE AREA - The surface area draining into a stream or drain at a given point. (Chapter 3)

DRAINAGE COURSE - By Administrative Rule R 281.817, is any conveyance other than the defined “inland lake and stream.” This would be the natural flow of water over the land as caused by the topography. (Chapter 2)

DRAINAGE STRUCTURE - Refers to manholes, catch basins, leaching basins, inlets, and drop inlets detailed in Design Standard Plans or in the contract plans. (Chapter 7)

DRAINAGE TAP - Connection to a sewer system through an existing drainage structure or junction chamber.

DROP INLET - A drainage inlet with a horizontal, or nearly horizontal, opening. (Chapter 7)

DRY PIT STATION - The dry pit station is comprised of two main chambers: a dry well and a wet well. The stormwater enters the station and is stored in the wet well. The wet well is usually separated from the dry well by a wall and is connected to the dry well by a suction line for each pump. See Chapter 10, Section 10.3.2.2 for more details. (Chapter 10)

DUNE - A sand wave of approximately triangular cross section (in a vertical plane in the direction of flow) formed by moving water or wind, with gentle upstream slope and steep downstream slope. Dunes travel downstream by the displacement of sediments on the upstream slope and their subsequent deposition on the downstream slope.

EA - Acronym for Environmental Assessment.

EASEMENT - MDOT secures its right-of-way for public use either by statutory (law), fee (purchase), or easement (purchase of a specific rights of use from a land owner). County drains are normally obtained by “easement.” (Chapter 2)

ECOREGION - Continuous geographical areas characterized by distinctive flora, fauna, land forms, climate, vegetation, and ecological climax.

ECOSYSTEM - The living organisms and the nonliving environment interacting in a given area. The elements of a community and its environment functioning as an ecological unit in nature.

EIS - Acronym for Environmental Impact Statement.

EMERGENCY ACTION PLAN (EAP) - A detailed description of the actions that must be taken to reduce flood losses [and hazards] and to disseminate information about an actual or expected flood hazard. *(27)*

EMINENT DOMAIN - In law, the right of a government to take, or to authorize the taking of, private property for public use with just compensation being given to the owner.

ENCROACHMENT - A highway action within the limits of a base (100-year) floodplain. With a design or review storm system, encroachment is sometimes used when referring to the width gutter flow spreads onto a traveled way as measured perpendicular from either the edge of the traveled way or from the face of the curb. A longitudinal encroachment roughly parallels a channel or floodplain. A transverse encroachment crosses a channel or flood plain. See Spread.

END SECTION – A concrete or metal structure attached to the end of a culvert for purposes of appearance, anchorage, retaining the embankment from spilling into the waterway, etc.

ENERGY - The capacity to perform work; kinetic energy is that due to motion, and potential energy is that due to position. In a stream the total energy at any section is represented by the sum of its potential and kinetic energies.

ENERGY DISSIPATION - The phenomenon whereby kinetic energy is dissipated or used up.

ENERGY EQUATION - The work-energy relationship, reduced to the simplified form from the Bernoulli equation (Bernoulli's Theorem which states that $P/\gamma + Z + v^2/2g = \text{constant}$). The equation is:

$$v_1^2/2g + \rho_1/\gamma + Z_1 = V_2^2/2g + \rho_2/\gamma + Z_2 + h_L$$

where subscripts 1 and 2 denote the upstream and downstream cross section.

ENERGY GRADE LINE (EGL) - A line joining the elevation of energy heads; a line drawn above the hydraulic grade line a distance equivalent to the velocity head of the flowing water at each section along a stream channel or conduit. (Chapters 5 and 7)

ENERGY GRADIENT - The slope of the energy line with reference to any plane or, more simply, the slope of the energy grade line. The slope of this line represents the rate of loss of head, and it must always slope downward in the direction of flow. Equivalent to energy gradient. Compare with Hydraulic Gradient and Friction Slope.

The energy of a stream referred to its bed; namely, depth plus the velocity head based on the mean velocity.

ENTRANCE LOSS - The head lost in eddies and friction at the inlet to a conduit or structure, expressed as a coefficient (K_e) times velocity head = K_e ($V^2/2g$).

EPA - Acronym for Environmental Protection Agency.

EPE - Acronym for Early Preliminary Engineering.

EQUALIZER - An opening, such as a culvert or bridge, placed where it is desirable to equalize the water level on both sides of an embankment.

EROSION - Displacement of soil particles on the land surface due to such things as water or wind action. The wearing away or eroding of material. (Chapter 9)

EVAPORATION - The process by which water passes from the liquid to the vapor state. *(13)* In hydrology, evaporation is vaporization that takes place at ambient temperature.

EVAPOTRANSPIRATION - Surface evaporation of water and transpiration through plants. (Chapter 3)

FAPG - Acronym for Federal Aid Policy Guide, Title 23 - CFR.

FAUNA - The animals of a particular region or time.

FEDERAL REGISTER - A daily publication of the Federal Government making Federal regulations, legal notices, Presidential Proclamations, Executive Orders, etc., known to the public as they are proposed and subsequently issued. See Code of Federal Regulations.

FEMA - Acronym for Federal Emergency Management Agency.

FETCH - The effective distance the wind blows over water in generating waves. The area in which waves are generated by wind having a rather constant direction and speed; sometimes and incorrectly used synonymously with "fetch length." The horizontal distance (in the direction of the wind) over which wind generates waves and wind setup.

FHWA - Acronym for Federal Highway Administration.

FILTER - Layer of synthetic fabric, sand, gravel, and/or graded rock placed (or developed naturally where suitable in-place materials exist) between the bank revetment and soil for one or more of three purposes: 1.) To prevent the soil from moving through the revetment by piping, extrusion, or erosion (exfiltrating); 2.) To prevent the revetment from sinking into the soil; 3.) To permit natural seepage from the stream bank, thus preventing buildup of excessive hydrostatic pressure. Also may be a device or structure for removing solid or colloidal material from stormwater and floodwater or preventing the migration of fine-grained soil particles as water passes through soil, i.e., the water is passed through a filtering medium, usually a granular material or finely woven or non-woven geotextile. Depending on context, may be used to remove material other than soils from a substance.

FILTER BLANKET - One or more layers of graded, intermediate size gravel or a geotextile material laid between fine-grained material and riprap to prevent the migration of the finer material (exfiltration).

FIRST FLUSH BASIN - A basin designed to capture the initial 1/2-inch to 1-inch of runoff from a storm. (Chapter 8)

FIS - Acronym for Flood Insurance Study.

FLAP GATE - The purpose of a flap gate is to restrict water from flowing back into the discharge pipe and to discourage entry into the outfall line. Flap gates are usually not watertight so the invert elevation of the discharge pipe should be set above the high water levels in the receiving structure. If flap gates are used, it may not be necessary to provide for check valves. (Chapter 10)

FLOOD - In common usage, an event that overflows the normal flow banks or runoff that has escaped from a channel or other surface waters. See Normal Flow and Bank. In frequency analysis, it can also mean an annual flood that may not overflow the normal flow banks. In technical usage, it refers to a given discharge based, typically, on a statistical analysis of an annual series of events.

An overflow or inundation that comes from a river or other body of water and causes or threatens damage. Any relatively high stream flow overtopping the natural or artificial banks in any reach of a channel. A relatively high flow as measured by either gage height or discharge quantity.

An overflow or other body of water that causes or threatens damage. *(4)* Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream. *(31)* A relatively high flow as measured by either gage height or discharge quantity. *(29).*

FLOOD EXCEEDANCE PROBABILITY - Probability that a random flood event will exceed a specified magnitude in a given time period, usually one year unless otherwise indicated.

FLOOD FREQUENCY - The number of times a flood of a given magnitude can be expected to occur on an average over a long period of time. Frequency analysis is then the estimation of peak discharges for various recurrence intervals. Another way to express frequency is with probability. Probability analysis seeks to define the flood flow with a probability of being equaled or exceeded in any year, i.e., 2 percent chance flood flow in any given year is a 50-year flood flow. Drainage structures are designed based on specified flood frequencies. However, certain hydrologic procedures use rainfall and rainfall frequency as the basic input. Thus, in those procedures, it is commonly assumed that the 10 percent chance (10-year) storm will produce the 10 percent chance (10-year) flood. (Chapter 3)

FLOOD HAZARD - Potential consequences, hazards, and inconveniences encountered by the traveling public, imposed on adjacent property owners, and incurred by the environment from a flood or a highway action in areas subject to flooding; included are such things as potential property loss or damage, loss of life, temporary or long-term loss of a transportation facility, permanent or long-lasting environmental damage, circuitous or interrupted highway travel, hydroplaning, and other roadway overtopping related hazards.

FLOOD OF RECORD - The maximum estimated or measured discharge that has occurred at a site.

FLOOD ROUTING - The process of determining progressively the timing and shape of a flood wave at successive points along a river. *(7)*

Determining the changes in a flood wave as it moves downstream through a valley or through a reservoir (then sometimes called reservoir routing). Graphic or numerical methods are used. *(36*

FLOOD STAGE - The gage elevation of the lowest bank of the reach in which the gage is situated. The term “lowest bank” is, however, not to be taken to mean an unusually low place or break in the natural bank through which the water inundates unimportant and small areas. *(32)* The [elevation or] stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the elevation is measured: U.S. Weather Bureau.

FLOOD WAVE A distinct rise in stage culminating in a crest and followed by recession to lower stages. *(30)* The rise and fall in stream flow during and after a storm. *(36)*

FLOODPLAIN - The land bordering a stream that is subject to inundation by floods. (Chapter 6)

FLOODWATERS - Floodwaters are former stream waters which have escaped from a watercourse (and its overflow channels) and flow or stand over adjoining lands. They remain floodwaters until they disappear from the surface by infiltration or evaporation or return to a natural watercourse (Chapter 2).

FLOODWAY - The channel of a river or a stream and those parts of the floodplain adjoining the channel which are reasonably required to carry and discharge a 1 percent chance (100-year) flood (Chapter 6).

FLORA - The plants of a particular region or time.

FLOW - A stream of water; movement of such things as water, silt and/or sand; discharge; total quantity carried by a stream. Characterized by the haphazard movement of small elements of a fluid undergoing translation. In terms of the Reynold's number, turbulent flow corresponds to high values of that number.

FLOW LINE - The lowest physical surface elevation in a drainage system. For storm sewers, the flow line is the same as the invert. This may not be true for culverts that are recessed. (Chapter 5)

FLOW REGIME - The system or order characteristic of stream flow with respect to velocity, depth, and specific energy. See Subcritical Flow and Supercritical Flow.

FLOW SLIDE - Saturation of a bank to the point where the soil material behaves more like a liquid than a solid; the soil/water mixture may then move downslope resulting in a bank failure.

FLOW TYPE - The USGS has established seven culvert flow types which assist in determining the flow conditions at a particular culvert site. Diagrams of these flow types are provided in the design methods. (Chapter 5)

FLOW-DURATION CURVE - A cumulative frequency curve that shows the percentage of time that specified discharges are equaled or exceeded. *(39)*

FLUME - An open or closed channel used to convey water. An open conduit of such things as wood, concrete, or metal on a prepared grade, trestle, or bridge. A flume holds water as a complete structure. A concrete lined canal would still be a canal without the lining, but the lining supported independently would be a flume. A large flume is also termed an aqueduct.

FORD - A location where a highway crosses a channel by allowing high annual or larger flows to pass over the highway and lower flows to pass through a culvert(s). Often used with cutoff walls, roadway lane markers, and paved roadway embankments and traveled way (and shoulders). Warning signs may be included also.

FRAZIL ICE - A French-Canadian term for fine spicular ice, derived from the French for cinders which this variety of ice most resembles. It is composed of fine particles which, when first formed, are colloidal and not seen in the water in which they are floating. *(3) (38)*

FREEBOARD - Is the vertical distance between the level of the water surface, usually corresponding to design flow, and a point of interest such as a low chord of a bridge berm or specific location on the roadway grade. For example, the bottom of subbase grade. (Chapter 4)

FREE OUTLET - An outlet that has a tailwater equal to or lower than critical depth. For culverts having free outlets, lowering of the tailwater has no effect on the discharge or the backwater profile upstream of the tailwater. (Chapter 5)

FREE WATER SURFACE - The water surface of flow in an open channel or in a closed conduit not flowing full.

FREQUENCY - See Flood Frequency.

FRICTION LOSS (OR HEAD) - The head or energy loss as the result of disturbances set up by the contact between a moving stream of water and its containing conduit. For convenience, friction losses are best distinguished from losses due to such things as bends, expansions, obstruction, and impacts, but there is no recognized line of demarcation between them and all such losses are often included in the term “friction loss.”

FRICTION SLOPE - The friction loss (or head) per unit length of conduit. For most conditions of flow, the friction slope coincides with the energy grade line, but where a distinction is made between energy losses due to such things as bends, expansions, and impacts, a distinction must also be made between the friction slope and the energy grade line. Friction slope is equal to the bed or surface slope only for relatively uniform flow in nearly uniform channels. Compare with Energy Grade Line and Hydraulic Grade Line.

FRONTAL FLOW - The portion of the flow which passes over the upstream side of a grate. (Chapter 7)

FROUDE NUMBER - A dimensionless number (expressed as $F = V/(gy)^{1/2}$) that represents the ratio of inertial to gravitational forces, i.e., at a Froude number of unity the flow velocity and wave celerity are equal (see Celerity, Wave). High Froude numbers can be indicative of a high velocity associated with supercritical flow and thus, the potential for scour and high momentum forces. Stated another way, a number which varies in magnitude inversely with the relative influence of gravity on the flow pattern: $F > 1.0$ indicates rapid (supercritical) flow; $F < 1.0$ indicates tranquil (subcritical) flow.

FWPCA - Acronym for Federal Water Pollution Control Act.

GABION - A rectangular basket made of steel wire fabric or mesh which is filled with rock or similar material of suitable size and gradation. Used to construct such things as flow-control structures, bank protection, groins, jetties, permeable dikes, and riparian spur dikes. When filled with cobbles, masonry remnants, or other rock or suitable size and gradation, the gabion becomes a flexible and permeable block with which the foregoing structures and devices can be built. Compare with Riprap.

GAGED SITES - This is a site at or near a gaging station and the stream flow record is long enough to be statistically analyzed to estimate peak discharges. (Most sites in this category will be greater than the current regulatory drainage area limit and will be determined by the MDEQ’s Hydrologic Studies Unit. The log-Pearson Type III probability distribution is used to analyze gaged flows.) (Chapter 3)

GATE VALVE - A gate valve is a simple shut-off device that can be used to isolate pumps and facilitate removal. These valves should not be used to throttle flow. They should be either totally open or totally closed. (Chapter 10)

GEOMORPHOLOGY - A study of the structure and formation of the earth's features. That branch of both physiography and geology that deals with the form of the earth, the general configuration of its surface and the changes that take place due to erosion of the primary elements and in the buildup of erosional debris. See Morphology.

GRADIENT - Change of elevation, velocity, pressure, or other characteristics per unit length; slope. Compare with Energy Grade Line.

GRADUALLY VARIED FLOW - Flow in which changes in depth and velocity take place slowly over large distances, resistance to flow dominates, and acceleration forces are neglected.

GRATE INLET - A drainage inlet composed of a grate in the roadway section or at the roadside in a low point, swale, or channel. (Chapter 7)

GRATE PERIMETER - The sum of the lengths of all sides of a grate, except that any side adjacent to a curb is not considered a part of the perimeter in weir flow computations. (Chapter 7)

GROUNDWATER - Subsurface water occupying the saturation zone from which wells and springs are fed. A source of base flow in streams. In a strict sense, the term applies only to water below the water table. Water at and below the water table; basal or bottom water; phraetic water. Used also in a broad sense to mean all water below the ground surface.

Water in the ground that is in the zone of saturation, from which wells, springs and groundwater runoff are supplied. *(33)* The Groundwater Subcommittee offers numerous definitions: 1.) That part of the subsurface water that is in the saturated zone; 2.) Loosely, all subsurface water as distinct from surface water; 3.) All water which occurs below the land surface [and] it includes both water within the unsaturated and saturated zones; 4.) Means water below the land surface in a zone of saturation; 5.) Groundwater is the water contained within an aquifer; 6.) All water which occurs below the land surface; 7.) All subsurface water as distinct from surface water; 8.) Subsurface water that fills available openings in rock or soil materials to the extent that they are considered water-saturated; 9.) Water below the land surface in a zone of saturation; 10.) Water in a saturated zone or stratum beneath the surface of land or water.

The water contained in interconnected pores located below the water in an unconfined aquifer or located in a confined aquifer. *(13)*

The water in the saturated zone beneath the water table. A source of base flow in streams. *(36)*

GROUNDWATERS - In legal considerations, groundwaters are divided into two classes, percolating waters and underground streams. The term "percolating waters" generally includes all waters that pass through the ground beneath the surface of the earth without a

definite channel. The general rule is that all underground waters are presumed to be percolating. To take them out of the percolating class, the existence and course of a permanent channel must be clearly shown. Underground streams are waters passing through the ground beneath the surface in permanent, distinct, well-defined channels. (Chapter 2)

GUIDE BANK (SPUR DIKE) - Relatively short embankments generally in the shape of a quarter of an ellipse and constructed at the upstream side (and sometimes the downstream side) of either or both bridge ends as an extension of the abutment spill slope. The purpose is to align the flow with the bridge opening so as to decrease scour at the bridge abutment by spreading the flow and any resultant scour throughout the bridge opening. May also be a training dike (usually when constructed downstream). Sometimes referred to using the outdated term “Spur Dike.”

GUTTER - That portion of the roadway section adjacent to the curb which is utilized to convey stormwater runoff. A uniform gutter section has one constant cross-slope. (Chapter 7)

HARMFUL INTERFERENCE - Causing an unnaturally high stage or unnatural direction of flow on a river or stream that causes, or may cause, damage to property, a threat to life, a threat of personal injury, or a threat to water resources. (Chapters 5 and 6)

HDS - Acronym for Hydraulic Design Series.

HEAD - The height of water above any point, plane, or datum of reference. Used also in various computations, such as energy head, entrance head, friction head, static head, pressure head, lost head, etc. The height of the free surface of a body of water above a given point.

HEADLOSS - A loss of energy in a hydraulics system generally expressed in feet of head.

HEADWALL - The structural appurtenance usually applied to the end of a culvert inlet and outlet or storm drain outlet to retain an adjacent highway embankment and protect the culvert ends.

HEADWATER (HW) - The depth of water impounded upstream of a culvert due to the influence of the culvert constriction, friction, and configuration.

HEADWATER DEPTH - Depth of water above the inlet flow line at the entrance of a culvert or similar structure. Depth of water upstream of a contraction such as occurs at a bridge or similar structure. Natural flow depth plus backwater.

HEC - Acronym for Hydraulic Engineering Circular (FHWA).

HEC - Acronym for Hydraulic Engineering Center (USACE).

HGL - Acronym for Hydraulic Grade Line.

HIGHWATER MARK - A mark left as evidence of the height to which a flood reached; usually in the form of such things as deposited sediment, debris and detritus.

HYDRAULIC DESIGN ENGINEER - A hydraulics engineer who designs hydraulic structures. An engineer whose practice is limited primarily to hydraulics and river mechanics.

HYDRAULIC GRADE LINE (HGL) - A profile of the piezometric level to which the water would rise in piezometer line tubes along a pipe run. In open channel flow, it is the water surface. (Chapters 5 and 7)

HYDRAULIC GRADIENT - The slope of the hydraulic grade line; the slope of the water surface in uniform, open channel flow.

The change in total head with a change in distance in a given direction. The direction is that which yields a maximum rate of decrease in head. *(13)* The slope of the hydraulic grade line through a channel reach or drainage structure. Compare with Energy Grade Line and Friction Slope.

HYDRAULIC JUMP - The sudden and usually turbulent passage of water from a stage below critical depth (supercritical flow) to a stage above critical depth (subcritical flow) during which the velocity passes from supercritical to subcritical. It represents the limiting conditions of the water surface curve (or profile) wherein it tends to become perpendicular to the streambed.

A hydraulic phenomenon, in open channel flow, whereby supercritical flow is converted to subcritical flow. This can result in a relatively abrupt and turbulent rise in the water surface. See Critical Depth.

HYDRAULIC MODEL - A small-scale physical representation of a flow situation. May also refer to a mathematical model.

HYDRAULIC RADIUS - A measure of the boundary resistance to flow, computed as the cross-section area of flow divided by the wetted perimeter. For wide shallow flow, the hydraulic radius can be approximated by the average flow depth. Compare with Wetted Perimeter.

HYDRAULIC ROUGHNESS - A composite of the physical characteristics which influence the flow of water across the earth’s surface, whether natural or channelized. It affects both the time response of a watershed and drainage channel, as well as the channel storage characteristics. (Chapter 3)

HYDRAULIC STRUCTURE - A facility used for such things as to impound, accommodate, convey, or control the flow of water, such as a dam, weir, intake, culvert, channel, or bridge.

HYDRAULICS - The characteristic of fluid mechanics involved with the flow of water in or through drainage facilities.

HYDROGRAPH - Is a graph of the time distribution of runoff from a watershed. (Chapter 3)

HYDROLOGIC CYCLE - A term to denote the circulation of water from the sea, through the atmosphere to the land, and thence, back to the sea by overland and subterranean routes and in part by way of the atmosphere; also, the many short circuits of the water that are returned to the atmosphere without reaching the sea. *(34)*

HYDROLOGIC SOIL GROUP (HYDROLOGIC SOIL COVER COMPLEX) - A group of soils having similar runoff potential under similar storm and cover conditions. *(36)* A combination of a hydrologic soil group and a type of cover. *(36)*

HYDROLOGIC STUDIES - Studies to determine the runoff and flood characteristics to be expected at a highway drainage site. A most important step prior to the hydraulic design of a highway drainage structure. Such studies are necessary for determining the rate of flow, runoff, or discharge that the drainage facility will be required to accommodate.

HYDROLOGY - The science and study concerned with the occurrence, circulation, distribution, and properties of the waters of the earth and its atmosphere.

HYETOGRAPH - Is a graph of the time distribution of rainfall over a watershed. (Chapter 3).

IMPERVIOUS - Impermeable to water.

IMPERVIOUS SURFACE – A surface that does not allow infiltration of water. (Chapter 9)

IMPROVED INLET - An inlet that has an entrance geometry which decreases the flow contraction at the inlet and thus increases the capacity of culverts. These inlets are referred to as either side- or slope-tapered (walls or increased flow-line slope at the entrance) and sometimes are beveled edged. (Chapter 5)

INFILTRATION - The part of rainfall that enters the soil. The passage of water through the soil surface into the ground. Used interchangeably with percolation. (Chapters 3 and 9)

INFILTRATION BASINS OR TRENCHES - A basin or trench that discharges stored water into the ground. (Chapter 8)

INFILTRATION RATE - The rate at which water enters the soil under a given condition. The rate is usually expressed in inches per hour, feet per day, or cubic feet per second.

INFLOW - The rate of discharge arriving at a point (in a stream, structure, or reservoir).

INLAND LAKE OR STREAM - Is defined under MCL 324.30101 as "…a natural or artificial lake, pond, or impoundment; a river, stream, or creek which may or may not be serving as a drain as defined by the Drain Code of 1956, 1956 PA 40, MCL 280.1 to 280.630; or any other body of water that has definite banks, a bed, and visible evidence of a continued flow or continued occurrence of water…" (Chapter 2)

INLET - Structures for capturing concentrated surface flow. May be located along the roadway, in a gutter, in the highway median, or in a field. (Chapter 7)

INLET CONTROL - Occurs when the culvert barrel is capable of conveying more flow than the inlet will accept. The control section of a culvert operating under inlet control is located just inside the entrance. Critical depth occurs at or near this location, and the flow regime immediately downstream is supercritical. Hydraulic characteristics downstream of the inlet control section do not affect the culvert capacity. The upstream water surface elevation and the inlet geometry represent the major flow controls. The inlet geometry includes the barrel shape, cross-sectional area, and the inlet edge. (Chapter 5)

INLET EFFICIENCY - The ratio of flow intercepted by an inlet to total flow in the gutter. (Chapter 7)

INTENSITY - The rate of rainfall upon a watershed, usually expressed in inches per hour.

INTERCEPTION - Storage of rainfall on foliage and other surfaces during a rainfall event. (Chapter 3)

INTERMITTENT STREAM - A stream which flows only at certain times of the year when it receives water from springs or from some surface source such as melting snow in mountainous areas. *(30)*

INVERT - The lowest interior elevation of a culvert, sewer, or tunnel. Compare with Crown. (Chapters 5 and 7)

INVERTED SIPHON - A structure used to convey water under a road using pressure flow. The hydraulic grade line is above the crown of the structure.

ISTEA - Acronym for Intermodal Surface Transportation Efficiency Act.

KINETIC ENERGY - Energy due to motion. The kinetic energy of a given discharge is generally taken as proportional to the product of its weight per unit of time and the velocity head of its mean velocity. For a constant discharge, kinetic energy may be represented by a line at a distance above a flowing water surface proportional to the velocity head of its mean velocity. The elevation of such a line above any datum represents the total energy (potential plus kinetic) of the given discharge above that datum. Strictly, the kinetic energy of a given discharge is the integral of the kinetic energies of its particles.

LAG TIME - Is defined as the time from the centroid of the excess rainfall to the peak of the hydrograph. (Chapter 3)

LAMINAR FLOW - That type of flow in which each particle moves in a direction parallel to every other particle and in which the head loss is approximately proportional to the first power of the velocity. It is sometimes designated “streamline flow” or “viscous flow.” Laminar flow is characterized by the steady, translatory motion of adjacent small elements of the fluid. Tendencies toward turbulence or instability in truly laminar flow are damped out by viscous shear forces. In terms of the Reynold’s number, laminar flow corresponds to low values of that number.

Flow in which the head loss is proportional to the first power of the velocity. *(25)*

That type of flow in which the fluid particles follow paths that are smooth, straight, and parallel to the channel walls. In laminar flow, the viscosity of the fluid damps out turbulent motion. *(13)*

Laminar flow changes to turbulent flow in a pipe between the critical value of 2,000 and about 50,000 (there is no definite upper limit). Compare with Turbulent Flow.

LAND USE - A term which relates to both the physical characteristics of the land surface and the human activities associated with the land surface. *(1)* A highway facility to accommodate land uses is termed a land use structure or facility.

A land classification. Cover, such as row crops or pasture, indicates a kind of land use. Roads may also be classified as a separate land use. *(36)*

LEACHING BASIN - A drainage structure with a porous sump bottom, as opposed to the concrete sump of the catch basin. Leaching basins should only be used where soils will allow infiltration and where potential groundwater contaminants will not be introduced through stormwater. (Chapter 7)

LEVEE - An embankment, generally landward of a top bank, that confines flow during high water periods, thus preventing overflow into lowlands. A linear embankment outside a channel for containment of flow. Longer than a dike. Compare with Dike.

LONGITUDINAL PROFILE - The profile of a stream or channel drawn along the length of its centerline. In drawing the profile, elevations of the water surface or the thalweg are plotted against distance as measured from the mouth or from an arbitrary initial point.

LWMD - Acronym for Land and Water Management Division of Michigan Department of Environmental Quality.

MANNING'S EQUATION - An empirical formula devised by Manning, based upon original work by Ganguillet and Kutter, for computing flow in open channels and pipes. In its present form it has been modified to: $v = (1/n)R^{2/3}S^{1/2}$ where v = velocity, R = hydraulic radius or A/Wp where A = cross section area, Wp = wetted perimeter, and S = Hydraulic Gradient. See Manning's Roughness Coefficient.

MANNING'S ROUGHNESS COEFFICIENT (n) - A coefficient of roughness, used in a Manning's equation for estimating the capacity of a channel to convey water. Generally, "n" values are determined by inspection of the channel *(36).* The roughness coefficient, n, in the Manning equation for determination of a discharge. Compare with Hydraulic Roughness. See Manning's Equation.

MCL - Acronym for Michigan's Compiled Laws.

MDA - Acronym for Michigan Department of Agriculture.

MDEQ - Acronym for Michigan Department of Environmental Quality.

MDOT - Acronym for Michigan Department of Transportation.

MEA - Acronym for Municipal Enforcing Agencies.

MEAN ANNUAL FLOOD - Maximum annual flood peak having a 2.33-year frequency interval (recurrence interval). Flood where, if the total population of floods were known, half would be larger and the remaining half would be smaller.

MEAN ANNUAL FLOW - The annual mean flow, Q_a, for the year based on the 12 monthly means.

MEAN SEA LEVEL - Mean sea level is the plane about which the tide oscillates. It is determined from tidal observations by averaging the recorded hourly heights of the tide over a period of several years.

MEAN VELOCITY - Two definitions are provided: 1.) The velocity at a given section of a stream obtained by dividing the discharge of the stream by the cross section area at that section; 2.) Mean velocity may also apply to a reach of a stream by dividing the discharge by the average area of the reach.

MEANDER - The winding of a stream channel. *(30)* The changes in direction and winding of flow, usually in an alluvial channel which is sinuous in character. Any reverse or letter-S channel pattern fashioned in alluvial materials by erosion of the concave bank, which is free to shift its location and adjust its shape as part of a stage in the migratory movement of the channel as a whole down an erodible, alluvial valley. A meander is characterized by curved flow patterns and alternating shoals and bank erosion.

MEANDERING CHANNEL - A channel exhibiting a characteristic process of bank erosion, crossover, and point bar deposition associated with systematically shifting meanders. See Meander.

A channel having a sinuosity greater than some arbitrary value, herein placed at 1.25. The term also implies a moderate degree of pattern symmetry, imparted by regularity of size and repetition of meander loops.

MILD SLOPE - Occurs where critical depth is less than normal depth. (Chapter 5)

MIOSHA - Acronym for Michigan Occupational Safety and Health Act.

MITIGATE - The act of lessening, offsetting, or compensating an impact on surface waters. To moderate (a qualifying or condition) in force or intensity. To decrease or rectify an adverse condition or action. See Mitigation Alternatives, Mitigation Measures, and Mitigation Methods.

MITIGATION ALTERNATIVES - Environmental mitigation alternatives for surface waters in order of priority are currently (1992) defined as: 1.) Avoidance; 2.) On-site mitigation; 3.) Off-site mitigation within the same drainage area; 4.) Off-site mitigation within the same drainage and biotic region; 5.) No mitigation.

MITIGATION MEASURES - Mitigation measures for surface waters are defined as the site-specific action or construction necessary to accomplish the mitigation to the extent practicable.

MITIGATION METHODS - Mitigation methods for surface waters are defined as either the on-site or off-site: 1.) Construction of new surface waters; 2.) Enhancement of existing surface waters; 3.) Acquisition in perpetuity and enhancement of existing surface waters; 4.) Combinations thereof.

MOMENTUM - The impetus of a moving body; the quantity of motion in a body as measured by the product of its mass by its velocity.

MORPHOLOGY - The biological study of the form and structure of living organisms. May also be shortened term hydraulics engineers, for convenience, often used (or misused) when referring to fluvial geomorphology (technically this is incorrect but commonly used).

MS4 - Acronym for Municipal Separated Storm Sewer System.

NAPPE - A sheet or curtain of water overflowing such things as a weir or drop structure. A stable nappe has an upper and a lower water surface exposed to the atmosphere

NATIONAL GEODETIC VERTICAL DATUM of 1929 (NGVD) - A geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada. It was formerly called “Sea level Datum of 1929” or “mean sea level” [in the annual WRD data reports]. Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place. *(37)*

NBIS - Acronym for National Bridge Inventory System.

NCDC - Acronym for National Climatic Data Center.

NEC - Acronym for National Electrical Code.

NEPA - Acronym for National Environmental Policy Act.

NFIP - Acronym for National Flood Insurance Program.

NOAA - Acronym for National Oceanic and Atmospheric Administration.

NON-STRUCTURAL FLOOD CONTROL MEASURES - These include: 1.) Flood warning and preparedness; 2.) Temporary or permanent evacuation and relocation; 3.) Emergency flood fighting and financial relief; 4.) Land use regulations including floodway delineation, floodplain zoning, subdivision regulations, and building codes; 5.) Flood proofing with or without land use regulations; 6.) Area renewal and conversion to open space; 7.) Flood insuring. The fundamental goal is to develop, define, and recommend a robust solution that has public and institutional support (having appropriately determined how well an economical plan can be made to function, how capable are the responsible interests to operate and maintain it, and how safe will be the people who will depend on it). Methods of reducing damage from floods include local flood warning and response systems, temporary permanent evacuation and relocation of people or property, emergency flood fighting and financial relief, land use regulations and building codes, flood proofing, area renewal and conversion to open space, and flood insurance. *(26).*

NON-UNIFORM FLOW - A flow, the velocity of which is undergoing a positive or negative acceleration. If the flow is constant, it is referred to as “steady non-uniform flow.” A flow in which the velocities vary from point to point along the stream or conduit, due to variations in cross section, slope, etc. Compare with Uniform Flow.

NORMAL DEPTH - The depth at normal flow. (Chapter 5)

NORMAL DEPTH - The depth of water in an open conduit that corresponds to uniform velocity for the given flow. It is a hypothetical depth under conditions of steady nonuniform flow; the depth for which the water surface and bed are parallel. Normal depth and velocity apply only to uniform flow with a free water surface. These conditions will be approached with a steady discharge in a length of uniform channel that is sufficient to establish uniform flow.

NORMAL FLOW - Occurs in a channel reach when the discharge, velocity, and depth of flow do not change throughout the reach. The water surface and channel bottom will be parallel. This type of flow will exist in a culvert operating on a constant slope provided the culvert is sufficiently long and the backwater is less than the normal depth. (Chapter 5)

NPDES - Acronym for National Pollutant Discharge Elimination System.

NPSH - Acronym for net positive suction head.

NRCS - Acronym for National Resources Conservation Service.

NREPA - Acronym for National Resources and Environmental Protection Act, Michigan Act 451, Public Acts of 1994, as amended.

NWS - Acronym for the National Weather Service. More specifically, the United States Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service; formerly the U.S. Weather Bureau.

O&M Handbook - Acronym for Operations and Maintenance Handbook.

OHWM - Acronym for ordinary high water mark.

ONE-DIMENSIONAL WATER SURFACE PROFILE - An estimated water surface profile which recognizes flow only in the upstream-downstream direction; vertical and transverse velocity vector components are ignored. Compare with Two-Dimensional Water Surface Profile.

ONE-HUNDRED-YEAR FLOOD - Magnitude of the flood that has a 0.01 probability of being exceeded in any given year and has about a 63 percent chance of being exceeded during a 100 year [period]. It is now in vogue to call the 100-year flood the one-percent probability (chance) flood. In highway drainage design the 100-year flood is sometimes termed the base flood. See Base Flood. Note: It is proper to say “...probability of being exceeded in any...,” rather than “...exceeded.” Compare with Flood, One-Thousand Year. See Flood Frequency.

ONE-THOUSAND-YEAR FLOOD - Magnitude of the flood that has a 0.001 probability of being exceeded in any given year. Over an infinitely long period of time it would occur on an average once every thousand years. It should be noted that over a 1000 years [year period] there is about a 63 percent chance of at least one occurrence and there is a significant chance of two, three, or more floods of this magnitude occurring during the thousand years. *(11)* Again, "...probability of being exceeded in any..." is proper. See One-Hundred Year Flood; and Flood Frequency.

OPEN CHANNELS – Are a natural or constructed conveyance for water in which:

- The water surface is exposed to the atmosphere.
- The gravity force component in the direction of motion is the driving force. (Chapter 4)

OPEN CHANNEL FLOW - Flow in any open or closed conduit where the water surface is free; that is, where the water surface is at atmospheric pressure. Compare with Open Channel.

OPERATIONAL BMP - Used to educate and improve awareness of soil erosion, sedimentation, and other water quality issues so that nonpoint source pollution is not generated. (Chapter 9)

ORDINARY HIGH WATER (OHW) - A term for defining a regulatory-related water surface for a natural channel or the shore of standing waters. This intersection reflects the highest level water reaches in an average runoff year as indicated by such things as erosion, shelving, change in the character of soil, destruction of terrestrial vegetation or its inability to grow, the presence of litter and debris; or in the absence of such evidence, an arbitrarily estimated water surface might be used such as that associated with the mean annual flood. For the purposes of this Glossary, in no instance will the OHW be considered as exceeding the estimated water surface level of the mean annual flood unless so mandated by the cognizant regulatory agency(ies). The sum of the water right, flood right, and mean annual flood may be used to arbitrarily determine the maximum OHW for irrigation channels intercepting runoff.

ORDINARY MEAN HIGH WATER MARK - The line on the shore of a waterway that is:

- Established by the fluctuations of water
- Indicated by physical characteristics such as a clear and natural line impressed on the bank, shelving, changes in the character of the soil, the destruction of terrestrial vegetation, or the presence of litter or debris. (Chapter 5)

ORIFICE - Two definitions are pertinent: 1.) A hole or opening, usually in a plate, wall, or partition, through which water flows, generally for the purpose of control or measurement; 2.) The end of a small tube, such as the orifice of a pitot tube or piezometer.

ORIFICE FLOW - Flow similar to that through an orifice. For highway drainage design, in culvert flow it corresponds to flow-type V, i.e., a culvert flowing part-full under high head.

OUTFALL - The point where: 1.) Water flows from a conduit; 2.) The mouth (outlet) of a drain or sewer; 3.) Drainage discharges from a channel or storm drain.

OUTLET CONTROL - Occurs when the culvert barrel is not capable of conveying as much flow as the inlet opening will accept. The control section for outlet control flow in a culvert is located at the barrel exit or further downstream. Either subcritical or pressure flow exists in the culvert barrel under these conditions. All of the geometric and hydraulic characteristics of the culvert play a role in determining its capacity: water surface elevation at the outlet, slope, length, and hydraulic roughness of the culvert barrel. (Chapter 5)

OVERBANK FLOW - Water movement over the top of a bank either due to a rising stream stage or to inland surface water runoff. Compare with Flood and Overland Flow.

OVERLAND FLOW - The flow of rainwater or snowmelt over the land surface toward stream channels. After it enters a stream, it becomes runoff. *(30)*

The flow of water over a land surface due to direct precipitation. Overland flow generally occurs when the precipitation rate exceeds the infiltration capacity of the soil and depression storage is full. Also called Horton's Overland Flow. *(13)*

Runoff which makes its way over the land surface prior to concentrating in gullies and streams; sometimes termed sheet flow. Compare with Overbank Flow.

OVERTOPPING FLOOD - Incipient discharge escaping via such things as over a highway, at a watershed divide, or through emergency relief facilities. Stated another way, the flood which, if exceeded, results in flow over a highway, bridge or culvert, over a watershed divide or dike, or through structures provided for emergency relief. The worse case scour condition may occur with the overtopping flood. The total flood magnitude cannot exceed the probable maximum flood and its frequency accuracy is limited by the state-of-the-art capability to estimate a recurrence interval.

PA - Acronym for public act.

PARTS PER MILLION - The ratio used in expressing the concentration of suspended sediment given in either parts per million (PPM) or percent. Methods of determination: 1.) weight of dried sediment divided by weight of sample; 2.) Weight of the dried sediment divided by weight of distilled water with a volume equal to that of the sample; 3.) Weight of the dried sediment divided by the weight of the water in the sample, including the dissolved material. Either method 1.) or 2.) is used when the concentration is less than one percent. Current practice is to use milligrams per liter (mg/L) rather than parts per million.

PEAK DISCHARGE - The maximum rate of flow of water passing a given point as a result of a rainfall event of snowmelt; sometimes called peak flow. (Chapter 3)

PEAK FLOW - Maximum discharge rate on a runoff hydrograph.

PERCENT CHANCE - A probability multiplied by 100. *(28)*

PERCHED GROUNDWATER (or PERCHED WATER TABLE) - The Groundwater Subcommittee offers this definition. *(25)* [Unconfined] Groundwater separated from an underlying body of groundwater by an unsaturated zone. Its water table is a perched water table. Perched groundwater is held up by a perching bed whose permeability is so low that water percolating downward through it is not able to bring water in the underlying unsaturated zone above atmospheric pressure.

PERCOLATION - The flow of a fluid through a substance via pores or small openings. Two definitions are offered by the Groundwater Subcommittee: 1.) The downward movement of water through the unsaturated zone; 2.) The downward flow of water in saturated or nearly saturated porous medium at hydraulic gradients of the order of 1.0 or less.

Movement of water through the interstices of a substance, as through soils. The movement or flow of water through the interstices or the pores of a soil or other porous medium.

The movement, under hydrostatic pressure, of water through the interstices of a rock or soil, except the movement through large openings such as caves. *(33)* Compare with Infiltration.

PERMANENT BMP - Used to reduce soil erosion and sedimentation after construction on the site is complete. These BMPs require maintenance. (Chapter 9)

PERMEABILITY - The property of a material that permits appreciable movement of water through it when it is saturated and movement is actuated by hydrostatic pressure of the magnitude normally encountered in natural subsurface water.

PERVIOUS SOIL - Soil containing voids through which water will move under hydrostatic pressure, percolate, or infiltrate.

PERVIOUS SURFACE – A surface that allows infiltration of water. (Chapter 9)

pH - The reciprocal of the logarithm of the hydrogen ion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water (or soil) has a pH value of 7.

PHREATIC LINE - The upper boundary of the seepage water surface landward of a stream bank.

POND - Very small, very shallow bodies of standing water in which quiescent water and extensive occupancy by higher aquatic plants are common characteristics. Regional usage may refer to a lake as a pond.

PRECIPITATION - The process by which water in liquid or solid state falls from the atmosphere. The total measurable supply of water received directly from clouds, as rain, snow, and hail; usually expressed as depth in a day, month, or year and designated as daily, monthly, or annual precipitation. Not synonymous with rainfall.

As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water. The term “precipitation” is also commonly used to designate the quantity of water that is precipitated. *(33)*

Precipitation includes rainfall, snow, hail, and sleet and is, therefore, a more general term than rainfall. *(30)*

PRESCRIPTIVE DRAINAGE EASEMENT - A prescription (prescriptive right) which has been established through long, uninterrupted and undisputed use of a drainage facility or channel and thus precludes increasing the existing flood hazard or changing the drainage pattern or amount at such a drainage facility or channel for any recurrence interval. The free or unencumbered use of some drainage facility for drainage or other purposes.

PRESSURE FLOW - Where flows passing through a bridge type opening are contracted vertically by the superstructure to the extent that the flow has a pressure head and flow streamlines analogous to that occurring at a sluice gate.

PRESSURE HEAD - The height of a column of water that would exert a unit pressure equal to the pressure of the water. (Chapter 7)

PRINCIPAL SPILLWAY - Conveys all ordinary discharges coming into a reservoir and that portion of an extreme discharge that does not pass through the emergency spillway or outlet works.

A concrete or metal pipe or conduit used with a drop inlet dam or floodwater retarding structure. It conveys, in a safe and non-erosive manner, all ordinary discharges coming into a reservoir and all of an extreme amount that does not pass through the emergency spillway. *(36).*

PROFILE - A graphical representation of elevation plotted against distance. In open channel hydraulics, a water surface profile is a plot of water surface elevation against channel distance. See Hydraulic Grade Line and Water Surface Profile.

PUMP - A device that increases the static pressure of fluids. In other words, pumps add energy to a body of fluid in order to move it from one point to another. (Chapter 10)

PUMP CONTROL - A pump control is a device that activates pumps successively in response to a rising water level in the sump. The controls regulate the pump activity until the inflow into the wet well has ceased. (Chapter 10)

PUMP DRIVER - The device used to provide power to the pump. Alternating current electric motors are the most common type of driver. Squirrel cage (single speed), induction, or synchronous motors (large horsepower with low rpm) are preferred by MDOT. Although less frequent, engines by also be used as pump drivers.

RAINFALL EXCESS -The water available to runoff after interception, depression storage, evapotranspiration, and infiltration have occurred. (Chapter 3)

RAPIDLY VARIED FLOW - Flow in which changes in depth and velocity take place over short distances, acceleration forces dominate and energy loss due to friction is minor.

RATING CURVE - A graph of the discharge of a river at a particular point as a function of the elevation of the water surface. *(27)* A graphic (or tabular) representation of rating; a calibration; a curve (table) relating stage to discharge. Compare with Stage-Discharge Curve.

RATIONAL FORMULA - An empherical equation for estimating the flood discharge given as Q = CIA, where Q = peak discharge (cfs), C = a runoff coefficient, I = rainfall intensity in inches per hour for a duration equal to the concentration time of the basin, and A = area of basin in acres.

RDM - Acronym for Road Design Manual.

REACH - A segment of stream or valley, selected with arbitrary bounds for purposes of study. A comparatively short length of a stream or channel.

General Introduction and Hydrologic Definitions (30) offers five definitions: 1.) The length of channel uniform with respect to discharge, depth, area, and slope; 2.) The length of a channel for which a single gage affords a satisfactory measure of the stage and discharge; 3.) The length of a river between two gaging stations; 4.) More generally, any length of a river; 5.) A length of stream or valley selected for convenience in a study.

REASONABLE USE DOCTRINE AND RULE - A rule under which, in some jurisdictions, a riparian owner, acting in good faith and for a legitimate purpose, may use and/or alter the natural flow of water from his land without liability to other owners, so long as such use and action is reasonably necessary and beneficial and reasonable care is taken to avoid unnecessary injury or hindrance to the use of the land below.

REGIONAL ANALYSIS - Flood frequency [relationships] lines for gaged watersheds in a similar [homogeneous physiographic] area or region are used to develop a flood-frequency line for an ungaged watershed in that [same] region. Also used with other types of hydrologic data. Method is a simple (usually graphical and freehand) form of “regression analysis” used by statisticians. *(36)*

A statistically based regional study of gaged stream data from a homogeneous physiographic region which produces regression equations relating various watershed and climatological parameters to such things as discharge frequency for application on ungaged streams. Used to formulate methods of predicting flood-frequency relationships for the hydraulic design of drainage facilities in hydrologically similar ungaged watersheds having characteristics similar to those used in the regression analysis.

REGULATORY FLOOD - The 100-year flood, which was adopted by the FEMA, as the base flood for most floodplain management purposes. See Base Flood.

REGULATORY FLOODWAY - The floodplain area that is reserved in an open manner by Federal, State, or local requirements, i.e., unconfined or unobstructed either horizontally or vertically, to provide for the discharge of the base flood so that the cumulative increase in

water surface elevation is no more than a designated amount. May also be considered as: 1.) A channel and floodplain regulated by an agency having jurisdiction over dredge and fill activities; or 2.) A channel and floodplain requiring approval for a channel change or flood storage. Compare with Floodway.

RESERVOIR - A pond, lake, or basin, either natural or artificial, for the storage, regulation and control of water. *(30)* Reservoirs regulate floods downstream from the dam by temporarily storing some part of the flood volume and releasing it later. The impact downstream is to lower flood stages, increase the duration of flooding and shift the flood to a later time. It is normal for dam and reservoir projects to effect some control on and lower flood stages for, all magnitudes of floods. *(26)*

RESERVOIR ROUTING - Flood routing through a reservoir. *(36)* Flood routing of a hydrograph through a reservoir taking into account reservoir storage, spillway, and outlet works discharge relationships.

RESIDENCE TIME - The time that water stays in lake with no outlet, or with a very limited outlet. May also refer to the time floodwaters for a given frequency flood are expected to be detained in a retention basin, retarding reservoir, recharge basin, or flood control reservoir.

RETENTION - The process of collecting and holding surface and stormwater runoff. (Chapter 8)

RETENTION BASIN - A basin or reservoir wherein water is stored and which regulates a flood. It has a controlled outlet. The stored water is discharged by infiltration, injection or dry wells, or by release to the downstream drainage system during and after a storm event. The release may be through a gate-controlled gravity system or by pumping. The basin maintains a permanent pool elevation. (Chapter 8)

RETURN FLOW - That part of irrigation water that is not consumed by evapotranspiration and that returns to its source or another body of water. The term is also applied to the water that is discharged from industrial plants. Also called return water. *(30)*

RIPARIAN - Pertaining to the banks of a stream. *(30)* Of, on, or pertaining to the bank of a channel or the shore of a pond or a lake. Pertaining to anything connected with or adjacent to the banks of a channel or other body of water; a riparian owner is one who owns the banks.

RIPARIAN DOCTRINE OR RULE - A doctrine that holds that the property owner adjacent to a surface water body has first right to withdraw and use the water. *(13)* This doctrine may be set aside by a state’s statutory law that holds that all surface waters are the property of the state.

RIPARIAN RIGHTS - The rights of the owners of lands along a watercourse, relating to such things as water, its use, ownership of soil under the stream or river, and accretions. The legal right of a riparian owner to use the water on his riparian land originated in the common law, which permitted him to require that the waters of a stream or river reach his land undiminished in quantity and unaffected in quality except for minor domestic uses. Compare with Riparian Doctrine or Rule.

RIPRAP - Stones placed in a loose assemblage along the banks and bed of a channel to inhibit erosion, stream instability, or scour.

RIVER - Under Michigan's Natural Rivers Act, is defined under MCL 324.30501, to "…means a flowing body of water or a portion or tributary of a flowing body of water, including streams, creeks, or impoundments and small lakes thereon." (Chapter 2)

ROADSIDE DITCHES - Artificial channels distinguished from canals or streams by their smaller size. Roadside ditches convey runoff from roads and adjacent tributary areas. (Chapter 4)

ROUTING - The attenuation of flow created by storage in a system (such as a stream or reservoir).

R.O.W. - Acronym for right-of-way.

RUNBY/BYPASS - Flow which bypasses an inlet on grade and is carried in the street or channel to the next inlet downgrade. Inlets can be designed to allow a certain amount of runby for one design storm and larger or smaller amounts for other storms. (Chapter 7)

RUNOFF - That part of the precipitation which runs off the surface of a drainage area after all abstractions are accounted for.

RUNOFF COEFFICIENT (C) - A factor representing that portion of runoff which results from a unit of rainfall. Dependent on topography, land use, and soil conditions. A factor used in the Rational Method.

RUNOFF, "FIRST FLUSH" - The condition, often occurring, in which a disproportionately high pollution load is carried in the first portion of urban runoff. *(1)*

RUNOFF VOLUME - The area under hydrograph minus the base flow. (Chapter 3)

SAG CULVERT - A culvert where the inlet and outlet flow line is above the barrel flow line. A culvert that "sags" in order to pass under a low highway grade line. More commonly used to convey irrigation flows; not suitable for drainage subject to freezing. In the common but incorrect highway vernacular, a "siphon" or "inverted siphon."

A pipeline crossing a depression or under a highway, railroad, canal, etc., that makes use of pressure flow. A closed conduit, a part of which rises above the hydraulic grade line. It utilizes atmospheric pressure to affect or control the flow of water through it. The term "inverted siphon" or "siphon" is commonly and incorrectly used in highway drainage as such structures have none of the properties of a true siphon, i.e., these two terms are misnomers.

SBP - Acronym for Standby power.

SCOUR - The displacement and removal of channel bed material due to flowing water; usually considered as being localized as opposed to general bed degradation or headcutting. The result of the erosive action of running water which excavates and carries away material from a channel bed. Compare with Erosion.

SCOUR, CONTRACTION - The response of a river or drainage facility (such as bridge) to the change in its bed load requirement as a result of a natural or constructed contraction of flow, i.e., the flow contraction is due to an encroachment of either the main channel or the floodplain by a natural constriction or the highway embankment.

SCOUR, GENERAL - Scour in a channel or on a floodplain that is not localized at a pier, abutment, bendway, or other obstruction to flow. In a channel, general scour usually affects all or most of the channel width, i.e., general scour involves the removal of material from the bed across all or most of the width of a channel as a result of a natural flow contraction which causes increased velocities and bed shear stress. Compare with Scour, Contraction.

SCOUR, LOCAL - Removal of material from the channel bed or banks which is restricted to a relatively minor part of the width of a channel. Scour in a channel or on a floodplain that is localized at a pier, abutment, or other obstruction to flow. Local scour is caused by the acceleration of the flow and the development of a vortex system induced by the obstruction to the flow. Does not include the additional scour caused by any contraction, natural channel degradation, or bendway.

SCREW PUMP - A positive displacement pump comes with two or three screws (a single screw version is called a “progressing cavity” pump). The pump forms cavities, which contain the fluid and move it along the screw. Screw pumps are not normally used in MDOT’s stormwater applications. (Chapter 10)

SCS - Acronym for Soil Conservation Service, now known as NRCS.

SCUPPER - A vertical hole through a bridge deck for the purpose of deck drainage. Sometimes a horizontal opening in the curb or barrier is called a scupper. (Chapter 7)

SEDIMENT - Fragmental material that originates from weathering of rocks and is transported by, suspended in, or deposited by water or air or is accumulated in beds by other natural agencies. *(15).*

SEDIMENTATION - The process involving the deposit or formation of sediment caused by soil particles which have been carried by water or wind action. (Chapter 9)

SEDIMENTATION BASIN - A basin or tank in which floodwater or stormwater containing settleable solids is retained to remove by gravity or filtration a part of the suspended matter. Compare with Detention Basin and Retention Basin.

SEICHE - The free oscillation of the bulk of water in a lake and the motion caused by it on the surface of the lake. *(5)*

Long-period oscillation of a lake or similar body of water. An oscillation of the water surface of a lake or other large land-locked body of water due to unequal atmospheric pressure, wind, landslides, earthquakes, or other causes, which sets the surface in vibration. Waves that oscillate in lakes, bays, and gulfs from a few minutes to a few hours. Also associated with hurricanes on waters which are not landlocked.

SESC - Acronym for Soil Erosion and Sedimentation Control.

SEWER - A conduit for conveying flows. The conduit may carry sanitary waste or stormwater. Compare with Storm Sewer and Sewer, Combined.

SEWER TAP - Connection made to a sewer without the use of a drainage structure or junction chamber.

SIDE FLOW INTERCEPTION - Flow which is intercepted along the side of a grate inlet, as opposed to frontal interception. (Chapter 7)

SLOTTED DRAIN INLETS - A drainage inlet composed of a continuous slot built into the top of a pipe which serves to intercept, collect, and transport the flow. Two types in general use are the vertical riser and the vane type. (Chapter 7)

SPAN - Terminology used with culverts (and similar type openings) as the horizontal width dimension of such things as a box, pipe-arch, or arch structure, as in Span X Rixe. May also be the horizontal distance between bridge piers or abutments.

SPECIFIC ENERGY - The energy contained in a stream of water expressed in terms of head, referred to the bed of a stream. It is equal to the mean depth of water plus the velocity head of the mean velocity.

SPILLTHROUGH ABUTMENT - A bridge abutment having a fill slope on the channel side. The term originally referred to the “spill-through” of fill at an open abutment but is now applied to any abutment having such a slope.

SPLASH-OVER - Portion of frontal flow at a grate which skips or splashes over the grate and is not intercepted. (Chapter 7)

SPREAD - The accumulated flow in and next to the roadway gutter. This water often represents an interruption to traffic flow during rainstorms. The lateral distance, in feet, of roadway ponding from the curb. (Chapters 6 and 7)

STAGE - The elevation of the water surface above some elevation datum at a specific location. (Chapter 3)

The height of a water surface above an established datum plane. *(30)* The depth of water in a river or stream above the gage datum, or 0.0 level. *(27)*

STAGE-DISCHARGE CURVE - A graph showing the relation between the gage height, usually plotted as ordinate and the amount of water flowing in a channel, expressed as volume per unit of time, plotted as abscissa. *(30)*

The relation expressed by the Stage-Discharge Curve. *(30)* The relation between gage height (stage) and the volume of water, per unit of time, flowing in a channel. *(37)*

The relation between stage and the discharge of a stream or river at a particular site, usually presented in the form of a graph or table. Sometimes referred to as the rating curve of a channel cross section. A correlation between channel flow rates and corresponding water surface elevations. A rating curve showing the relation between stage and discharge of a channel.

The relation expressed by the stage-discharge curve. Note that stage-discharge (stage versus discharge) is hyphenated when referring to a curve or relationship; for a particular event, it is more appropriate to refer to the discharge stage (not hyphenated). Compare with Rating Curve.

STANDARD PLANS - Supplementary drawings of standard construction details that are not unique to any one project and are included with the project plans for construction.

STEADY FLOW - A flow in which the flow rate or quantity of fluid passing a given point per unit of time remains constant. A constant discharge with respect to time.

STEEP SLOPE - Occurs where critical depth is greater than normal depth. (Chapter 5)

STILLING BASIN - A device or structure placed at or near the outlet of a structure for the purpose of inducing energy dissipation where flow velocities are expected to cause unacceptable channel bed scour and bank erosion.

STOP-LOGS - Devices used for temporary closure of an opening in a hydraulic structure. A generic term which is not intended to imply wood logs are used exclusive of other material, i.e., a log, wood plank, cut timber, steel, or concrete slab, or beam of some synthetic material fitting into end guides between walls or piers to close or limit an opening to the passage of water.

STORAGE - “General Introduction and Hydrologic Definitions” *(30)* suggests two definitions: 1.) Water artificially impounded in surface or underground reservoirs, for future use (the term regulation refers to the action of this storage in modifying stream flow; 2.) water naturally detained in a drainage basin, such as groundwater, channel storage, and depression storage [where] the term “drainage basin storage” or simply “basin storage” is sometimes used to refer collectively to the amount of water in natural storage in a drainage basin.

STORAGE FACILITY - A type of drainage control facility designed either to hold water for a considerable length of time and then release it. (Chapter 8)

STORAGE-INDICATION METHOD - Name often given to a flood-routing method. Also often called the Puls method (after Lows G. Puls), though it is actually a variation of the method devised by Puls. *(36)*

STORM SEWER - A closed or open conduit that conveys stormwater that has been collected by inlets to an adequate outfall. It generally consists of laterals or leads, and trunk lines or mains. Culverts connected to the storm sewer system are considered part of the system. (Chapter 7)

STREAM - A river, creek, or any other body of water that has definite banks, a bed, and visible evidence of a continued flow or continued occurrence of water. (Part 301)

STREAM CHANNELIZATION - Anything that straightens or changes the geometry to a fixed cross-section. (Chapter 6)

STREAM CHANNELS - Are usually:

- Natural channels with their size and shape determined by natural forces.
- Compound in cross-section with a main channel for conveying low flows and a floodplain to transport flood flows.
- Shaped geomorphologically by the long-term history of sediment load and water discharge which they experience. (Chapter 4)

STREAM GAGING - The process and art of measuring the depths, areas, velocities, and rates of flow in natural or artificial channels. *(12)*

STREAM GAGING STATION - A gaging station where a record of discharge of a stream [or river] is obtained. Generally, this term is used only for those gaging stations where a continuous record of discharge is obtained; *General Introduction and Hydrologic Definitions. (30)*

STREAM WATERS - Stream waters are former surface or groundwaters, which have entered and now flow in a well-defined natural watercourse, together with other waters reaching the stream by direct precipitation or rising from springs in the bed or banks of the watercourse. A watercourse in the legal sense refers to a definite channel with bed and banks within which water flows either continuously or intermittently. (Chapter 2)

STRUCTURAL BMP - Physical, constructed controls that may remove pollutants from runoff. They may limit the rate of runoff from MDOT R.O.W. and other facilities. Includes temporary and permanent BMPs. (Chapter 9)

STRUCTURAL CONTROL - Use of engineered facilities and outlet to control the rate of stormwater runoff released from a storage facility. This may include using a principal and an auxiliary spillway. (Chapter 8)

SUBCRITICAL FLOW - In this state, gravity forces are dominant so that the flow has a relatively low velocity and is often described as tranquil or streaming. Also, that flow which has a Froude number less than unity. Flow at velocities less than critical velocity; flow at depths greater than critical depth. Flow at velocities less than one of the recognized critical values; specifically, turbulent flow with a mean velocity less than Belanger's critical velocity; streaming flow. Compare with Supercritical Flow.

SUBMERGED INLET - Occurs when the headwater is greater than 1.2D, where D is the culvert diameter or barrel height. (Chapter 5)

SUBMERGED OUTLET - Occurs when the tailwater elevation is higher than the crown of the culvert. (Chapter 5)

SUBMERGENCE - The ratio of the tailwater elevation to the headwater elevation when both are higher than the crest, the overflow crest of the structure being the datum of reference. The distances upstream or downstream from the crest at which headwater and tailwater elevations are measured are important, but have not been standardized. In culvert

terminology, the condition where tailwater or headwater elevation are greater than elevation of the conduit top (soffit).

SUMP PUMP - A pump installed in the sump of wet wells of wet pit and dry pit stations. The sump pump is used to pump out the water remaining in the well after the water level has dropped and all the primary pumps are no longer pumping. The sump pump may also remove the accumulation of solids, such as silt, sand, and debris that accumulate at the bottom of the wet well. MDOT does not recommend the use of sump pumps. (Chapter 10)

SUPERCRITICAL FLOW - In this state, inertia forces are dominant so that flow has a high velocity and is usually described as rapid or shooting. Also, that flow which has a Froude number greater than unity. Flow at velocities greater than critical velocity; flow at depths less than critical depth. Flow at velocities greater than one of the recognized critical values; specifically turbulent flow with a mean velocity equal to or greater than Belanger's critical velocity; shooting flow; rapid flow. Compare with Subcritical Flow.

SURFACE WATERS - Surface waters are those waters which have been precipitated on the land from the sky or forced to the surface in springs, and which have then spread over the surface of the ground without being collected into a definite body or channel. (Chapter 2)

SWALE - A wide, shallow ditch usually grassed or paved and without well-defined bed and banks. A slight depression in the ground surface where water collects and which may be transported as a stream. Often vegetated and shaped so as not to provide a visual signature of a bank or shore.

SWMP - Acronym for stormwater management plan.

SYNTHETIC HYDROGRAPH - A hydrograph determined from empirical rules. Usually a hydrograph based on the physical characteristics of the basin. A graph developed for an ungaged drainage area based on known physical characteristics of the watershed basin.

The hydrograph of surface runoff (not including groundwater runoff) on a given basin due to an active rain falling for a unit of time. *(40)* A discharge hydrograph coming from 0.04 inch of direct runoff distributed uniformly over the watershed, with the direct runoff generated at a uniform rate during the given storm duration. A watershed may have 1-hour, 2-hour, etc., unit hydrographs. *(36)*

A typical stream flow hydrograph of a river basin produced by 0.04 inch of surface runoff uniformly distributed over the watershed during a specified period of time. *(27)*

A hydrograph of a direct runoff resulting from 0.04 inch of effective rainfall generated uniformly over the watershed area during a specified period of time or duration. The discharge hydrograph resulting from 0.04 inch of direct runoff generated uniformly over the tributary area at a uniform rate during a specified period of time. Compare with Hyetograph.

TAILWATER (TW) - The depth of flow in the channel directly downstream of a drainage facility. Often calculated for the discharge flowing in the natural stream without the highway effect (but may include other local effects from development), unless there is a significant

amount of temporary storage that will be (or is) caused by the highway facility; in which case, a flood routing analysis may be required. The tailwater is usually used in such things as culvert and storm drain design and is the depth measured from the downstream flow line of the culvert or storm drain to the water surface. May also be the depth of flow in a channel directly downstream of a drainage facility as influenced by the backwater curve from an existing downstream drainage facility. With such things as releases from a dam, the water just downstream from a structure.

TDH - Acronym for total dynamic head.

TEMPORARY BMP - Used during the construction process to reduce soil erosion and sedimentation. (Chapter 9)

THALWEG - The line or path (such as a rill) connecting the lowest flow points along the bed of a channel. The line does not include local depressions. The path very low flows would follow in proceeding down a stream, river, swale, or channel. The line extending along a channel profile that follows the lowest elevation of the bed.

TIME OF CONCENTRATION - The time it takes water from the most distant point (hydraulically) to reach a discharge point. (Chapter 3)

TOTAL HEAD - The total head of a liquid at a given point is the sum of three components: 1.) The elevation head, which is equal to the elevation of the point above a datum; 2.) The pressure head, which is the height of a column of static water that can be supported by the static pressure at the point; and 3.) The velocity head, which is the height at which the kinetic energy of the liquid is capable of lifting the liquid. *(25)*

TRACTIVE FORCE - The drag on a stream bank caused by passing water which tends to pull soil particles along with the stream flow. The force or drag developed at the channel bed by flowing water. For uniform flow, this force is equal to a component of the gravity force acting in a direction parallel to the channel bed on a unit wetted area. Usually expressed in units of stress, i.e., force per unit area. The force per unit area on a stationary boundary exerted by a fluid flowing past that boundary. Compare with Critical Shear Stress.

TRANSPIRATION - The quantity of water absorbed and transpired and used directly in the building of plant tissue in a specified time. It does not include soil evaporation. *(6)*

The process by which water vapor escapes from the living plant, principally the leaves, and enters the atmosphere. The process by which plants give off water vapor through their leaves. *(13)*

TRASHRACK - A device used to capture debris, either floating, suspended, or rolling and saltating along the bed, before it enters a drainage facility. A grid or vertical screen across a stream or entrance to a drainage facility designed to catch debris.

TRIBUTARY - Branch of the watershed stream system.

TRUNK LINE - The main storm sewer line. Lateral lines may be connected in at inlet structures or access holes. A trunk line is sometimes referred to as a “main.” (Chapter 7)

TSC - Acronym for Transportation Service Center.

TURBULENT FLOW - The flow condition in which inertial forces predominate over viscous forces and in which head loss is not linearly related to velocity. *(25)* That type of flow in which the fluid particles move along very irregular paths. Momentum can be exchanged between one portion of the fluid and another. That type of flow in which any particle may move in any direction with respect to any other particle and in which the head loss is approximately proportional to the second power of the velocity. Compare with Laminar Flow.

TVA - Acronym for Tennessee Valley Authority.

TWO-DIMENSIONAL WATER SURFACE PROFILE - An estimated water surface profile with recognizes flow only in the upstream-downstream and transverse direction; vertical velocity vector components are ignored.

UNGAGED SITES - Those sites where no recorded stream flow data are available. (Chapter 3)

UNGULA - A section or part of a cylinder, cut off by a plane oblique to the base. Used to describe the volume of water (in line) in the pipe upstream of a pump station. For further information on ungula volume and its use in pump station design see, *Highway Storm Water Pumping Stations*, Volumes 1 and 2, FHWA-IP-82-17. (Chapter 10)

UNIFORM FLOW - Flow of constant cross-section and average velocity through a reach of channel during an interval of time. A constant flow of discharge, the mean velocity of which is also constant. Uniform flow is also referred to as “steady uniform flow.” It is an ideal condition that can, in reality, only be approximated. If the velocity of the constant discharge varies, the flow is defined as “steady non-uniform.” When the average velocities at successive points or sections in the direction of steady flow are the same, the flow is described as uniform. Truly uniform flow, although frequently assumed for computational convenience, seldom occurs in natural open channels. Constant depth flow through a straight reach of a uniform artificial canal is an example of reasonably uniform flow. Compare with Non-uniform Flow. See Steady Flow.

UNIT HYDROGRAPH - The direct runoff hydrograph resulting from a rainfall event that has a specific temporal and spatial distribution. A unit hydrograph lasts for a specific duration and has unit volume. When a unit hydrograph is shown with units of cubic feet per second, it is implied that the ordinates are cubic feet per second per inch of direct runoff. (Chapter 3)

UNSTEADY FLOW - Flow of variable cross section and average velocity through a reach of channel during an interval of time. A changing discharge with respect to time; opposite of steady flow; frequently labeled “varied flow.” Compare with Steady Flow.

UPLIFT - The upward water pressure force on the base of a structure.

USACE - Acronym for United States Army Corps of Engineers.

USBR - Acronym for United States Bureau of Reclamation.

USC - Acronym for United States Code.

USCG - Acronym for United States Coast Guard.

USCS - Acronym for United States Code Service.

USDOT - Acronym for United States Department of Transportation.

U.S. EPA - Acronym for United States Environmental Protection Agency.

USFWS - Acronym for United States Fish and Wildlife Service.

USGS - Acronym for United States Geological Survey.

VEGETATIVE BMP - Vegetation used to control nonpoint source pollution; generally near the source. (Chapter 9)

VELOCITY - The rate of motion of a stream or river or of the objects or particles transported therein, usually expressed in distance per time. Rate of travel; distance per unit of time.

VELOCITY HEAD - A quantity proportional to the kinetic energy of flowing water expressed as a height or head of water, ($V^2/2g$). (Chapter 7)

VELOCITY HEAD COEFFICIENT (α) - A correction factor, α, (alpha) applied to the velocity head for the mean velocity, to correct for non-uniformity of velocity in a cross section. The factor is 1.0 where velocities are identical across a section and greater than 1.0 where velocities vary across a section. Regular channels have coefficients as low as 1.10 whereas over-flooded river valleys may have coefficients as high as 2. *(8)*

VENA CONTRACTA - The most contracted section area of a stream, jet, or nappe beyond the plane of the constriction through which it issues.

WATER BUDGET - An evaluation of all the sources of supply and the corresponding discharges with respect to an aquifer or a drainage basin. *(13).*

WATER EQUIVALENT OF SNOW - Amount of water that would be obtained if the snow should be completely melted. Water content may be merely the amount of liquid water in the snow at the time of observation. *(30).*

The depth of water obtained by melting a given thickness of snow. *(13)* The depth of water, in millimeters, that results from melting a given depth of snow. *(36)*

WATER SURFACE PROFILE - A graph of water levels plotted against stream distance at a particular time or for a particular condition, such as for a flood peak or for a low-flow period. Two other definitions are appropriate: 1.) The longitudinal profile assumed by the surface of a stream of water flowing in an open conduit (the surface curve of a stream of water is the curve of equilibrium of all forces acting on the flowing water); 2.) The hydraulic grade line. See Hydraulic Grade Line. Water-surface curves or profiles are generally catalogued into

12 classifications, three of which are designated strictly as backwater curves. The classifications are accounted for by the different bottom slopes and relative values of normal and critical depth. The curves are classified by the nomenclature; M1, M2, and M3 for mild slope (backwater curves); C1 and C3 for critical slope; H2 and H3 for horizontal (zero slope); S1, S2, and S3 for steep slope; and A2 and A3 for adverse slope.

WATER TABLE - The upper surface of a zone of saturation, except where that surface is formed by an impermeable body. See Perched Groundwater.

WATER YEAR - In the Federal agency reports dealing with surface-water supply, the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ended September 30, 1959, is called the "1959 water year." *(30).*

The year taken as beginning October 1. Often used for a convenience in stream flow work, since in many areas stream flow is at its lowest at that time. Used by the U.S. Geological Survey in their WSP National Engineering Handbook. *(36)*

WATERCOURSE - A stream, river, or channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. See Channel and Stream.

WATERWAY - Any stream, river, lake, pond, or ocean that can be traversed for purposes of commerce or recreation. May also refer to a channel. See Channel and Watercourse.

WATERWAY OPENING AREA - Area of bridge opening at (below) a specified stage, measured normal to principal direction of flow.

WAVE ATTACK - Impact of waves on a channel bank or shore.

WAVE PERIOD - Time period between arrivals of successive wave crests at a point.

WAVE RUN-UP - Height to which water rises above still-water level when waves meet such things as a beach, wall, embankment, or causeway. Compare with Wave Set-Up.

WAVE SET-UP - The creation of waves from wind. Compare with Wave Run-Up.

WEEPHOLE - An opening left in such things as an impermeable wall, revetment, apron, lining, or foundation to relieve the neutral stress or pore water pressure and permit drainage.

WEIR - A dam across a channel for diverting flows or for measuring the flow.

WEIR, BROAD-CRESTED - An overflow structure on which the nappe is supported for an appreciable length; a weir with a significant dimension in the direction of the stream. Highways generally function as broad-crested weirs when overtopped by floodwaters.

WEIR, SHARP CRESTED - A contracted weir with its crest at the upstream edge or corner of a relatively thin plate, generally of metal.

WEIR, TRAPEZOIDAL- A contracted weir with a trapezoidal notch.

WEIR, TRIANGULAR - A contracted weir notch with sides that form an angle with its apex downward; the crest is the apex of the angle; a V-notch weir.

WEIR FLOW - Free surface flow over a control surface which has a defined discharge versus depth relationship.

WELL - A chamber from which stormwater is pumped. Stations in which the pumps are placed in the wet well are known as wet pit stations. Some stations use a separate well (dry well) to house the pump and driver and are referred to as dry pit stations. (Chapter 10)

WET PIT STATION - A wet pit station typically comprises of a wet well or several wet wells and a pump house. Generally, one of two configurations is used: rectangular or caisson. Two types of pumps, vertical and submersible, may be installed in the wet well of the wet pit station. See Section 10.3 for more details. (Chapter 10)

WETLAND - (The following definition is taken from Part 303 of NREPA Act 451.) Land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation and aquatic life, and is commonly referred to as a bog, swamp, or marsh and which is any of the following:

- Contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream.
- Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and more than 5 acres in size; except this subparagraph shall not be of effect, except for the purpose of inventorying, in counties of less than 100,000 population until the department certifies to the commission it has substantially completed its inventory of wetlands in that county.
- Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and 5 acres or less in size if the department determines that protection of the area is essential to the preservation of the natural resources of the state from pollution, impairment, or destruction and the department has so notified the owner; except this subparagraph may be utilized regardless of wetland size in a county in which information given in the bullet above is of no effect; except for the purpose of inventorying at the time. (Chapter 8)

WETTED PERIMETER - The boundary over which water flows in a channel or culvert, taken normal to flow. See Hydraulic Radius.

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