WVDOH Standards Committee Meeting

Meeting Time/Date: Tuesday, December 1, 2026 at 9:00AM
Meeting Location: MCS&T (Library Room), 190 Dry Branch Drive, Charleston, WV
Also, meeting virtually via Google Meet. Email distribution includes instruction.

Files are available: https://transportation.wv.gov/standards-and-manuals-committee

Approved Standard changes from the last Committee Meeting (10/06/26):

- DD-101-Correspondence

Old Business:

ITEM	Champion
2nd time to Committee • *Standard Detail: GR5-Flared End Terminal* This revision updates the terminal offset requirements to be consistent with the manufacturer's recommendations for the approved crash-tested system. The fixed 4'-0" offset was removed and replaced with "Manufacturer Specified Offset" in Standard Sheet GR5 in both the Flared End Terminal Parabolic Layout (Sheet 1) and Flared End Terminal Straight Layout (Sheet 2). The Standard Detail has been updated since last meeting for both Sheet 1 and 2. Item is up for a vote.	T. Whitmore

New Business:

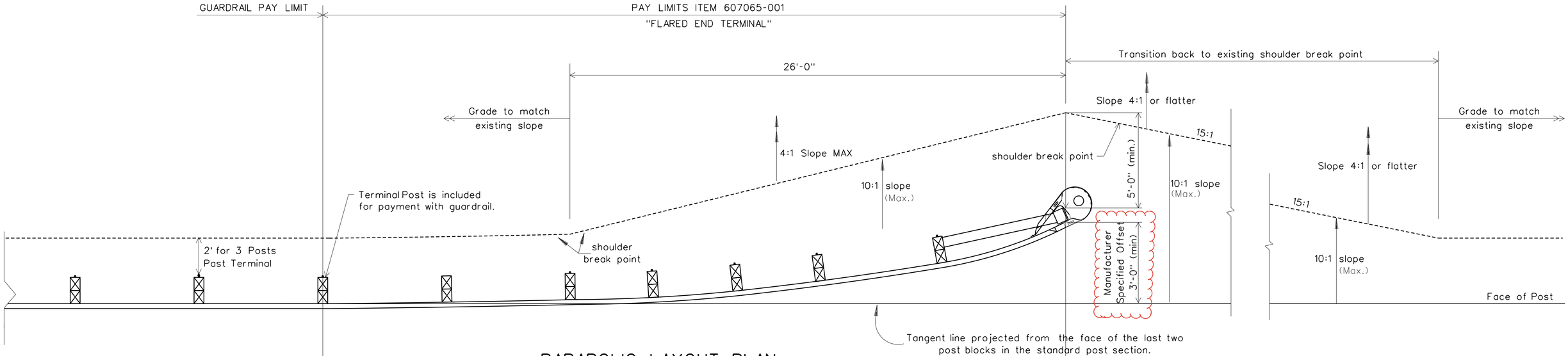
ITEM	Champion
1st time to Committee • *DD-688-Temporary Work Zone Positive Protection.* A complete rewrite of DD-688, including updated guidance for determining when temporary positive protection should be considered, required, and documented. Also introduces a new Work Zone Positive Protection Analysis Form to provide a consistent process for evaluating, documenting, and supporting positive protection decisions.	L. Hostuttler
1st time to Committee • *DD-301, DD-644, DD-701, and DD-813: Website Reference and Hyperlink Updates* Administrative revisions to update hyperlinks and webpage references affected by the recent WVDOH website restructuring. Changes include correcting outdated links, directing users to current publication and resource locations, and making minor formatting and grammatical edits. No policy or procedural changes are proposed.	S. Fisher

Housekeeping:

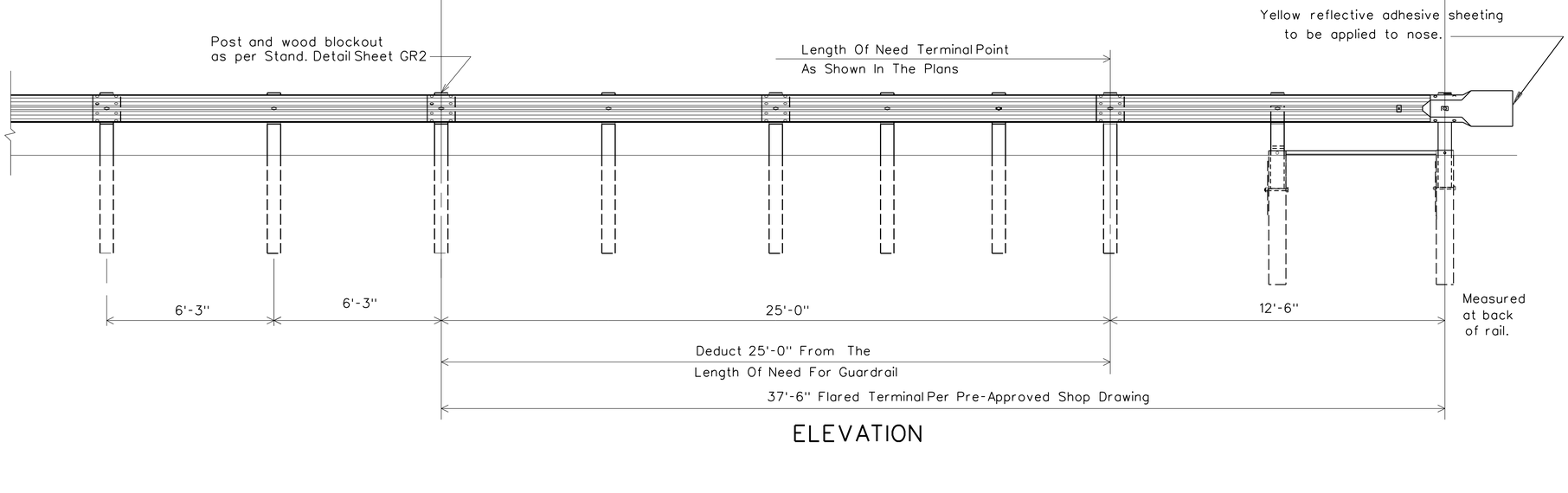
Next Meeting – February 2, 2027
Deadline for Submissions – January 5, 2027
Comments for next meeting – January 26, 2027

Comments are requested as they help in the decision-making process. Please send comments by the deadline to Kristy.J.Huffman@wv.gov and Nicholas.S.Broyles@wv.gov.

DRAFT



PARABOLIC LAYOUT PLAN



ELEVATION

NOTES

For details of Flared End Terminal see pre approved shop drawings.

All materials used shall meet the applicable requirements of Section 607 of the Standard Specifications Road and Bridges.

The post offset dimensions are given to the center of the traffic face of the blockouts; except at the first post, where the dimension is to the center of the traffic face of the post. Offset points are to be located by measurements at the back of rail equal to the nominal post spacings shown on pre-approved shop drawings. Posts are to be set approximately radial to the railing at each location.

When a wood block is used adjacent to a wood post, the block shall be nailed to the post with a galvanized steel 10d common nail. The nail is to be driven into the center of the top or bottom of the block.

The cost of furnishing and installing the Flared End Terminal, complete with all miscellaneous hardware and parts as detailed on the pre-approved shop drawings , is to be included in the unit price bid for "Flared End Terminal".

Yellow reflective sheeting shall cover the entire nose of those terminals with a flat impact head. Those terminals with a rounded impact head shall be covered with a 1'-0" X 3'-0" yellow reflective sheet.

As of 11-13-12 revision date, this detail is obsolete and no longer used for new construction.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED 7-1-99

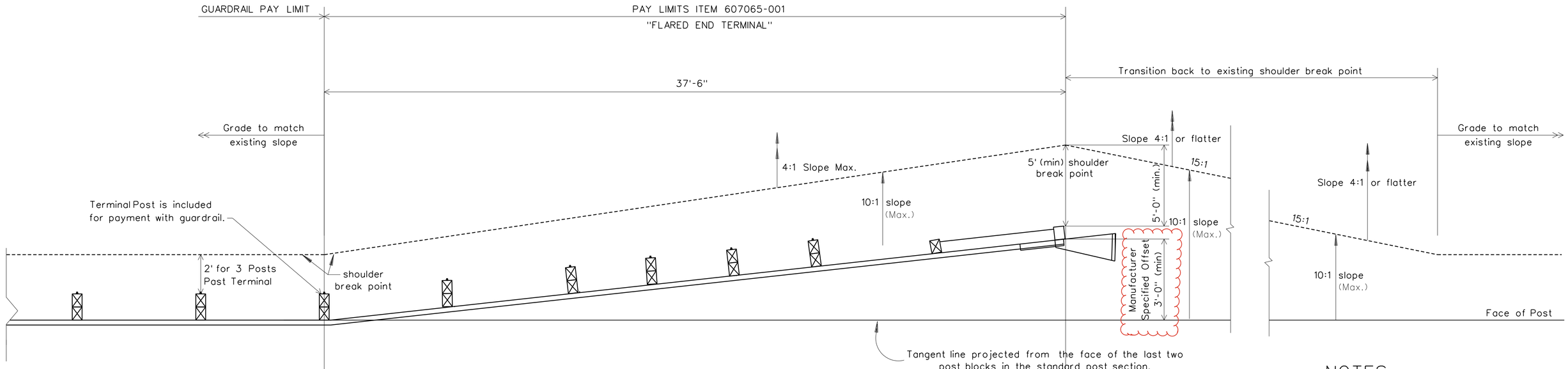
REVISION DATE
11-13-12
11-03-26

FLARED END TERMINAL PARABOLIC LAYOUT

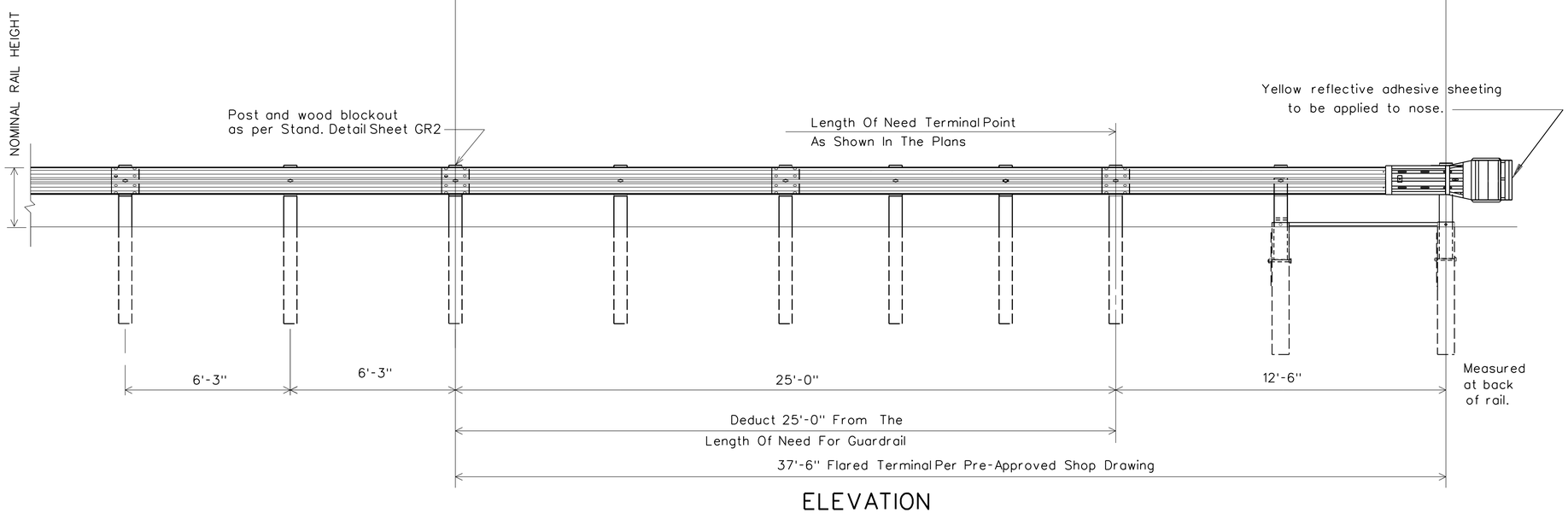
(SHEET 1 OF 2)

STANDARD SHEET GR5

DRAFT



STRAIGHT LAYOUT PLAN



ELEVATION

NOTES

Flared End Terminal shall meet NCHRP-350 and/or Mash testing for appropriate height.

Separate Approved Product Lists will be maintained for both 28 1/2" and 31" terminal heights.

For details of Flared End Terminal see pre approved shop drawings.

Post and splice locations are per manufacturer.

All materials used shall meet the applicable requirements of Section 607 of the Standard Specifications Road and Bridges.

The post offset dimensions are given to the center of the traffic face of the blockouts; except at the first post, where the dimension is to the center of the traffic face of the post. Offset points are to be located by measurements at the back of rail equal to the nominal post spacings shown on pre-approved shop drawings. Posts are to be set approximately radial to the railing at each location.

When a wood block is used adjacent to a wood post, the block shall be nailed to the post with a galvanized steel 10d common nail. The nail is to be driven into the center of the top or bottom of the block.

The cost of furnishing and installing the Flared End Terminal, complete with all miscellaneous hardware and parts as detailed on the pre-approved shop drawings , is to be included in the unit price bid for "Flared End Terminal".

Yellow reflective sheeting shall cover the entire nose of those terminals with a flat impact head. Those terminals with a rounded impact head shall be covered with a 1'-0" X 3'-0" yellow reflective sheet.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED 7-1-99

REVISION DATE
11-13-12
11-03-26

FLARED END TERMINAL STRAIGHT LAYOUT

(SHEET 2 OF 2)

STANDARD SHEET GR5

SECTION BREAK

NEW BUSINESS ITEMS

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
DESIGN DIRECTIVE

DD-688
TEMPORARY BARRIER

July 28, 2011

This Design Directive provides all designers, In-House, District, and consultant, with the West Virginia Department of Transportation (WVDOT), Division of Highways' (DOH) policy and guidance for use of Temporary Longitudinal Barrier when required on construction projects.

10. General

Work zones on construction projects will be designed to provide maximum protection for workers and equipment necessary to do the work prescribed by the Contract Documents. The WVDOH "Manual on Temporary Traffic Control for Streets and Highways" establishes principles to be observed in the design, installation, and maintenance of traffic control devices and prescribes standards where appropriate. These principles and standards are aimed at promoting the safe and efficient movement of traffic through the work zone and the safety of the workers in the work zone. Work zones should also be developed to provide maximum protection to pedestrians and bicyclists by providing safe pathways through the work zone whereby adjacent excavations or any other unsafe areas are shielded.

The July 1987 AASHTO *Summary Report on Work Zone Accidents* contains several conclusions related to crashes in work zones: 1) Crashes in work zones are generally more severe producing more injuries and fatalities than the national average for all crashes; 2) Crashes involving fixed objects occur more frequently and result in more injuries and fatalities than vehicle to vehicle crashes; and 3) About half of all work zone, fixed object crashes occur at night. Also, tractor-trailer injury and fatality crashes in work zones are higher than the national average for other types of crashes involving these vehicles.

The work area "recovery zone" is the unobstructed relatively flat area impacted by construction that extends outward laterally from the edge of the traveled way. Due to the reduced horizontal clearance available and the heightened awareness of motorists through the work area, the "recovery zone" lateral requirements are less than those required if the work zone was not in place. The amount of available lateral "recovery zone" affects the decision to delineate or shield exposed hazards. These hazards include, but are not limited to, approach ends of any temporary barrier placed, fixed objects, steep slopes, or pavement-edge drop-offs.

Good engineering judgment must be used when applying the lateral "recovery zone" concept to work zones. The lateral "recovery zone" distance is also known as the "buffer zone". The term "buffer zone" will be used hereinafter in this Design Directive. The width of these buffer zones will help determine the deflection range of temporary traffic barrier required. Test Levels may be found in NCHRP Report 350 in Table 3.1, "Test Matrix for Longitudinal Barriers", an excerpt of which is shown below. This table shows the combinations for different vehicles, speeds and impact angles for each test for a better understanding of their applicability.

Current Version

Test Matrix for Longitudinal Barriers

Test Level	Test Designation	Impact Conditions		
		Vehicle	Nominal Speed mph	Nominal Angle
1	1-10	820C	31	20
	S1-10	700C	31	20
	1-11	2000P	31	25
2	2-10	820C	43.5	20
	S2-10	700C	43.5	20
	2-11	2000P	43.5	25
3	3-10	820C	62	20
	S3-10	700C	62	20
	3-11	2000P	62	25
4	4-10	820C	62	20
	S4-10	700C	62	20
	4-11	2000P	62	25
	4-12	8000S	50	15
5	5-10	820C	62	20
	S5-10	700C	62	20
	5-11	2000P	62	25
	5-12	36000V	50	15
6	6-10	820C	62	20
	S6-10	700C	62	20
	6-11	2000P	62	25
	6-12	36000V	50	15

Excerpted from NCHRP 350 Table 3.1

820C is a passenger car weighing 820 kg
700C is a small passenger car weighing 700 kg
2000P is a pickup truck weighing 2000 kg
8000S is a standard unit truck weighing 8000 kg
36000V is a tractor trailer weighing 36000 kg

Traffic barriers are designed as either permanent or temporary barriers. Temporary barriers can be easily relocated if and when required by the project's construction sequence. Temporary barriers have the following functions, at minimum:

- Protect traffic from entering the work area;
- Provide positive protection for workers within the work area;
- Separate two-way traffic;
- Protect construction such as falsework and other exposed objects; and 5) Separate pedestrians from vehicular traffic.

20. Factors to Consider and References

Use of temporary longitudinal barriers will be based on an engineering analysis of each work zone situation. The need for and location of temporary longitudinal barriers should be based on engineering judgment and consider the posted speed limit through the work zone and the proximity of vehicles to workers/pedestrians, construction equipment and any material stockpiles, etc. Other factors to consider are the type and duration of the proposed work, and the volume and characteristics of the traffic stream impacted by the proposed work. **A false sense of security can be imparted to both the motorists and the workers if temporary longitudinal barrier is improperly located**.

The designer is hereby directed to Design Directive (DD) 681, "Work Zone Safety and Mobility"; DD-685, "Drop-Off Guidance"; Traffic Engineering Directive (TED) 601-4, "Preparation of Maintenance of Traffic Plans"; the latest edition of the "Manual on Temporary Traffic Control for Streets and Highways"; and the latest edition of the "Roadside Design Guide" for further and more detailed information regarding the need for and placement of temporary longitudinal barriers. All of these publications are available on the Division's website.

30. Design and Plan Requirements

As described in DD-681, "Work Zone Safety and Mobility", the designer (In-house, District, or Consultant) is required to determine the need for and location of any temporary barrier, which would include temporary longitudinal barrier. The designer must also determine the available buffer zone behind the barrier in each construction phase. The available buffer distance and deflection characteristics may be different for each phase of construction. The designer need not specify the material to be used for the temporary barrier. The Traffic Engineering Division or District Traffic Engineer (for District-designed projects) will review and recommend the locations, Test Levels, and deflection characteristics of temporary longitudinal barriers provided by the designers. Temporary traffic control barriers, which include temporary longitudinal barriers, should only be used when the barrier itself offers the least hazard potential.

The following guidelines should be used to determine if anchoring of temporary barrier is appropriate:

- If the barrier is placed within 2 ft of a trench or drop off with a depth of 4 ft or greater.
- On bridge decks, unless another barrier is present between the drop off.
- Anytime barrier is used as a bridge parapet.
- When equipment, materials, or other hazards exist or are stored in the unanchored barrier buffer area.
- When workers are in the unanchored barrier buffer area for a significant amount of time.

From the Roadside Design Guide, ends of runs of temporary barrier will be flared away from traffic at rates ranging from 4:1 (lower speed roadways) to 8:1 (high-speed roadways such as the interstate system). Consult the Roadside Design Guide for more information.

40. Criteria For Use and Item Number

Test Levels are based on NCHRP Report 350 Table 3.1, "Test Matrix for Longitudinal Barriers". Test Level determination shall not be site or project-specific, but be based on and consistent with the overall roadway system. Temporary Barrier should meet or exceed the following criteria:

1. TL-3, when any of the following conditions apply:

   a. Roadway or bridge is on the National Highway System
   b. Design Speed is greater than 45 MPH
   c. Design ADT is greater than 3500 vehicles per day

   (Note: TL-3 is the standard test level for the majority of roadways and bridges in the State of West Virginia.)

2. TL-2, for all other roadways and bridges (The higher of design speed and posted speed must be less than 45 MPH to use a TL-2 barrier)

Deflection characteristics for the Item Supplemental Description shall be determined from the table below and are based on the width of the available buffer zone with consideration being given to factors listed in Section 20. The designer is hereby cautioned that deflections shown in the table are approximate and for comparison only to aid the designer in choosing appropriate temporary barrier for individual situations. Because of a multitude of variables including vehicle type, speed, impact angle, point of measurement, anchorages, etc., deflections can and do vary from values listed below.

Supplemental Description	Deflection Criteria (Buffer Zone available)
I	< 6”
II	< 24”
III	< 60”
IV	< 96”

The pay item is to be based on the Test Level and deflection characteristics required, i.e. 636017 Temporary Barrier, TL-3, IV. (Note: TL – 3 is considered the minimum Test Level for use on expressways and interstate highways).

Temporary Barrier
Product Guideline

Current Version

Test	Standard Test	Minimum Deflection Range I				Low Deflection Range II			
		Concrete Barriers Anchored	Concrete Barriers Unanchored	Steel Barriers Anchored	Steel Barriers Unanchored	Concrete Barriers Anchored	Concrete Barriers Unanchored	Steel Barriers Anchored	Steel Barriers Unanchored
TL-2	NCHRP 350 or Mash	636017-***, TL-2, I	Not Available	636017-***, TL-2, I	Not Available	636017-***, TL-2, II	Not Available	636017-***, TL-2, II	Not Available
TL-3 Basic Level	NCHRP 350 or Mash	636017-***, TL-3, I	Not Available	636017-***, TL-3, I	Not Available	636017-***, TL-3, II	Not Available	636017-***, TL-3, II	Not Available

Test	Standard Test	Medium Deflection Range III				High Deflection Range IV			
		Concrete Barriers Anchored	Concrete Barriers Unanchored	Steel Barriers Anchored	Steel Barriers Unanchored	Concrete Barriers Anchored	Concrete Barriers Unanchored	Steel Barriers Anchored	Steel Barriers Unanchored
TL-2	NCHRP 350 or Mash	636017-***, TL-2, III				636017-***, TL-2, IV			
TL-3 Basic Level	NCHRP 350 or Mash	636017-***, TL-3, III			Not Available	636017-***, TL-3, IV			

Products available

Item number 636017-***, Test Level, Deflection Range

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 688
TEMPORARY WORK ZONE POSITIVE PROTECTION

Insert Approval Date

Supersedes July 28, 2011

10. GENERAL

Temporary work zone positive protection is provided by a variety of different device types such as portable concrete and steel barrier, and truck or truck trailer mounted attenuators. Such devices are designed to contain or redirect vehicles to protect construction site personnel and vulnerable road users (pedestrians and bicyclists) from errant vehicles, to protect motorists from temporary construction area hazards or temporarily unshielded permanent hazards, to protect critical temporary or permanent structural supports, and/or to divide opposing flows of traffic. This Design Directive provides all designers—In-House, District, and consultants—with the West Virginia Department of Transportation (WVDOT), Division of Highways' (DOH) policy and guidance for the systematic consideration, design, and use of positive protection and other safety management measures (exposure control measures and additional safety countermeasures) for worker and driver exposure. Safety management measures may be appropriate to utilize in lieu of or in addition to positive protection in some cases.

Compliance with the requirements contained in this Directive is mandatory for projects utilizing any portion of Federal-aid funding and are highly encouraged for non-Federal-aid projects to establish a uniform standard of safety.

Work zones shall be designed to provide protection for workers, equipment, construction elements, and motorists and vulnerable road users traversing through the construction zone. The protection provided shall be as determined to be appropriate for the specific project and the work prescribed by the Contract Documents. This may be appropriately accomplished by utilizing positive protection, exposure control Measures, and/or additional safety countermeasures, all of which are described herein. In addition to the guidance provided by this Directive, the WVDOH "Manual on Temporary Traffic Control for Streets and Highways" establishes principles to be observed in the design, installation, and maintenance of traffic control devices and prescribes standards where appropriate. These principles and standards promote the safe and efficient movement of traffic through the work zone and protect workers.

20. DEFINITIONS

- **AASHTO HCM:** The American Association of State Highway and Transportation Officials publication "Highway Capacity Manual", latest Edition.
- **AASHTO RDG:** The American Association of State Highway and Transportation Officials publication "Roadside Design Guide", latest Edition.
- **Additional Safety Countermeasures:** All strategies and devices—excluding positive protection devices and exposure control measures—used to reduce work zone crashes, such as enhanced signing, changeable message signs, temporary rumble strips, enhanced temporary delineation such as delineators on existing point and longitudinal objects and

temporary raised pavement markers, automated flagger assistance devices (AFADs), ITS devices such as truck entering warning systems and queue detection systems, and traffic directors. Additional safety countermeasures shall be proposed and used in compliance with all other agency guidelines, standards and policies as well as the MUTCD

- **AFAD:** Automated Flagger Assistance Device
- **Agency or WVDOH:** The West Virginia Department of Transportation, Division of Highways
- **Buffer Zone or Recovery Zone:** Unobstructed, traversable empty space that separates moving traffic from the active work area. The available width of this zone is a determining factor for the use of and required deflection characteristics of positive protection. Plans should clearly identify areas intended to serve as buffer zones and should specify that no equipment, vehicles, materials, temporary structures, or workers are to be within the buffer zone during the normal course of work. If the buffer zone does not have longitudinal positive protection separating it from traffic, the buffer zone serves as an available recovery zone for errant vehicles to safely stop or regain control. If longitudinal positive protection is used, a buffer zone is still required behind the barrier based on the maximum expected deflection of the barrier when impacted.
- **Clear Zone:** The total unobstructed, traversable roadside area starting from the edge of the through traveled way that allows a driver to safely stop or regain control of an errant (out-of-control) vehicle. Recommended clear zone widths based on various factors are provided in the AASHTO RDG.
- **Crashworthy:** Meeting the crash testing performance requirements of MASH at the applicable MASH Test Level (2 or 3).
- **Engineer of Record (EOR):** WV licensed professional engineer who prepares, oversees, or coordinates a project's design and takes legal and professional responsibility by sealing or stamping the final engineering drawings, reports, and calculations.
- **Escape Path (or Escape Route):** A clearly identifiable, traversable, contiguous, and illuminated (if the work is being done at night) route lateral to the traffic lanes that allows a highway worker to rapidly move to a location not being utilized for non-work related traffic to evade a vehicle intruding into the work area.
- **Exposure Control Measures:** Strategies that reduce or eliminate the exposure of project personnel to vehicular traffic and the exposure of motorists to roadside hazards. Examples of traffic management strategies that eliminate exposure include full road closures, ramp closures, crossovers, off-site detours, and rolling roadblocks. Strategies that otherwise reduce or eliminate worker or motorist exposure without alternative traffic management include eliminating or relocating roadside hazards, creating or increasing work area buffer zones such as by closing additional lanes, and utilizing AFADs to reduce flagger personnel exposure. Exposure control measures shall be proposed and used in compliance with all other agency guidelines, standards and policies as well as the MUTCD
- **Federal-Aid Highway Project:** Any highway construction project funded in whole or in part with Federal-aid highway funds.
- **High Anticipated Operating Speed (or High-Speed Facility):** Work zones with anticipated operating speeds of **45 mph or greater**.
- **Level of Service:** AASHTO HCM based qualitative letter grade system (ranging from A to F) to describe the operational quality of a roadway stream and how drivers perceive it.

  - LOS A: Free-flow traffic where drivers are completely unhindered and travel at desired speeds.
  - LOS B: Reasonably free flow; maneuverability is only slightly restricted.
  - LOS C: Stable flow with motorist speeds and maneuverability more noticeably restricted.
  - LOS D: Approaching unstable flow; drivers have restricted freedom to select speeds and cope with higher densities.
  - LOS E: Capacity operations; unstable flow where traffic has reached maximum capacity limit, minor disruptions cause breakdowns.
  - LOS F: Forced or breakdown flow; stop-and-go gridlock with demand exceeding capacity.
- **MASH:** The American Association of State Highway and Transportation Officials publication "Manual for Assessing Safety Hardware", latest Edition
- **Motorized Traffic:** The traveling public using the highway for transport. This term excludes construction or maintenance vehicles and equipment operating within the protected workspace.
- **No Means of Escape:** A condition where workers are exposed to live traffic and do not have a reasonable escape path from errant or intruding vehicles due to unreasonable physical constraints or hazards. For the purposes of this Directive, the following scenarios shall be considered ones in which no reasonable escapable route is provided. This list is not intended to be comprehensive:
  - Work adjacent to fill slopes 2:1 or steeper
  - Work adjacent to cut slopes steeper than 4:1
  - Work adjacent to barrier or retaining walls taller than 32-inches
  - Work adjacent to tunnel walls
  - Work adjacent to outer bridge parapets or the outer edge of the bridge deck if the parapet is removed.
  - Work adjacent to fill slopes shallower than 2:1 that are heavily obstructed by trees and/or vegetation which will significantly impede someone from quickly traversing the slope and are not shielded by a barrier ≤ 32-inches in height.
  - Work adjacent to cut slopes 4:1 or shallower that are heavily obstructed by trees and/or vegetation which will significantly impede someone from quickly traversing the slope and are not shielded by a barrier ≤ 32-inches in height.
  - Workers operating from lifts, bucket trucks, or other elevated platforms.

  Except for the condition of workers operating from lifts, bucket trucks, or other elevated platforms, if there is an area 10-feet or wider between the work area and the condition, the work shall not be required to be considered adjacent to the condition described. This area may consist of a travel lane and/or shoulder not being worked in.
- **Positive Protection Devices:** Devices that physically contain and/or redirect vehicles to prevent intrusions into the workspace. To be considered crashworthy, these devices must meet or exceed the performance evaluation criteria of MASH **Test Level 2 (TL-2) or Test Level 3 (TL-3)**. Eligible devices include portable concrete barriers, portable steel barriers, temporary guardrail and terminals, movable barrier systems, Truck-Mounted Attenuators (TMAs), and Trailer Truck Mounted Attenuators (TTMAs). TL-2 devices shall only be specified on roadways with a normal posted speed limit of 40 MPH or less, regardless of

the work zone posted speed limit. Additional restrictions on the use of TL-2 devices herein may apply.

- **Positive Protection Engineering Study:** The analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices for the purpose of determining the choice and application of work zone positive protection devices, exposure control measures, and/or additional safety countermeasures to safely manage work zones.
- **Safety Management Measures**: For the purposes of this Directive, this term shall be taken as referring to Additional Safety Countermeasures and Exposure Control Measures collectively.
- **Traffic Control Manual**: The WVDOH publication "Manual on Temporary Traffic Control for Streets and Highways", latest Edition.
- **Traffic Director:** Off duty uniformed police officer in properly identified police vehicle with blue lights.
- **Work Zone Operating Speed:** The speed at which 85% of vehicles traveling through the work zone are anticipated to be traveling at or below. Note that the work zone operating speed may not equate to the normal posted and work zone posted speed limits. The designer must make a determination of the anticipated operating speeds based on engineering judgement and/or available data. The designer may request available operating speed data for the project area from the Traffic Engineering Division as a reference for making this determination.
- **Workspace or Work Area:** The specific portion of the highway closed to road users and set aside for workers, equipment, and material storage.

20.1 Directive Purpose and Guidance

To mitigate work zone hazards and decrease the likelihood of fatalities and serious injuries to workers and road users, this Directive establishes a systematic, data-driven framework for selecting and implementing safety management measures.

With respect to positive protection devices, this Directive establishes the following circumstances under which the omission of temporary positive protection shall be justified with the support of a documented positive protection engineering study which includes a risk assessment. In circumstances where the designer determines reasonable justification has been established to not utilize positive protection, the designer shall consider additional safety management measures as previously defined and shall implement them as determined to be appropriate based on the study risk assessment.

- Work areas along facilities with anticipated work zone operating speeds of 45 mph or greater where workers have no means of escape as previously defined.
- When required based on Design Directive 685, "Drop-Off Guidance".
- Work areas where existing permanent positive protection devices must be removed, or are otherwise taken out of service, to perform the work and the removal exposes a previously shielded hazard that will be within the AASHTO RDG recommended clear zone.
- Work areas where material, vehicles or equipment that pose a hazard to motorists will be stored or present within the AASHTO RDG recommended clear zone.
- Work areas where falsework and/or other temporary non-crashworthy supports/structures will be placed within the AASHTO RDG recommended clear zone. In this circumstance,

the designer should consider the potential effect on these features from an errant vehicle impact in addition to the hazard they pose to motorists.

- Permanent non-crashworthy supports/structures placed within the AASHTO RDG recommended clear zone and remaining exposed until permanent positive protection is installed. In the risk assessment, it would be appropriate for the designer to only consider the temporary exposure period as the duration. The designer may mitigate the risk and the need for temporary positive protection by requiring the permanent positive protection to be installed immediately after the installation of the supports/structures, if feasible.
- Circumstances where vulnerable road users (i.e. pedestrians, bicyclists) will be traversing through the work zone and the risk to vulnerable road users will be increased relative to the preconstruction condition due to the path going from elevated above the road surface (i.e. raised sidewalk) to non-elevated and/or the buffer space between the edge of the travel lane and the path reduced to 5 feet or less

Under the following circumstances, longitudinal positive protection shall be required regardless of duration due to the potentially catastrophic nature of potential incidents the positive protection is intended to prevent, and cannot be feasibly justified for omission:

- On bridges where the outside parapet barrier is removed and is reachable from an open travel lane.
- Where the temporary removal of a permanent barrier exposes a retaining wall drop off or a fill slope steeper than 3:1 and is reachable from an open travel lane.
- Separating opposing directions of traffic for crossovers or contra-flows on divided facilities with a normal posted speed limit of 50 MPH or greater.

A wide variety of potential justifications for omitting positive protection exist. This Directive does not attempt to provide specific criteria for such justifications. Factors typically considered for potential justifications for omitting positive protection by themselves or in combination include but are not limited to the following. The designer must weigh potential negative impacts of positive protection against the benefits provided:

- Increased work zone crashes and potential secondary crashes
- Consequences of striking the positive protection are assessed to be more serious than striking a fixed object or running off the road
- Reduced roadside forgiveness and recovery area
- Time period that the protection will be in place versus time and cost for setup and removal
- Exposure of traffic and workers during setup and removal
- Reduction or elimination of non-traffic occupied areas to pull off the roadway in an emergency situation
- Reduction in work area access points for work and emergency vehicles
- Roadway drainage issues
- Reduced sight distance for motorists and construction vehicles

When determining the positive protection to implement, the designer must consider the most appropriate positive protection for the situation. Although temporary longitudinal barriers are commonly used as positive protection, truck and truck trailer mounted attenuators are also a form of positive protection and may be more appropriate in some circumstances, particularly mobile operations and work areas that will be in place for a short duration or short term.

When implementing longitudinal positive protection into a project, the designer must take into consideration providing appropriate means for work vehicles and equipment to enter and exit active travel lanes, as well as delivery of construction materials to the workspace.

Prior to specifying positive protection, designers should consider the feasibility of more preferable exposure control measures that eliminate or greatly reduce the exposure of project personnel to vehicular traffic and the exposure of motorists to roadside hazards and positive protection devices. This includes full road closures, detours, ramp closures, traffic diversion (median crossovers, upgrading and running traffic on shoulders, diverting traffic along interchange exit and entrance ramps), night work, rolling road blocks, temporarily or permanently removing hazards, closing additional lanes to create or expand buffer areas, and limitations on work during peak traffic periods.

Traffic Directors are an effective additional safety countermeasure for improving driver alertness and speed compliance. Traffic Directors are eligible for Federal-aid participation and should be strongly considered along with other safety management measures when appropriate. The need for law enforcement is greatest on high-speed, high-volume projects, particularly during nighttime operations, complex traffic pattern changes, and work zones with frequent worker presence adjacent to traffic without positive protection.

Through the systematic evaluation and application of positive protection, exposure control strategies, and targeted safety countermeasures, this Directive serves its fundamental purpose: providing a data-driven framework to effectively mitigate work zone hazards and protect workers and road users from fatal and serious injuries.

30. POSITIVE PROTECTION ENGINEERING STUDIES

For Federal-aid projects, omission of temporary positive protection in circumstances previously described in this Directive shall be based on a documented positive protection engineering study that includes risk analysis. The study shall also require or recommend additional safety management measures based on the assessment of vehicular intrusion risk. Designers may also perform a study to determine the appropriateness of positive protection or other safety management measures for circumstances where they are being considered, but are not required by this Directive to omit the positive protection. The need for and location of temporary positive protection in a project shall be based on one or more studies and engineering judgment. The EOR for the project shall formalize their concurrence with the conclusions/recommendations of all positive protection engineering studies for the project.

More than one study may be appropriate for a project as it may be appropriate to consider each phase, and associated maintenance of traffic plan, separately. For each phase, it may also be appropriate to consider the work areas within the project holistically along the entire project length, or it may be appropriate to consider two or more work areas along the project length separately, particularly when considering isolatable scenarios where the omission of positive protection must be supported by a study based on this Directive. Such scenarios may not extend for the entire length of the project and in some cases, the amount of time that site personnel and/or motorists are exposed under isolated scenarios may be for a more limited duration.

This Directive is not intended to dictate a specific study approach, as there is not one correct approach. The engineer designing the temporary traffic control and ultimately the EOR is responsible for determining an appropriate study approach and making the final determination on the use of positive protection and additional safety management measures. This Directive

does provide a minimum required standard risk based engineering study approach for consideration by and as a potential aid for the designer.

30.1 Minimum Required Standard Positive Protection Engineering Study Approach

The example positive protection engineering study approach provided considers and evaluates the following safety and operational factors.

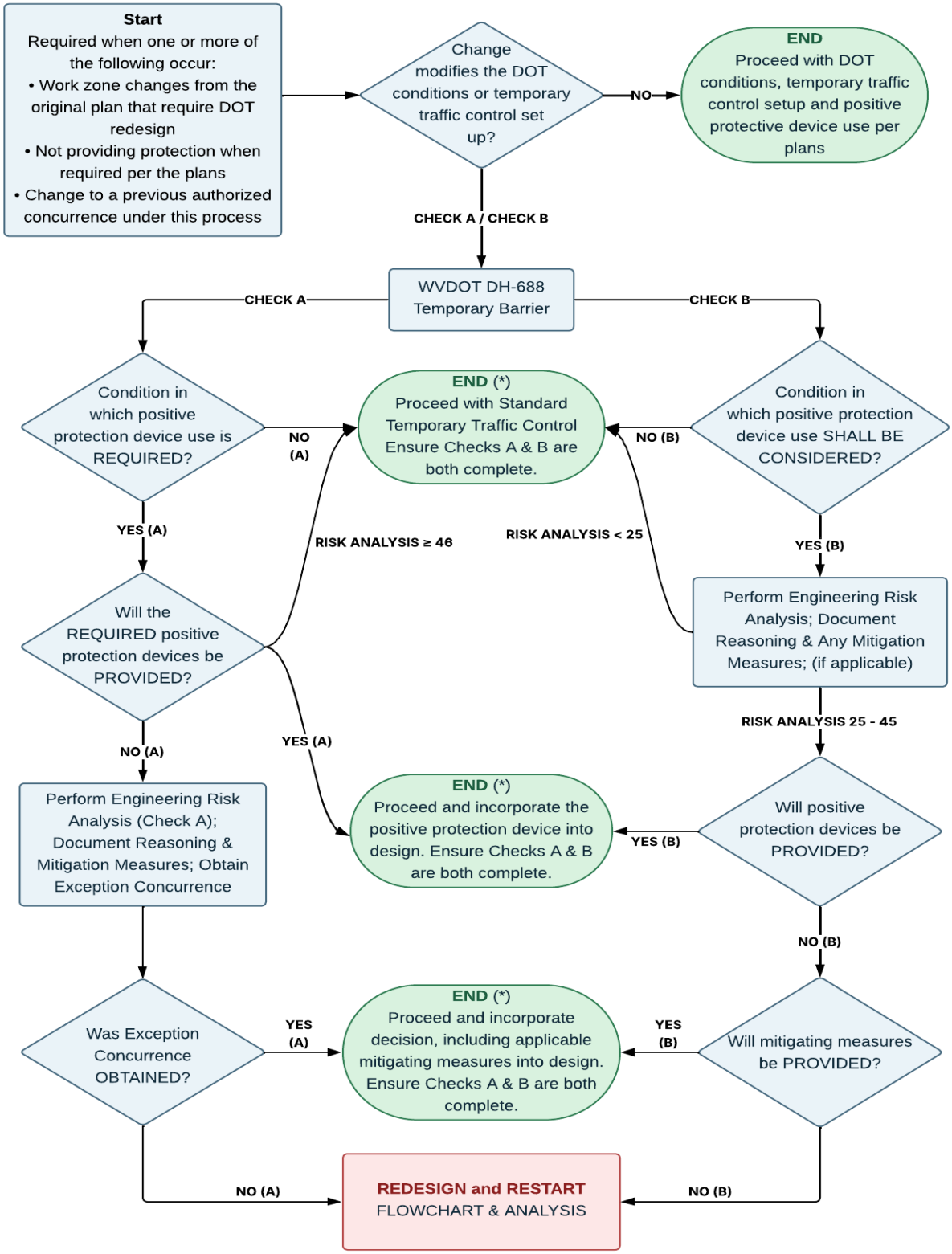
1. **Project scope and duration**.
2. **Anticipated operating conditions** including nature of traffic flow, vehicle mix, and speeds through the work zone.
3. **Anticipated traffic safety impacts**.
4. **Type of work** as it relates to worker exposure and crash risks.
5. **Distance between traffic and workers**, and the overall extent of worker exposure.
6. **Escape paths** available for workers to avoid a vehicle intrusion into the workspace.
7. **Time of day** of work operations (e.g., night work).
8. **Work area restrictions**, including their direct impact on worker exposure.
9. **Consequences to road users** and workers resulting from roadway departures.
10. **Potential hazard presented by the safety device itself** during installation, presence, and removal.
11. **Roadway geometrics** that may increase crash risks (e.g., poor sight distance, sharp curves).
12. **Access requirements** to and from the active workspace.
13. **Roadway functional classification**.
14. **Impacts on project cost and duration**.

To facilitate the evaluation of these factors, as well as documentation, a Work Zone Positive Protection Analysis Form is included with this Directive as an online form. One or more of these forms may be completed for the project as needed. This form includes a minimum required standard risk assessment methodology to further aid the designer in making decisions with respect to positive protection and may be considered an appropriate positive protection engineering study meeting the intent of this Directive. As a further aid to the designer, a flow chart illustrating a recommended positive protection assessment workflow is provided as WVDOH Work Zone Positive Protection Decision Flowchart.

40. REFERENCES

The designer is hereby directed to Design Directive (DD) 681, "Work Zone Safety and Mobility"; DD-685, "Drop-Off Guidance"; Traffic Engineering Directive (TED) 601-4, "Preparation of Maintenance of Traffic Plans"; the latest edition of the "Manual on Temporary Traffic Control for Streets and Highways"; the latest edition of the AASHTO "Roadside Design Guide" for further and more detailed information regarding temporary barrier systems and clear zone recommendations; and WVDOH Work Zone Positive Protection Analysis Form.

WVDOH Work Zone Positive Protection Decision Flowchart



50. SELECTING AND SPECIFYING PORTABLE TEMPORARY LONGITUDINAL POSITIVE PROTECTION

The designer is advised to consider the following guidance and requirements when specifying portable temporary longitudinal barrier (temporary barrier) on projects.

All temporary barriers are required by the Standard Specifications to meet the crashworthiness requirements established by MASH.

The designer shall specify the appropriate MASH Test Level and allowable impact deflection of the barrier based on the Bid Item Number and Supplemental Description used. Separate bid items are provided for Test Level 2 and Test Level 3:

- Temporary Barrier, TL-2
- Temporary Barrier, TL-3

The Test Level 2 bid item shall only be specified for use along roadways with a normal posted speed limit of 40 MPH or less unless otherwise specified herein. Regardless of the normal posted speed limited, Test Level 3 shall be specified for the circumstances previously described within this Directive for which omission of positive protection cannot be justified:

- On bridges where the outside parapet barrier is removed and is reachable from an open travel lane.
- Where the temporary removal of a permanent barrier exposes a retaining wall drop off or a fill slope steeper than 3:1 and is reachable from an open travel lane.
- Separating opposing directions of traffic for crossovers or contra-flows on divided facilities with a normal posted speed limit of 50 MPH or greater.

The designer is to determine the maximum allowable deflection of the barrier and shall specify this using the appropriate supplemental description in the bid item description. Typically, the maximum allowable deflection is based on the amount of buffer zone that can be provided behind the barrier or the distance from the back of the barrier to a point where the barrier would no longer be supported, such as the edge of a bridge deck. This may vary for different scenarios within the work zone and may vary for different phases of the work. The maximum allowable deflection based on the Supplemental Description specified is defined in the Table below:

Supplemental Description	Deflection Criteria (Buffer Zone available)
I	6”
II	24”
III	60”
IV	96”

The supplemental description used, and associated maximum deflection, defines the required buffer zone behind the barrier. Anything behind the barrier and within the maximum allowable deflection of the barrier should be considered to be unshielded.

The Designer must clearly specify in the Plans the required Test Level and deflection criteria for all runs of temporary barriers.

Designers are advised that deflections shown in the table are approximate and for comparison only to aid the designer in choosing appropriate temporary barriers for individual situations. Because of a multitude of variables including vehicle type, speed, impact angle, point

of measurement, anchorages, etc., deflections can and do vary from values listed.

The WVDOH does not maintain an "Approved Products List" for temporary longitudinal barriers. The Standard Specifications require the Contractor to submit Temporary Barrier Installation Plans for approval which include details of the proposed barrier installation such as barrier type, barrier connection type, MASH test approval and data, individual segment length, anchorage details, end treatments, and transition details.

Contractors are required to install temporary longitudinal barriers in a manner consistent with how the product was MASH tested. Parameters include, but may not be limited to, anchorages, total length of barrier, individual segment length and connection details. The designer is advised that although there are some specific exceptions, generally the approach to the barrier during testing is relatively flat, level, and uniform. The designer shall ensure as much as feasibly possible that these characteristics are provided for approaches to temporary longitudinal barriers in projects. Significant deviations from this can result in significant effects on the performance of the barrier.

50.1 Standard Barrier Characteristics (Test Level 3)

Standard Test Level 3 (TL-3) portable barriers are 32 inches high. Typical dimensions, weights, and anchoring thresholds depend on the material:

- **Concrete Barriers:** Weigh approximately 400 lbs/foot with an average base width of 22 inches. Generally, they must be anchored to limit dynamic deflection to 6 inches (Type I).
- **Steel Barriers:** Weigh approximately 70 lbs/foot with a base width between 22 and 27 inches. Generally, they must be anchored to limit dynamic deflection to 24 inches (Type II).

50.2 Non-Standard Designer Requirements

When project constraints demand non-standard criteria such as bridge deck weight limits per foot, narrow footprints, or MASH Test Level 4 protection the designer must:

1. Confirm that commercially available barrier systems exist that satisfy these exact criteria.
2. Draft and include all corresponding Plan Notes and Project-Specific Special Provisions in the contract documents.

DRAFT

WORK ZONE POSITIVE PROTECTION ANALYSIS FORM

WORK ZONE INFORMATION Fill out all applicable information

HUB Project Number: _____

State Project Number: _____

Federal Project Number: _____

Project MOT Phase Key: _____

Route: _____

Direction: _____

Work Zone Begin Mile Point: _____

Work Zone End Mile Point: _____

Work Activity: _____

Duration (Days): _____

Suggested Work Zone Operating Speed (MPH): _____

Does work or project utilize any Federal-aid funding? ☐ Yes ☐ No

Analysis Performed By:

Name: _____

Title: _____

Employer: _____

Signature: _____

Engineer of Record concurrence with study conclusions and recommendations:

Name: _____

WV PE License Number: _____

Signature: _____

Basis for Positive Protection Engineering Study :

☐ Performing a Positive Protection Engineering Study for one or more scenarios in which a study is required for potential omission per Design Directive 688.

☐ Performing a Positive Protection Engineering Study for one or more scenarios where positive protection is being considered, but for which a study is not required for potential omission per Design Directive 688.

DRAFT

WORK ZONE POSITIVE PROTECTION ANALYSIS FORM

CONDITIONS THAT REQUIRE WORK ZONE POSITIVE PROTECTION DEVICES

Select the condition(s) in which positive protection is being studied for omission as required by Design Directive 688:

- ☐ Work area along facility with anticipated work zone operating speed of 45 mph or greater where workers have no means of escape
- ☐ Based on Design Directive 685, "Drop-Off Guidance"
- ☐ Existing permanent positive protection devices must be removed, or will otherwise be taken out of service, to perform the work and the removal will expose a previously shielded hazard that will be within the AASHTO RDG recommended clear zone.
- ☐ Material, vehicles or equipment that pose a hazard to motorists will be stored or present within the AASHTO RDG recommended clear zone.
- ☐ Falsework and/or other temporary non-crashworthy supports/structures will be placed within the AASHTO RDG recommended clear zone.
- ☐ Permanent non-crashworthy supports/structures will be placed within the AASHTO RDG recommended clear zone and will remain exposed until permanent positive protection is installed.
- ☐ Vulnerable road users (i.e. pedestrians, bicyclists) will be traversing through the work zone and the risk to vulnerable road users will be increased relative to the preconstruction condition due to the path going from elevated above the road surface (i.e. raised sidewalk) to non-elevated and/or the buffer space between the edge of the travel lane and the path reduced to 5 feet or less.
- ☐ NA

CONDITIONS THAT DO NOT REQUIRE A STUDY TO OMIT WORK ZONE POSITIVE PROTECTION DEVICES

Identify any scenario where positive protection is being considered as an optional measure but is not a requirement, and give supporting rationale.

DRAFT

WORK ZONE POSITIVE PROTECTION ANALYSIS FORM

Engineering Risk Analysis for Work Zone Positive Protection Device Use

For each factor based on your assessment, choose which condition best describes the analysis scenario.

FACTOR 1– DURATION OF SPECIFIC WORK ZONE ACTIVITY	**POINTS**	**RATING**
Long-Term Stationary Work Duration >6 Months	**10**	
Long-Term Stationary Work Duration of ≥3 Months to ≤6 Months	**8**	
Long-Term Stationary Work Duration >3 Days to <3 Months	**6**	
Intermediate-Term Stationary Work *(occupies a location >1 daylight period to ≤3 days, or nighttime work lasting >1 hour)*	**3**	
Short-Term Stationary Work *(daytime work occupying a location for > 1 hour within a single daylight period)*, Short Duration Work *(occupies a location ≤1 hour)*, and Mobile Work *(moves intermittently or continuously)*	**0**	

FACTOR 2– WORKER EXPOSURE	**POINTS**	**RATING**
Workers are expected on foot >0 feet to ≤6 feet of an open lane of traffic	**10**	
Workers are expected on foot within >6 feet to ≤15 feet of an open lane of traffic	**6**	
Workers are expected on foot within >15 feet to ≤30 feet of an open lane of traffic	**3**	
Workers are expected on foot more than >30 feet from an open lane of traffic	**0**	

FACTOR 3– WORK ZONE OPERATING SPEED	POINTS	RATING
Pre-Construction posted speed limit is 55 mph or greater	**10**	
Pre-Construction posted speed limit is 45 mph - 50 mph	**6**	
Pre-Construction posted speed limit is 30 mph - 40 mph	**3**	
Pre-Construction posted speed limit is 25 mph or less	**0**	

FACTOR 4– PRE-CONSTRUCTION TRAFFIC VOLUME	POINTS	RATING
≥ 10,000 AADT/Lane	**10**	
≥ 5,000 to < 10,000 AADT/Lane	**6**	
≥ 2,500 to < 5,000 AADT/Lane	**3**	
< 2,500 AADT/Lane	**0**	

FACTOR 5– ESCAPE ROUTES	POINTS	RATING
No reasonable escapable route from work zone intrusions	**10**	
Near barrier or other impediments but a reasonable escape route from work zone intrusions	**6**	
Area that has a viable escape route from work zone intrusion	**3**	
Area with multiple escape routes from work zone intrusions	**0**	

FACTOR 6– REDUCTION OF OPEN-TO-TRAFFIC ROADWAY WIDTH	POINTS	RATING
Pre-Construction width reduced by >4 feet	**10**	
Pre-Construction width reduced by >3 feet to ≤4 feet	**8**	
Pre-Construction width reduced by >2 feet to ≤3 feet	**6**	
Pre-Construction width reduced by >1 feet to ≤2 feet	**3**	
Pre-Construction width reduced by 0 feet to ≤1 feet	**0**	

Based on the total score for the analysis scenario, determine the action to be taken.

Total Rating (Points):

Score	Risk	Action to be Taken
46 or More	High	Work zone positive protection should be considered required without strong justification otherwise. Additional Exposure Control Measures and/or Safety Countermeasures are required in the event that positive protection is omitted.
25-45	Elevated	Work zone positive protection devices should be considered to be strongly encouraged and should be implemented if possible without reasonable justification otherwise. Additional Exposure Control Measures and/or Safety Countermeasures are required in the event that positive protection is omitted.
Less than 25	Low	Use standard temporary traffic control

WORK ZONE POSITIVE PROTECTION DEVICES

The following positive protection device(s) will be used for the scope (route, direction, phase, start/end station, work activity) of the project construction analyzed in this study:

Although the study indicates the risk is Elevated or High, positive protection is not recommended for implementation based on the following justification:

SAFETY MANAGEMENT MEASURES (Exposure Control Measures and Additional Safety Countermeasures)

Additional safety management measures are required if the assessed risk is Elevated or High. The following additional safety management measures are recommended for implementation:

DRAFT

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 301
RIGHT OF WAY PLAN DEVELOPMENT

Insert Approval Date~~March 13, 2024~~

Supersedes ~~January 28, 2021~~ March 13, 2024

TABLE OF CONTENTS

SECTION			Page
10	General		2
	10.1	Introduction	2
	10.2	Purpose	2
	10.3	Process	2
20	Plan Development		3
	20.1	Considerations	3
	20.2	General Specifications	6
	20.3	Plan Content	7
	20.4	Plan Limits	7
	20.5	Project Numbers	7
	20.6	Text	7
	20.7	Submission/Revision Date	7
30	Right of Way Plan Content		7
	30.1	Title Sheet	7
	30.2	Ownership & Utilities Index	8
	30.3	Property Maps	12
	30.4	Right of Way Plan Sheets	14
	30.5	Reference Point Sheets	22
	30.6	Geometric Layout Sheets	22
	30.7	Typical Sections	22
	30.8	Profile Sheets	22
	30.9	Cross Sections	22
40	SUBMISSION OF PLANS		22
	40.1	Submission Distribution	22
	40.2	RW-1 Plans	23
	40.3	RW-2 Plans	24
	40.4	RW-1 & RW-2 Combined Plan Submission	24
	40.5	RW-2 Revisions	24
	40.6	Advanced Acquisition Plats	25
	40.7	Whole Take Plans	25
	40.8	RW-3 Plans	25
	40.9	RW-3 Revisions	25
	40.10	RW-4 Plans	26

10. GENERAL:

10.1. Introduction: Right of way plans are used by engineers, attorneys, appraisers, negotiators, and are presented to property owners. Although the information should not conflict with the plans for construction, right of way plans are **not** construction plans and serve a different purpose.

10.2. Purpose: Right of Way plans are used to:

a. Determine the right of way necessary to construct and maintain the roadway;
b. Show property boundaries and current ownership;
c. Show existing and proposed ingress and egress;
d. Determine the value of the acquisition;
e. Write the necessary descriptions, and;
f. Negotiate and acquire the necessary right of way.

10.3. Process:

10.3.1. Determine Boundaries and Ownership: The location is set for the proposed project and the project area is mapped. Preliminary right of way limits are established to determine areas for acquisition. The ownership and boundaries of these areas are determined from courthouse records, field evidence and interviews.

10.3.2. Right of Way Questionnaires: Each affected property owner is interviewed and a completed right of way questionnaire is obtained for each property to be acquired. This information is used to verify ownership and use, property lines, identify public and private utilities and improvements. (See Section 20.1.2.3)

10.3.3. Develop Right of Way Plans: The submission and approval process that is to be followed on projects shall be one of the two processes described below and shall be determined by the Project Manager and included in the Scope of Work minutes. Development of right of way plans will typically utilize one of the following submission and approval processes. The submissions will follow the approved project CPM schedule.

10.3.3.1. Combined Process (Typical): This process involves the combining of the RW-1 and RW-2 submission per Section 40.4 of this design directive. It should only be used on small bridge replacement or roadway improvement projects where the final alignment can be approximately predicted during the early phases of design. Multi-lane highway projects on new alignment, large bridge replacement projects, or highway projects involving new roadway would normally use the Alternate Process and would be identified during the scope of work meeting.

10.3.3.2. Non-combined Process (Alternate): This process involves the separate submission, review, and approval of RW-1, RW-2, RW-3, and RW-4 plans as described below and in Section 40 of this design directive. The "Typical Process" shall be utilized on all projects unless approval is given by the Project Manager to utilize the "Alternate Process." The

"Alternative Process" shall be utilized when identified during the scope of work meeting where there is anticipated involvement of a large number of real estate parcels, or it can reasonably be expected that design revisions may occur during early phases of the plan development regardless of the number of anticipated real estate parcels.

10.3.4. RW-1 Plans: The first submission of right of way plans is used to review the documents of ownership, the plotting of the property lines and existing right of way. They may also be used to estimate preliminary right of way, for abstracting, and utility relocation cost and scheduling purposes. This RW-1 submission consists of the Title Sheet, Ownership and Utilities Index Sheet(s), Property Map Sheet(s), and RW-1 Plan Sheet(s). Copies of the R/W Questionnaires and supporting documents are to be included (See Section 40.2).

10.3.5. RW-2 Plans: This submission is used to estimate right of way and utility relocations and to review the proposed right of way and easement limits, determine the effect of the project on landowners, and to initiate abstracting. These plans consist of the contents listed above for RW-1 plans plus completely developed Right of Way Plan Sheet(s), Profile Sheet(s), and Typical Section Sheet(s) (See Section 40.3) and shall reflect resolution of RW-1, PFR and Slope Review.

10.3.6. RW-3 Plans: This submission is for appraisals, negotiations, writing descriptions and acquisition, and shall reflect resolution of all RW-2 and Final Field Review comments (See Section 40.8).

10.3.7. RW-4 Plans: This submission is a master set of right of way plans submitted after acquisition is complete and shall reflect the acquired right of way (See Section 40.10).

20. PLAN DEVELOPMENT:

20.1. Considerations: The development of right of way plans must be coordinated with and in conjunction with development of the construction plans. When establishing right of way limits on each project, consideration must be given to the following:

20.1.1. Right of Way Limits: Right of way lines must be set beyond the construction limits and to allow for future maintenance of the highway. In rural areas, on major roadway projects, construction activities and equipment will require approximately 30 feet beyond the construction limits for the construction and maintenance of the slopes, ditches, culverts, fencing, guardrail, etc. This distance may be reduced or increased after careful review, taking into account the nature of the terrain, the magnitude and stability of the cut or fill, drainage, and/or land value.

In an urbanized area, right of way limits shall be set so as to minimize the area to be acquired and to minimize damage to adjacent properties. Measures to reduce right of way limits, such as the use of a temporary construction easement,

realignment of fencing, etc., can often be taken to reduce right of way damages and help facilitate the acquisition process.

Right of Way Division may request adjustment in the final location of right of way lines during negotiations.

20.1.2. Property Ownership and Property Lines: Existing property ownership, property lines and areas must be established from courthouse records, deeds or wills of record, aerial maps, subdivision maps, surveys and plats, and information obtained from field evidence and the Right of Way Questionnaire.

20.1.2.1. Tax Maps: Tax maps may be used only as guidance for boundaries and in reconnaissance reports and as an aid in the development of the right of way plans.

20.1.2.2. Titleholders, Deed and Will Information: It is absolutely necessary that the name(s) of the titleholder(s), and deed book and page number of the full (100%) interest owner(s) be correctly determined for each parcel. Deed and/or will research must be performed for all properties affected by the project. The deed for each parcel is obtained and plotted to establish property lines. The project parcel number is to be shown in a circle in the upper right corner of each deed. It is necessary to research previous deeds until a plottable description is obtained. If a plottable description is not available, the designer shall prepare a "Property Line Discrepancy Report" per Section 40.2(c) of this directive.

If property has been distributed by virtue of a will, it is also necessary to obtain a copy of the last recorded source deed(s) with a full (100%) interest in the property. During the development of the plans, land transfers are to be current (within 6 months) at the time of the initial submission of RW-3 plans. Later revisions, due to land transfers, may be requested by Right of Way Division.

20.1.2.3. Right of Way Questionnaire (Form 5.01): A separate Right of Way Questionnaire for each project parcel is to be completed in full, based on courthouse records **and an actual interview with the property owner(s), tenants, or other knowledgeable sources**. For example, Parcels 2-1 and 2-2 would require separate questionnaires with supporting data attached. The assigned project parcel number is to be placed in the top right-hand field of the questionnaire. This form is to be signed and dated by both the person being interviewed and by the interviewer. If the owner refuses to sign or provide information, state such on the form. This two-page form, which includes instructions for completing, is available from the Right of Way Division and on the transportation.wv.gov website.

Information requested on the right of way questionnaire may be obtained from non-resident owners by telephone contact and so noted on the

questionnaire. If the owner cannot be contacted, get an address (i.e.: from the tax ticket) and provide a note with the questionnaire describing all of the methods used in trying to contact the owner.

If information requested on the questionnaire is not applicable, place "N/A" on that line to indicate that it has not been overlooked. Do not use "N/A" to indicate that the information is unknown.

While obtaining the information for the questionnaires, the interviewer shall look for and ask about property line discrepancies, storage tanks, sewage tanks, drain fields, water or gas/oil wells and lines, old graves and cemeteries on the subject or adjacent property, life estate or land contract interests, etc. There is an area provided on the reverse side of the questionnaire for additional information and sketches to locate existing features such as those listed above.

If a property is in heirship, this information must also be indicated on the questionnaire, along with a list of the heirs and addresses of each. Minor heirs, if any, shall be identified. If a property has been distributed by virtue of a will, the will book and page number must be provided, along with a reference to the last recorded deed (full interest) in the chain of title, and, when obtainable, copies of all applicable death certificates shall also be included with the questionnaire packet. (See Section 40.2.e for additional information.)

20.1.2.4. Field Evidence: A reasonable search is to be conducted in the field for any evidence of property lines or corners particularly in the area of proposed take. Such evidence, if found, is to be located by survey and identified on the plans.

20.1.3. Existing Improvements: An improvement is any addition to land intended to make the property more valuable and/or usable. All above and below ground improvements, within or in close proximity to the proposed right of way limits are to be shown and clearly labeled as to type. Each improvement (dwelling, garage, barn, storage shed, storage tank, well, sewage system, etc.) must be evaluated with particular emphasis on those improvements lying in the fringe areas of construction. The Designer shall adjust the construction and right of way limits to avoid such improvements, if feasible, without jeopardizing sound design standards.

All properties that are improved with buildings that are, or could be, utilized as inhabited dwellings or commercial establishments are assumed to have all utility services and facilities until otherwise verified. These facilities could include a sanitary sewer line connection to a public sewer, a private sewage system such as a tank and drainage field, an "outhouse," or "shotgun sewer" lines. When the project construction is in close proximity to such a property, each system must be completely shown.

All underground storage tanks and all known or possible hazardous waste sites must be shown and identified on the plans. Avoidance of these sites shall be given full consideration in the final approval of project location. Strict adherence with "Guidelines For Identifying And Dealing With Hazardous Waste On Highway Projects" is required (See "Hazardous Waste", DD-302).

20.1.4. Potential Slide Areas: When a geotechnical report indicates an area as a "Potential Slide Area", the limits shall be shown and labeled as such. When new construction will not remove the entire critical area, consideration shall be given to the acquisition of additional area beyond the normal right of way limits, particularly if the road construction might increase the probability of slide development. If the potential slide area will not be worsened by the road construction, it should not be acquired.

20.1.5. Access Control: For projects having grade separation interchanges and/or at-grade intersections, the controlled access line is placed to include the entire interchange area and shall be continuous throughout the entire controlled access project. The controlled access line is to be set at a minimum of 100 feet beyond the ramp radius return in urban areas and a minimum of 300 feet in rural areas.

The radius return is defined as that point on the ramp or intersection return where the radius or flare joins the tangent line of the edge of pavement of the intersecting roadway. In the case of a future widening of the intersecting roadway, the point shall be determined on the basis of the ultimate design width, even though its construction may be some years hence.

If access is to be provided under bridges or other structures, it shall be noted on the applicable plan sheets. Consideration should be given to providing an alternate access to abutting properties, such as where a frontage or access road may be utilized to prevent landlocking properties. For additional information refer to the Right of Way Manual.

The controlled access line may be located so as to facilitate maintenance of the roadway. It is not necessary for the controlled access line to follow the right of way line or to be located so as to include all construction features.

20.1.6. Legibility: Features must be prominently displayed and easily located, including centerline, stations and offsets, property lines, parcel and tract numbers, construction limits, and existing and proposed right of way and easement lines. Plan presentation shall have weights and symbology as shown on the Title Sheet conventional signs.

20.2. General Specifications: A standard sheet size (22"x 34", including border area) shall be utilized on all right of way plans. A 1 ¼" border on the left and a ½" border on all other sides is to be used. The plan sheets shall be in accordance with the WVDOH Engineering Division CADD Standards. The plan sheet cells are located in the WVDOT_Sheet

Borders.cel file in the WVDOH Workspace and are titled PLAN_SHEET_X, with X being their respective scale.

20.3. Plan Content: Right of Way Plans shall consist of, and be in the following order:

a. Title Sheet (See Section 30.1)
b. Ownership, Utilities Index, and Demolition Table Sheet(s)(See Section 30.2)
c. Property Map Sheet(s) (See Section 30.3)
d. Right of Way Plan Sheet(s) (See Section 30.4)
e. Cemetery Detail Sheet(s), if applicable (See Section 30.4.20)
f. Reference Point Sheet(s) (See Section 30.5) (If available) Including Survey Marker Table
g. Geometric Layout Sheet(s) (If available) (See Section 30.6)
h. Typical Sections Sheet(s) (See Section 30.7)
i. Profile Sheet(s), including detours, side roads, driveways, etc. (See Section 30.8)

20.4. Plan Limits: On all projects, additional features outside the project limits, consistent with the contract plan development, are to be shown on both ends of the project. Topography, houses, garages, existing right of way lines, roadways, utility facilities, and other improvements, along with any projected right of way lines for adjoining projects, if they are designed or currently in design but not yet constructed, shall be shown.

20.5. Project Numbers: Notes shall be placed on appropriate sheets indicating the construction project number and limits of work for the corresponding construction project. Right of Way Project termini and right of way project numbers for current adjacent right of way projects shall be indicated on the Title Sheet, Property Map Sheet(s) and Plan Sheet(s).

20.6. Text: All text should be of a minimum height and weight so as to be legible when half-size copies of plans are used in condemnation proceedings and when requested by Project Managers. Text should not be upside down or on top of other text or topography.

20.7. Submission/Revision Date: All sheets shall have the submission/revision date indicated near the lower left border. The type of submission should be listed with the date and any previous submission dates shall remain and be struck through if a revision is required to that sheet.

30. RIGHT OF WAY PLAN CONTENT:

30.1 Title Sheet: The Title Sheet border shall be in accordance with the CADD standards. The Title Sheet cell is located in the WVDOT_Sheet Borders.cel file in the WVDOH Workspace and is titled TITLE_SHEET.

30.1.1. Contents: The Title Sheet shall contain the following:

1) Standard Title Block
2) Project Identification Block
3) State District Map with respective county hatched, not shaded
4) State & Federal Project Numbers (inside lower left border of sheet and center top, and Project Identification Block).

5) Department Signature Block (See current DD-702)
6) Route Numbers and Type
7) Tax District or Corporation and County Name
8) Project Limits, R/W Project Limits and Construction Contract Section Limits
9) Type of Right of Way Plan Submission (under State District Map)
10) Vicinity Map from the WVDOH County Maps (Project Location and Extents)
11) List of all utilities and railroads encountered (See current DD-303)
12) Layout Map with North Arrow, graphic scale, plan sheet outline, and Right of Way Project Termini
13) Controlled Access Note, if applicable
14) Index to Sheets
15) Revision Block
16) Consultants Seal Block sealed by a PE registered in West Virginia, if applicable
17) Horizontal and Vertical Scale and Conventional Signs Legend
18) Submission date (Outside lower left corner)
19) Design Designation Block

30.1.2. Utilities Encountered: Indicate the type of service provided, in parenthesis, after the name. Example: Ridge Public Service District (Water).

30.1.3. Layout Map: The layout map shall show existing and proposed road alignments with the superimposed project centerline showing the relative plan sheet coverage by sheet number. All roads are to be labeled with names and route numbers, with directional arrows to the nearest community or intersecting routes. Include streams, corporation, county, state lines, right of way and construction project numbers and work limits, railways, and large industrial or commercial structures and plazas and Right of Way and Construction Project Termini.

30.1.4. Controlled Access Note: All projects with controlled access or partially controlled access shall define the locations of access on the Title Sheet of the Right of Way and Construction Plans. A "Fully Controlled Access Project" shall include a note on the Title Sheet stating the following: "This project is a fully controlled access facility with only vehicular access allowed as shown in these plans." "A Partially Controlled Access Project" shall have a note on the Title Sheet stating the following: "This project is a partially controlled access facility with access allowed only at the following locations: Sta Lt, Sta ____Rt, etc."

30.2 Ownership & Utilities Index: The Ownership and Utilities Index must be in accordance with the excel spreadsheet on the ~~www.transportation.wv.gov/highways/right-of-way~~ https://transportation.wv.gov/right-way-consultant-services website.

30.2.1 Names of Titleholders: Correct spelling of each property owner's names is

imperative. Use the name and spelling of the name as shown in the deed when different spellings appear on other documents. Revisions will then be made if corrections are later found. Holders of Life Estates are to be included in the Ownership Index.

30.2.2 Parcel Numbers: An individual parcel number shall be assigned to each property to be acquired and to each private utility. Parcel numbers may not be changed or reassigned once they have been assigned or reused if deleted. The parcels shall be numbered consecutively, starting with Number 1, and shall be placed in the index in numerical order. No Parcel Numbers are to be reserved for future use.

Property under the same ownership must meet all three of the following conditions before a single parcel number is assigned to the entire property: (1) Same Ownership, (2) Same Use, and (3) Contiguity. Noncontiguous parcels having the same ownership shall be identified with the same parcel number utilizing a numerical suffix. Examples of this are: 1-1, 1-2, 1-3, 2-1, 2-2, etc. **NOTE**: Existing highway or railroad right of way will separate a property into noncontiguous parcels.

Deleted parcels are to remain on the Ownership Index, Property Map and Plan Sheets for information only. A solid horizontal line is to be drawn through the parcel number, name, areas of take and remaining removed, "0" shown in the Total Taken column, and "No Take" entered in the "Remarks" column. A line is also to be drawn through the parcel number on the Property Map and Plan Sheets.

30.2.3 Tract Numbers: Tract numbers shall be assigned numerically for each parcel from which more than one tract of land is to be acquired. The tract numbers must begin anew for each individual parcel and are assigned consecutively in accordance with the type of acquisition, by priority; i.e., controlled access, noncontrolled access, permanent easements, and temporary easements. All tract numbers shall be complete for each classification before moving to the next classification (Example: Controlled Access – Tracts 1, 2, and 3; Noncontrolled Access – Tracts 4 and 5; Permanent Drainage Easement – Tracts 6 and 7; Permanent Ponding Easement – Tracts 8 and 9; Temporary Construction Easement – Tracts 10 and 11, etc.).

30.2.4 Recording Data: Deed and/or Will Book Numbers and Page Numbers must be shown in the "Recorded" column, with the appropriate references all the way back to the deed which conveys a full interest in the title. If a will has a codicil, show its Book Number and Page Number.

Only the current ownership deeds and/or wills, etc. are to be shown on the ownership index. Deeds involved as part of the chain of ownership are to be attached to the back of the deed and questionnaire.

30.2.5 Type of Take: Columns for indicating the area and type of take are provided for "Controlled Access" right of way, and "Noncontrolled Access" right of way. The "Easement" column has subheadings for "Type" and "Area".

30.2.6 Easements: All easements shall be identified in the Ownership Index as to type. Various types of easements and their use are discussed more fully in Section 30.4.4 below.

30.2.7 Areas: The areas of the various tracts to be acquired shall be shown on the Ownership Index in the appropriate column. Areas must be completed for all right of way takes and easements. "Remaining Left", "Remaining Right", "Total Remaining", "Total Taken", and "Parcel Total" are to be shown on the top line of the parcel listing.

Areas of take less than one acre shall be shown in square feet, rounded to the nearest square foot. Areas one acre or more, shall be shown in acres, to the nearest one-hundredth acre. If a parcel has areas of take less than one acre and a Parcel Total shown in acres, dual units (acres and square feet) are to be shown only for the take areas that are less than one acre. All parcels in urban areas and defined lots in subdivided areas shall show calculated areas in square feet.

All permanent easement areas excluding Permanent Aerial Easements will be included in the "Total Taken" column. Temporary easement areas are **not** to be included in the "Total Taken" column. If any portion or all of a residual area will be landlocked after construction, a note "Landlocked" shall be added in the Remarks Column.

The "Parcel Total" should, if possible, show the deed area. Otherwise, the parcel area will be calculated and denoted by "(C)" after the "Parcel Total" area. If the calculated total area is significantly different than the recorded deed area, use the calculated area and show the deed area in the "Remarks" Column, along with an explanation, if needed. For a parcel with an area greater than one acre do not show the parcel total in square feet unless shown as such in the deed.

All areas of acquisition from any agency of the Federal Government shall be the result of a computer calculation or by actual closed survey (See Section 30.4.21).

For noncontiguous parcels, such as parcels that have been split by right of way, the areas shall be calculated and the deed area shall be shown in the remarks column.

30.2.8 Remarks: The Remarks column should be reserved for notes such as the aforementioned. Other notes, such as landlocked areas, areas purchased as uneconomic remnants, billboard permit numbers, or special notes as requested

will be shown in the Remarks column.

30.2.9 Uneconomic Remnants: When the value of a remnant is small, a determination as to declare it "uneconomic" will be made by Right of Way Division. Uneconomic Remnants will not be added to the plans until acquisition of a parcel is complete.

30.2.10 Utility Index: All utilities encountered by the project shall be listed on the Utilities Index by correct company legal name, type and size and location of facility, with station/offset and sheet number. The disposition of the utility when clearly known is to be listed and updated as needed, i.e.: "To be relocated by owner", "To be abandoned in place", "To remain in service", "To be relocated by DOH", etc.

30.2.11 Private Utilities: Utilities are typically considered to be private when the utility is not regulated by the public service commission, such as privately owned oil and gas wells or a water line that does not serve the public. Private utilities are not to be listed in the Utilities Index. A private utility shall be assigned a parcel number and be listed in the Ownership Index, and no areas of take will be shown. A note in the Remarks column shall identify the type of improvement involved. Private utilities under the same ownership as the involved parcel of real estate will use the same parcel number, differentiating it by the use of a letter suffix, i.e., Parcels 14-A, 14-B, 21-A, 21-B, etc.

30.2.12 Private Water and/or Sewer: Partial acquisitions shall be carefully reviewed to ascertain whether private water and/or sewage systems will be taken. Water wells and sewage systems will not be allowed to remain inside areas of proposed right of way.

30.2.13 Billboards Each affected billboard is to be identified by owner and permit number. This information should be on the tag attached to the billboard. A note shall be provided on the Right of Way questionnaire if no information tag is found. Billboards are to be assigned a parcel number, which is the underlying owner's parcel number plus an alpha suffix, i.e., Parcel 13-A, Parcel 24-A.

30.2.14 Railroads: Easements to be acquired from railroads are to be identified with a parcel number and listed in the Ownership Index with the railroad valuation map reference placed in the "Remarks" column.

30.2.15 Division of Natural Resources: When the centerline of a project crosses over a stream, the State of West Virginia, Department of Commerce, Division of Natural Resources is to be shown as the titleholder on the Ownership Index. Types and areas of take are to be shown, however, no deed reference or "Parcel Total" is given. The name of the affected stream is placed in the "Remarks" column. (See Section 30.4.18.)

30.2.16 Demolition Table: The demolition table that is included in the construction plan set shall be included in the right of way plan set. (See DD-709)

30.3 Property Maps:

30.3.1. Property Map Sheet(s): These sheets must show a north arrow, proposed centerlines, route numbers and names of all existing streets and roads and other topographic features, existing and proposed right of way lines, easements of record, entire property boundaries, project parcel and tract numbers (not tax parcel number), major structures, existing utility transmission lines (above and below ground), cemeteries, and other topographic features. Each right of way line must be labeled frequently enough to clearly delineate the type of line. The Project Manager may require the major contours to be shown.

All underground storage tanks and potentially hazardous waste sites located within or in close proximity to the existing and/or proposed right of way lines shall be shown. Matching property map sheet numbers and stations are to be shown outside the matchlines. The property maps must be complete and include all corrections and comments presented at field and office reviews. Property Maps may be combined with the Ownership Index on small projects.

All existing right of way shall provide a reference of their source, i.e., "Project Number", statutory right of way, old Virginia turnpikes, etc. as determined by existing plans and records.

30.3.2. Parcels: The entirety of all parcels affected by the project are to be shown on the property maps, with the appropriate parcel and tract numbers affixed. Deed tract numbers are to be shown in parenthesis. Names or deed references are not to be shown on the property maps unless the property involves the U.S. Government.

For those parcels that are too large to show the entirety on a property map, an inset or supplemental sheets, at an appropriate indicated scale, must be utilized showing the parcel in its entirety. When using an inset, include properly labeled match or inset lines. If the scale does not facilitate labeling each property line, use a table format to list the property line information. Supplemental inset sheets, including sheets used for tables, are to be placed at the end of the Property Maps.

30.3.3. Property Lines: Property lines shall be labeled on the inside of the applicable property line, with deed bearings and distances shown in parentheses for each line. Use a land hook (land tie) symbol to identify interior deed tract lines. If records do not indicate metes and bounds, the distance along the property line shall be scaled and labeled to the nearest whole foot and indicated as such by adding the letter "(s)", in parenthesis, after the scaled distance. A calculated or project bearing shall not be shown. If deed distance is significantly different

than scaled distance, show both the deed and scaled distances.

30.3.4. Existing Features: Existing features include the following:

1) North arrow.
2) Private and public roads, streets, and alleys with identifying names and route numbers (where applicable) and old Virginia turnpikes.
3) Existing right of way and easement lines for all roadways, utilities, and private right of ways.
4) Access to all parcels.
5) Directional arrows, with distance to the nearest city, town, major route, or major intersection at each end of the project and/or existing road.
6) Bridges and major drainage structures.
7) Railroads with names, valuation centerlines, stationing, and right of way lines.
8) Corporation and tax district lines and names.
9) Streams with names and flow arrows.
10) Subdivisions with name, bearing and distances (in parenthesis), block numbers, street and road names, lot lines, lot numbers and lot dimensions.
11) Public utility and major private utility transmission lines with company name and type of facility.
12) Deep mines, surface mines and mine roads, including mine entrances and air shafts.
13) Entire property boundary lines of each parcel with property line symbols, deed tract numbers or lot numbers (in parenthesis), and deed bearings and distances (in parenthesis).
14) Land ties on interior deed tract lines.
15) Gas, oil and salt wells and lines along with owner's names and American Petroleum Institute (API) well tag number.
16) Outlines of structures (residential, commercial, schools, churches, and public buildings). (labels are not necessary)
17) Cemeteries.

30.3.5. Proposed Construction Features: Include the following:

1) Project centerline or baseline of all access roads, frontage roads, connector roads and temporary detours, with names.
2) Stationing labeled at 500 feet intervals, with 100 feet tic marks.
3) Right of Way project limits with stations.
4) Project Limits, R/W Project Limits and Construction Contract Section Limits
5) Parcel and tract numbers for all property to be acquired, with landlocked residues labeled.
6) Stream relocations or channel changes.
7) Structures such as bridges, major drainage structures, culverts, retaining walls, etc.
8) All proposed areas of permanent and temporary take.
9) Label any road to be terminated or abandoned as such.
10) Show all proposed access points.

30.3.6. Landlocked Areas and Vehicular Access: On a controlled access facility, all residual areas for which no vehicular or pedestrian access is provided shall be identified as "landlocked". This shall only be done if the residual area was landlocked as a result of activity of the road project.

On a noncontrolled access facility where restoring vehicular access is impractical, a note shall be added to the ownership index, property map(s) and plans, "No vehicular access provided". Resident areas abutting public roads other than the proposed controlled access facility, should not be identified as "Landlocked".

30.3.7. Subdivisions: All recorded subdivisions will be shown, complete with the name of the subdivision, street names, alleys, block numbers and lot numbers. If the involved streets are privately owned, a parcel number must be assigned and a titleholder identified. Lot numbers shall be shown in parenthesis to differentiate them from parcel numbers. A copy of each subdivision map is to be included with the RW-1 submission.

30.4 Right of Way Plan Sheets: The right of way plan sheets may be a duplicate of the construction plan sheets with the addition of the required parcel, tract, and property line information. However, it may be necessary to turn off certain layers of construction specific information in order to make the right of way plans legible. Contours are to be screened. Matchline stations and sheet numbers are to be shown on each sheet.

30.4.1. Centerline: The centerline or baseline layout shall be identical to that shown on the construction plans. All tangent portions of the centerline shall be identified with a bearing and all curve geometry shall be readily visible on each plan sheet. Stations should typically progress from West to East and/or from South to North, and match exactly those shown on the construction plans.

All station equations and the P.I., P.C., P.T., T.S., S.C., C.S., and S.T., etc. of each curve shall be shown. Curves are to be labeled on each sheet in which it appears on the inside of the curve. The centerline of new construction is to be designated as project centerline.

Beginning and Ending stations shall be shown for the Right of Way, Construction and/or Work. These stations should be at the furthest reaches of take along the centerline for stand-alone projects. For abutting projects, the right of way project limits will be at the centerline, preferably on a property line crossing, to avoid overlaps and gaps.

30.4.2. Construction Limits: The cut and fill slopes, as designated on the construction plans with standard symbols, are to be reproduced identically on the right of way plan sheets.

30.4.3. Right of Way Lines: Existing right of way lines are to be screened. All screened features must be legible. Plans with illegible features may be rejected. The proposed right of way lines shall be placed outside the construction limits, as indicated in Section 20.1.1. All existing and proposed right of way labels shall be shown on the inside of the line.

Proposed right of way lines (controlled or noncontrolled) shall consist of a series of tangent lines having directional changes when necessary to avoid excess acquisition. In establishing the breakpoints of the tangent right of way lines, consideration shall be given to the value of the property versus other factors which may be involved (See Section 20.1.1).

Each breakpoint or change in direction of the right of way lines (controlled and noncontrolled access) or easement lines shall be identified by station and offset distance, and both set to the nearest foot.

When an interest in railroad property is to be acquired, each highway station and offset must be equated to the railroad valuation station and offset distance. The actual railroad valuation centerline, with stationing, must be shown throughout the immediate area of involvement.

30.4.4. Easements: The future needs of the Division of Highways shall be considered: first, by covering all permanent construction areas with right of way, and then, by utilizing easements, permanent and/or temporary, where additional areas are necessary for a specific use. Easement lines should also consist of a series of tangent lines.

All easements shall be identified on the plan sheets as to tract number and type. The reason for the necessity of the easement must be clearly shown on the plans.

A **permanent easement** is defined as an area that is necessary for future maintenance of the highway.

A **temporary easement** is an area that will be used for a limited period of time during construction, and no future maintenance in, or access to, that area will be required. The topographical features of a temporary easement are to be returned, as nearly as possible, to their original condition.

Examples and descriptions of typical easements acquired include, but are not limited to, the following:

Permanent Drainage Easement (PDE): An area, outside normal right of way, where entry upon the land may be required from time to time to maintain or clean the pipe, ditch, channel, etc. The surface owner cannot construct any structure within this area that may affect the free flow of the water or ponding water.

Permanent Ponding Easement (PPE): An area, outside normal right of way, on the upstream end of a drainage structure, where ponding of water may occur during storms. Limits will be determined by the high water contour, as applicable. There are no provisions for entry on the land, just ponding of water.

Permanent Aerial Easement (PAE): Provides for the construction and maintenance of a structure above the owner's land, while allowing the owner to utilize the land under the structure in any manner that does not interfere with the functioning of the structure. A PAE provides no surface rights. This easement is frequently used at grade separations with a railroad. PAE's are NOT included in the Total Taken column.

Permanent Crossing Easement (PCE): Normally used only with railroads, this easement provides permission for a highway to cross a railroad right of way with an at-grade intersection.

Permanent Roadway Easement (PRE): Provides for construction and maintenance of a roadway and supporting structure on owner's land, while not obtaining full right of way. This type of easement is common when a roadway or embankment is located on railway property and the railway desires to grant permission for the roadway without disposing of the land.

Temporary Construction Easement (TCE): Provides work area for the temporary use of land outside normal right of way that is necessary for construction of the project. The use of this land will be for a specific time period and the purpose of the TCE must be clearly shown on the plans. Permanent grading changes are **not** normally performed on areas acquired as TCE. However, TCE's are commonly used for access points where minimum grade changes are necessary to tie existing roads or driveways back in.

30.4.5. Parcels and Tract Numbers: All parcels affected by the project are to be shown on the Right of Way Plan Sheet, with parcel numbers and tract numbers. Names or deed references are not to be shown on the property unless the acquisition involves an agency of the U.S. Government.

30.4.6. Property Lines: Each property line shall be labeled, with deed bearings and distances shown in parenthesis, inside the applicable property line. If records do not include metes and bounds descriptions, the distances along the property lines shall be scaled to the nearest whole foot, labeled, and indicated as such by adding the letter "(s)", in parenthesis, after the scaled distance. All found field evidence for property lines and corners shall be shown and labeled. If the plan sheets are of a scale that does not allow for property lines to be clearly labeled, the bearings and distances may be omitted at the request of the Project Manager.

If a property line described in a deed follows the center of a road, or crosses or enters existing right of way, the property line should be terminated at the existing right of way.

Property line intersections with existing or proposed right of way lines or easement lines are to be identified and labeled by station and offset, set to the nearest foot. Only those points necessary to describe the property to be acquired need to be labeled.

Station and offset labeling of all points and lines should be clearly placed in an area where other text or symbols do not interfere with the legibility of the data. Station and offset labels should be located on the same side of the road as the point and labeled horizontally in the order of occurrence.

30.4.7. Subdivisions: All recorded subdivisions must be shown. Information to be shown includes name of the subdivision, street names, alleys, block numbers, lot numbers, etc. Lot lines, not designated as property lines, must be shown with a "land tie" designation in lieu of property line symbology. The deed bearing and distance of each lot line is to be shown in parenthesis, inside each property line. Lot numbers shall be shown in parentheses to differentiate them from parcel numbers. Special diligence is required for the determination of ownership of the streets, which may be owned by a homeowner's association. If such is the case, a parcel number shall be assigned to the street.

30.4.8. Existing Features: All existing above and below ground topography that may affect the value of a property shall be shown on the Right of Way Plan Sheets. These features include all those existing features listed under Property Maps (Section 30.3.4), plus the following:

1) Dwellings, barns, sheds, outbuildings, commercial buildings, industrial buildings and conveyors, walls, wells, etc. along with a label indicating type of structure and use.
2) Edge of roads, driveways, trails, and parking lots labeled with type of surface.
3) Property corner monuments (iron pins, concrete, etc.) and deed tract and/or lot numbers (in parenthesis).
4) Screened contour lines.
5) Forested areas.
6) Major trees and shrubs with size and name.
7) Sewage systems and sanitary sewer service mains and size.
8) Septic tank and drain or leach field.
9) Utility transmission and distribution lines, with company ID numbers (See Section 30.4.10).
10) Satellite dish antenna.
11) Parcel number for each private utility.
12) Bridges, culverts, and retaining walls.
13) Playgrounds and equipment that are affixed.
14) Potential hazardous material or sites and type.
15) Fences and retaining walls.

16) Advertising signs. Show owner's name(s) and permit ID number.
17) Private improvements that are not permitted within existing right of way are to be labeled "Encroachment".

30.4.9. Underground Storage Tanks and Hazardous Waste Facilities: Special attention is called to underground storage facilities since it is imperative that these improvements be shown on the plans to allow consideration of their value during preparation of appraisals. All underground storage tanks must be shown and identified as to the size, type and material stored therein, to allow timely testing of the immediate area for leakage and the identification of hazardous wastes. For specific guidelines see "Hazardous Waste", DD 302.

30.4.10. Utilities: The type, size, location, and company name and identification numbers of all private and public utilities, including service lines, which may be affected by project construction, are to be shown on the plans. Include those utilities providing service that lie in close proximity to the project right of way limits, but from which no acquisition is necessary. In the case of total takings in built-up areas, where it is obvious that all properties have full utility service, a note stating this fact may be used in lieu of placing the individual lines on the plans. Utilities located within easements or rights of way shall be shown along with the defined easement or right of way limits.

Properties not served by a public water supply may have water wells or springs as their sole source of water. These wells or springs, including any pumps and associated service lines, must be located and shown on the plans.

The disposition of utility transmission and distribution lines shall be specifically shown for each location. Use notes indicating disposition of the facility (Not required for RW-1 submissions), such as the following:
1) To be relocated by owner
2) To remain in service
3) To be abandoned in place
4) To be relocated by DOH

30.4.11. Proposed Construction Features: Proposed construction features will include all those listed under Property Maps (Section 30.3.5), plus the following:
1) Construction limits labeled cut (- C -) or fill (- F -).
2) Geometric curve data, centerline bearings and equations.
3) Label all P.I., P.C., P.T., T.S., S.C., C.S., S.T., etc.
4) Label centerlines and baselines to match construction plans.
5) Station and offset, to the nearest foot, for each corner or break in the right of way and easement lines.
6) Right of Way markers and fencing.
7) Demolition item numbers on all structures taken.
8) Pavement, curbs, sidewalks, drop curbs.
9) Sedimentation control ponds.

10) Drainage with type, size, length, flow direction and invert elevations.
11) Drop inlets, manholes, etc.
12) Ditches and channel changes with flow arrows.
13) Vehicle turnarounds.
14) High water contour, as applicable.
15) Major temporary features that are to be removed (such as sediment basins, temporary construction features, etc.) label "To Be Removed".

30.4.12. Proposed Structures: All proposed structures, such as bridges, culverts, pipes, guardrail, lighting, etc., are to be indicated on the plans to provide the appraiser with relevant information for determination of value. Appropriate high water elevation contours are to be shown for major drainage backwater.

30.4.13. Demolition Numbers: See DD-709 "Numbering of Buildings, Septic Tanks, Wells or other structures" for assigning an identification number to buildings, wells, septic tanks, and other affixed structures.

30.4.14. Sidewalks: In an urban area where a sidewalk is to be constructed as a part of the highway facility, careful consideration shall be given to the placement of the right of way line. If minimal change in the ground line topography is made, the right of way line may be placed two feet back of the sidewalk with adequate temporary construction easement shown beyond that line to allow sufficient room to construct the project. If significant changes are to be made on a permanent basis, then a normal placement of the right of way line outside the construction limits shall be made. The placement of all easements and/or right of way lines in urban areas shall be the result of a prudent study, giving consideration to the effects on the remaining property.

30.4.15. Fencing: Where fencing is included in the construction plans, it must also be shown in the right of way plans. Generally, the fence will run parallel with, and one foot inside, the controlled access line. Refer to the current "Fencing Controlled Access Highways", DD-309, for specific criteria.

30.4.16. Right of Way Markers: Right of Way markers are required whether or not fencing is used and shall be shown on the Right of Way Plan Sheets at the outermost corners of the proposed right of way lines. For example, if a right of way line is outside a controlled access line, only the right of way (or outermost) line will be monumented. Marker locations shall be indicated by the right of way marker symbol, as shown in the DOH symbol library as "RWM". Markers shall be placed at all right of way line breakpoints and changes in direction, except where physically impractical, such as on steep bluffs, in streambeds, etc. Markers are not required at the corners of permanent or temporary easements.

30.4.17. Railroad Property Acquisition: Railroad valuation centerline, with stationing, must be shown throughout the area of involvement. Each highway

station and offset must be equated to the railroad valuation station and offset for points on the railroad parcel. All surface drainage shall be shown as "Permanent Drainage Easement", and the area included in the "Total Taken" column. When establishing proposed right of way lines, within existing railroad right of way, the designer shall coordinate with the Railroad and Utilities Section of Right of Way Division concerning location and type of acquisition. If the area includes an existing railroad crossing or bridge, indicate the DOT number. The DOT number is on the signals or cross bucks for at grade crossings and for grade separation structures it can be found on the Bridge Inspection Report or by contacting the Railroad and Utilities Section of Right of Way Division.

30.4.17.1 Railroad Grade Separations: The area of the Permanent Aerial Easement shall not be included in the "Total Taken" columns of the Ownership Index. Surface drainage shall be shown beneath the aerial easement as "Permanent Drainage Easement", and the area included in the "Total Taken" column. All other permanent areas of right of way and/or easement shall be included in the "Total Taken" column. Piers and abutments shall be located on a permanent take.

On all controlled access projects involving railroad grade separations, the controlled access line will be carried across the railroad right of way and will be designated and marked as follows: "Controlled access line – aerial easement subject to railroad right of way."

30.4.17.2 Railroad Grade Crossings: The area of the "Permanent Crossing Easement" is to be included in the "Total Taken" column. Only the area of proposed PCE should be included in the "Total Taken" column. Existing PCE should not be included.

30.4.18. Division of Natural Resources (DNR): The Division of Natural Resources (DNR) acts as the titleholder of the beds and all the material beneath them for all navigable or floatable waters within West Virginia. DNR is the agency which provides right of entry or a right of way agreement for all construction activity in a stream.

When any roadway centerline of a project crosses over a stream, the DNR is to be shown as a titleholder on the Ownership Index. When right of way is obtained from an owner, on whose property is located a navigable, floatable, or named stream, the surface owner holds the interest in the surface, while the DNR holds the interest in the streambed. The streambed is normally defined by the normal pool elevation. The common area is to be included in both the DNR take and the surface owner's take and will have two parcel numbers assigned: one for the surface owner and one for the DNR.

The area over the stream that falls within proposed right of way is shown as "Permanent Easement" and any temporary take is shown as "Temporary

Easement". Each type of take is to be shown on the appropriate plan sheet(s) by a different hatch pattern and indicated on the sheet(s) by a legend identifying owner: State of West Virginia, Department of Commerce, Division of Natural Resources, stream name, Parcel Number, Tract Number (if applicable), and the type and area of take.

DNR easements are not required for areas within existing right of way.

30.4.19. Special Design Features: All items, not heretofore mentioned, which may affect negotiations with the property owner(s), or which may have a direct effect on the market value of the property to be acquired, shall be indicated on the plans. Such items may be walls, steps, etc., that are to be replaced or reconstructed as a part of the project.

30.4.20. Cemeteries: Every reasonable effort should be made to avoid cemeteries. All cemeteries, whether public or private, shall be shown, with the name of the cemetery, on the Right of Way Plan Sheets and the Property Maps. A Cemetery Detail Sheet (CADD Standards cell "CEMTRY_SHT", see Section 20.2) shall be added to the plans, following the Right of Way Plan Sheets. The cemetery location as shown on the Property Maps and Plan Sheets will be identified by the cemetery name and be tied by survey to the project centerline. A note will be added referencing the plan reader to specific sheets in the set of plans for a detail of the cemetery itself. This detail or individual plan of the cemetery will show the actual cemetery boundary and its relationship to the project centerline, construction limits and right of way lines. Temporary exhumation easements shall be shown if the right of way line divides cemetery plots and leaves parts of graves outside the take area, but still necessary for relocation.

A number shall be assigned to all existing graves that shall be located by survey and identified on the plan, complete with headstone and/or footstone. If no stones are in evidence, the gravesite itself shall be shown without identifying markers. In established cemeteries with burial lot layouts, all grave lots will be numbered according to the recorded maps regardless of whether it is occupied or not. The improvements around the cemeteries, such as fencing, walls, flag poles, etc., shall also be shown. Roadways, walkways, etc., will be included in the layout. The cemetery perimeter will be accurately located and shown on the plans. If the cemetery is suspected of having unmarked graves, a complete matrix probe, using a five-foot matrix interval or grid, of the cemetery and immediate surrounding area is to be performed.

For cemeteries with undefined perimeters, a cemetery limit line shall be set around the entire cemetery to allow proper documents to be prepared through eminent domain procedures to grant right of entry to the cemetery for matrix probe as well as exhumation purposes.

All known and unknown gravesites are to be numbered consecutively and

shown on the detailed cemetery layout. These numbers will also appear on an Interment Index (CADD standards cell "CEMTRY_SHT", see Section 20.2) complete with an identification of each decedent. The complete name of the decedent is necessary. If unknown, it shall be so noted. Intensive research shall be made to identify all unknown decedents. In addition, the Interment Index shall provide necessary columns for reinterment data for each grave, including columns for the name of the reinterment cemetery, location of the cemetery, date of reinterment, lot, block, section numbers, etc., also shown by sketch, or stated to be of record and where found. These indices shall be completed in the RW-4 submission. Samples of these indices are available in the Right of Way Division. Right of Way Division must be provided with all documentation of the research and findings for each cemetery, including copies of work diaries verifying efforts to identify unknown decedents. The survey books locating all graves shall also be submitted with the RW-3 plans. For additional information refer to the Right of Way Manual.

30.4.21. Federal Lands: Projects requiring the acquisition of right of way from an agency of the U.S. Government shall portray that proposed acquisition by procedures as outlined in the Federal-Aid Policy Guide. These procedures include, but are not limited to, the requirement of providing bearings and distances for the entire area to be acquired, whether right of way or easement. State Plane Coordinates may be required for all corners. A standard note listing the U.S. parcels to be transferred shall be placed on all sheets where those parcel numbers appear. Examples of U.S. agencies are U.S. Forest Service, U.S. Corps of Engineers, U.S. Department of Interior, etc.

30.5 Reference Point Sheet(s): Reference Point Sheet(s) shall be provided to allow layout of the centerline, and Right of Way Limits.

30.6 Geometric Layout Sheet(s): Geometric Layout Sheet(s), from the construction plans, shall be provided to aid in the layout of the Right of Way.

30.7 Typical Sections: Typical Section Sheet(s) shall be provided for the proposed mainline, detours, connector roads, frontage roads, access roads, relocated roads, driveways, etc.

30.8 Profile Sheet(s): Profile Sheet(s) shall be provided for all proposed mainline, detours, connector roads, frontage roads, access roads, relocated roads, driveways, bridges, etc. Profiles for bridges will show the abutments and piers and include the clearance information.

30.9 Cross Sections: Cross sections are not a formal part of right of way plans but a set is required with the RW-3 submission. See DD-202 for distribution.

40. SUBMISSION OF PLANS:

40.1. Submission Distribution: Submissions shall be in accordance with the "Plan Distribution Schedule" of the current design directive "Field And Office Reviews For

Initial Engineering And Final Design", DD 202,

40.2. RW-1 Plans: This submission is to be made as shown on the approved project CPM and as soon as the information below is assembled by the Designer. It normally occurs prior to the Preliminary Field Review. The submission may be requested in a roll format. All supporting documents shall be labeled with the state project number.

The following information shall be provided as a minimum:

a. Title Sheet: Showing project numbers, project name, layout map, latest signature block, and list of public utilities and railroads involved.

b. Ownership and Utilities Index: Include all parcel numbers, names of owners, deed or will references, and only "Parcel Total" areas are required.

c. Property Maps: Refer to Section 30.3, for required content. The proposed right of way lines shall be shown based upon the best information available at the time of submission. A Property Line Discrepancy Report is to be prepared when there are significant gaps and overlaps in property lines. The report should show how these discrepancies were resolved. Problems are to be identified, and the method of resolution presented. Information submitted should include weight given to conflicting evidence, and work plots of each parcel plotted per deed with **NO** adjustments are to be a part of the report.

d. RW-1 Plan Sheets: The proposed Right of Way Plan Sheets shall be provided with the following information.

- Existing Property Lines
- Existing Right of Way Lines
- Existing Topographic and Physical Features
- Preliminary Roadway Centerline with stations shown
- Major Contours

e. Right of Way Questionnaire and Supporting Documents: One Right of Way questionnaire and deeds/wills (current within 6 months), properly collated, are to be provided. Include copies of all plats or maps referenced in deeds. If a plat does not exist, make note "Not Found" on deed, adjacent to plat reference, and sign and date.

All supporting documents shall be sorted and combined into one pdf document with each corresponding questionnaire, with a file name indicating the project parcel number. Each severed parcel, i.e., Parcel 4-1 and Parcel 4-2, requires an individual questionnaire with all supporting data included.

A copy of pertinent subdivision maps, railroad valuation maps, and the appropriate tax map(s) are also to be included. Include existing right of way plans or documentation of the statutory right of way width, determined by existing plans and records.

After review, a pdf set of redlined (marked or highlighted) plans, indicating

corrections and additional information needed shall be returned to the designer. No additional writing is to be added to these redlined plans by the designer. This redlined set of plans is to accompany the RW-2 submission.

40.3. RW-2 Plans: The primary purpose of this submission is to enable the review of the right of way and easement limits, the effect of the project right of way on the properties and landowners, and to initiate abstracting of the affected parcels. It is necessary to label the stations and offsets of the right of way line breaks on this submission. The RW-2 submission shall be made after the slope review and in conjunction with the submission of preliminary field review plans.

This submission shall be in accordance with the "Plan Distribution Schedule" of the current "Field And Office Reviews For Initial Engineering And Final Design", DD 202, and shall include the returned redlined RW-1 plans. These plans are to be virtually complete in every detail, with the contents as listed in Section 20.3, including type and area of take, and area remaining. An electronic copy of the spreadsheet used to create the Ownership Index shall also be included as part of the submission.

The most important items on these plans are the centerline(s) and baseline(s), property lines, existing and proposed right of way lines, easement lines and construction limits, proposed major drainage structures, parcel and tract numbers, and property lines. The construction limits shall be accurately depicted, and all topographic features shall be current and verified as of the specified date of submission.

Within two weeks of the preliminary field review the District Right of Way shall provide markups and comments to the reviewer assuring all items of real value are identified, generally located correctly, and properly labeled for estimation and value determination, as well as verifying the correct owners have been identified and property lines, private utilities, accesses, etc. are shown properly. After reviews are complete, a pdf of the comments shall be provided by the Project Manager on one set of redlined (marked) RW-2 plans, indicating revisions and additional information needed. No additional writing is to be added to these redlined plans by the designer. These redlined plans are to be returned with the RW-3 submission.

40.4. RW-1 & RW-2 Combined Plan Submission: The Project Manager may choose to combine RW-1 and RW-2 submissions into one submission. When this combined submission is requested, all of the requirements for Sections 40.2 and 40.3 must be met. Generally, a combined RW-1 & RW-2 submission should not be used on large projects or projects where revisions are likely in the early phases of design. See Section 10.3.3 of this design directive for further guidance on utilizing a combined RW-1 and RW-2 submission. This submission is generally made at or prior to the Preliminary Field Review, however, it shall be in accordance with the approved CPM Schedule for the project.

40.5. RW-2 Revisions: After the RW-2 submission, but before the RW-3 is requested, changes that affect the number of parcels involved are to be forwarded with each affected sheet, consisting of a new reproducible; and a pdf highlighted in color, showing all changes

since the last revision. Revised sheets are to be identical size and borders of previous submissions. These revisions shall be forwarded with a transmittal letter listing and explaining the parcel changes or corrections, along with questionnaires and deeds for any added parcels. **After RW-2 plans have been submitted, no changes in parcel numbers will be allowed.**

40.6. Advanced Acquisition Plats: These plats may be requested by Right of Way Division to acquire "hardship case or protective buy" parcels. Examples of these plats and other required supporting documents are available from the Project Manager.

40.7. Whole Take Plans: Prior to the submission of RW-3 tracings, when it becomes obvious or apparent that a substantial number of parcels will be taken in total, RW-3 plats for "Whole Takes Only" for specific parcels may be requested to initiate the acquisition process. Such plans shall meet all criteria and requirements as listed below for an RW-3 submission.

40.8. RW-3 Plans: The purpose of this submission is to review property descriptions, perform appraisals, and begin acquisition of the right of way necessary for the project, and shall reflect the resolution of all RW-2 and final field review comments. The RW-3 Title Sheet shall be submitted with the seal of the designer. An electronic copy of the spreadsheet used to create the Ownership Index shall also be included as part of the submission. Property descriptions shall also be included with this submission. This submission is normally made prior to the Final Office Review; however, it shall be in accordance with the approved CPM Schedule for the project.

Where construction limits or right of way lines for a particular parcel are uncertain or unknown, omit the areas of take and remaining on the Ownership Index and show only the total area of the property. Place a "Hold Acquisition" note in the "Remarks Column" with the reason. In general, changes to right of way limits after the RW-3 submission are not acceptable.

40.9. R/W-3 Revisions: RW-3 Plan revisions should be held to a minimum since the appraisal and acquisition processes will have begun. Requests for changes to right of way limits by District or Central Office Right of Way staff should be approved by the District Right of Way Manager and the Director of Right of Way, as applicable, prior to consideration for plan revisions. **Verify with the Project Manager whether a particular parcel has been appraised or acquired before submitting revisions.** Revisions to the RW-3 plans shall contain one pdf of only the revised sheets and one pdf of only the revised sheets with the changes highlighted in color.

All revisions shall be forwarded with a transmittal letter listing and explaining, in parcel order or sheet number, the changes or corrections. Examples describing the area changes are available from the Project Manager. Revised sheets are to be submitted in the same pdf sheet size as the original submission.

When additional tracts are added as a revision to the RW-3 plans, the added tracts shall be placed in the proper order. The original tract numbering shall not be changed after an

offer has been made to the property owner. The status of acquisition can be obtained from the Project Manager.

40.10. RW-4 Plans: This submission is a full-size master set of right of way plans in pdf format and shall be submitted only after acquisition is essentially complete and will reflect the acquired right of way. This information can be obtained from the Project Manager and will be supplied upon request for the RW-4 plans. These plans shall be identical with the working RW-3 plans and the transmittal letter shall certify that these right of way plans agree with the construction plans in every aspect, with the exception of minor construction details. The RW-4 Title Sheet with the seal of the designer and current date shall accompany this submission. The remaining signature blocks shall be removed from the RW-4 Title Sheet.

This submission becomes the record set of "As Acquired" right of way.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 644
ASPHALT PAVEMENT
Insert Approval Date
Supersedes June 2, 2026

This Design Directive (DD) provides guidance on selecting asphalt pavement mix design methods and types of asphalt pavement. It also provides descriptions of situations that require polymer-modified asphalts, and methods for calculating quantities and types of materials that are to be used.

TYPES OF ASPHALT MIX DESIGNS

Marshall Asphalt Mix Design: Bruce Marshall developed the "Marshall" method of asphalt mix design in the late 1930's for the Mississippi Highway Department. This method has been used by the WVDOT since the 1970's.

Superpave Asphalt Mix Design: "Superpave" stands for Superior Performing Asphalt Pavements. It represents an improved system for specifying the components of asphalt concrete, asphalt mixture design and analysis, and asphalt pavement performance prediction. The Strategic Highway Research Program (SHRP) developed the Superpave asphalt pavement mix design method in the early 1990's.

ASPHALT PAVEMENT MIX DESIGN TYPE SELECTION

Superpave asphalt mixture types are to be used for the following type projects:

1. New construction of multilane divided highways where the mainline pavement is asphalt pavement.
2. Overlay or 3R type projects on existing multilane divided highways where the asphalt pavement overlay is three (3) inches or more.
3. Overlay type projects on existing National Highway System (NHS) highways where the asphalt pavement overlay is three (3) inches or more.
4. Projects on other highways were approved by the Deputy State Highway Engineer of Development or Operations.

Either Superpave or Marshall asphalt mixture types may be utilized on projects with design ESALs less than 3 million. Marshall Mixtures shall not be used on projects with greater than or equal to 3 million

SPECIFICATION SELECTION CRITERIA

There are three (3) specifications available when identifying the asphalt requirement for projects. Specifications Sections 401, 402 and 410 shall be used based on project criteria.

- Section 401 is the standard asphalt pavement specification, covering most roadways.
- Section 402 is utilized for roadways needing polish resistant aggregates to promote skid resistance. Section 402 shall be used for the surface course on projects with a current ADT of 3000 or more vehicles per day.

- Section 410, "Percent Within Limits", is a specification for use when there is a need for performance related results. This Specification uses mathematical models to quantify relationships between quality characteristics and product performance. These characteristics include mat density, asphalt content, bond strength and others, with samples taken directly from the roadway. Acceptance according to Section 410 (PWL) shall be limited to the top two (2) layers of the pavement, scratch and P&L do not count as pavement layers. Other materials below the top two (2) layers shall be accepted in accordance with Section 401.

Section 410 (PWL) of the Specification shall be used on the following project types:

1. New Construction where the mainline is asphalt pavement.
2. Overlay projects on existing multilane divided highways.
3. Overlay projects on any National Highway System (NHS) routes, as found on the Divisions website using the latest version of the "Annual Roadway Inventory Statistics".
4. Projects on other highways where approved by the Deputy State Highway Engineer of Development or Operations.

Additionally, a project must meet all of the following specific requirements for the use of Section 410:

1. The layer exceed 5,000 tons (scratch and P&L do not count as layers)
2. The overall width of asphalt equals or exceeds 20 feet in width
3. Project paving is continuous for a minimum of 1500 feet
4. Posted speeds greater than 35mph

Section 410 shall not be specified if cities or areas with a high density of utilities are within the project limits. The Specifications in Section 401 and 402 shall be used for all other projects.

DETERMINATION OF EQUIVALENT SINGLE AXLE LOAD (ESAL)

The "ESAL Calculator" program shall be used to calculate the projected design ESALs for all projects unless one of the following applies.

1. The "ESAL Calculator" program produces a value exceeding 10,000,000.
2. When a traffic study has been performed. (i.e. When traffic movements or traffic counts are provided by the Traffic Modeling and Analysis Unit of the Planning Division)
3. On roadway realignment projects that exceed 1000 feet of relocated roadway.
4. When there is an expected development in the area that may change or alter the nature or character of the expected traffic. (i.e. Shopping centers, schools, etc.)
5. The project is on the CRTS (Coal and Resource Transportation System).

The ESAL Calculator program can be obtained from the West Virginia Department of Transportation's Materials Toolbox website at ~~https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx~~ https://transportation.wv.gov/agencies/highways/divisions/materials-control-soils-and-testing-division/tool-box, then under the "Pavement" heading choose "ESAL Calculator".

When the ESAL Calculator program cannot be used to calculate the ESALs, then the

ESALs or the percentage of traffic in each of the 13 classes shall be obtained from the Traffic Monitoring Unit of the Traffic Engineering Division. The Traffic Monitoring Unit can be emailed at TMATrafficMonitoring@wv.gov. The designer is cautioned that the development of appropriate data to establish accurate ESAL estimates should be requested prior to the Design Study Office Review (if there is one) or prior to the Preliminary Field Review (if there was not a design study).

Projects shall show the projected design ESALs on the general notes and the typical section sheets showing the pavement details.

SURFACE PREPARATIONS

Milling is used to remove surface distresses, create a better bond for an overlay, restore cross slope, and maintain vertical geometric properties, such as bridge clearance, guardrail height, and grade with gutter area. Milling shall be the preferred method of correcting deviations to the road surface prior to resurfacing.

When milling is specified by the contract, the thickness of milling specified by the Designer shall be at least 1/4 inch into the layer just below the layer(s) being removed. The intent is to mill off entire layers, and not leave any partial layers.

Section 415 of the Specifications, *Milling of Asphalt Pavement Surfaces,* contains three (3) types of milling: Standard Milling, Fine Milling, and Micromilling. These are differentiated primarily by the carbide tooth spacing, typically 15, 8, and 5 mm respectively, resulting in finer textured surfaces. These milling types specify the final surface texture prior to any overlay. The following describes the conditions in which the designer should use each type of milling:

- Standard Milling: Used as the default milling of asphalt pavement. It is intended for general removal of existing asphalt pavement in preparation for resurfacing or overlay, or to restore pavement section to a specified depth. Standard milling is appropriate where high levels of profile and slope control are not required.
- Fine Milling: Used when the Division intends to overlay the milled surface with a two (2) inch or less asphalt course. It shall also be used when the contract contains pay items from Section 410 of the Specifications, *Asphalt Base and Wearing Courses, Percent Within Limits (PWL).* It is intended to be used when control of the profile and slope of the milled surface is important. Fine milling shall only be used if there is a minimum of 5,000 SY of fine milling.
- Micro Milling: Used for smoothness correction, skid correction, bump and/or grade corrections on existing or newly paved surfaces. This milling is typically less than one (1) inch. It is not intended to be used when additional asphalt will be placed on the milled surface.

If fine milling is needed and multiple milling passes are necessary, standard milling shall be used to cut down to one (1) inch above the final prepared surface. The designer shall document in the plans the estimated thickness of each type of milling.

ASPHALT MATERIAL (TACK COAT)

Asphalt Material (Tack Coat) (Section 408) shall be specified for placement on all existing pavement prior to placing asphalt pavement. If the designer can anticipate phased construction where part of the base or intermediate course will be open to traffic prior to final lift placement additional Asphalt Material should be included.

SCRATCH

Scratch Course is normally used in rehabilitation or resurfacing projects that do not contain a milling item. Scratch should be used to correct rutting and other deviations up to about one (1) inch when the milling operation will cause an unnecessary disruption to the traveling public. If milling is performed on the project, Scratch Course shall not be used.

Scratch Course can be placed over the entire project or to the limits established by the designer. If the Scratch Course is not to be placed over the full width of the project, it shall be specified full lane width increments. Although Scratch Course can be placed over the entire project, it is not a constant thickness layer. The term "Scratch Course" comes from the method of placement of this item. The paving equipment is set to drag on or “scratch” the high areas of the existing pavement, only depositing material in the low areas; thereby creating a smooth surface on which to place the next layer of asphalt pavement.

Scratch course may be specified as a 9.5 mm or a 4.75 mm mix. Scratch Course shall be shown on the plan typical sections as a line without a thickness or application rate. Scratch Course is not included in the structural design of the pavement.

Scratch Course shall not be used on new construction.

PATCH AND LEVEL

Patching and Leveling is to be placed at various locations throughout the project to remove irregularities in the existing pavement, such as dips, or to raise the outside edge of the existing pavement to provide a uniform template prior to placing a base or wearing course. Patching and Leveling shall not be specified as a continuous layer or course to be placed over the full width and length of the project.

Patching and Leveling shall be used only in resurfacing or rehabilitation projects, not in the construction of new pavements. It shall be specified when the deviations in the existing pavement are one (1) inch or greater in depth.

Patching and Leveling shall be shown on the plan typical sections as a layer with thickness specified as "variable - 2" maximum lift thickness. No application rate shall be shown. Patching and Leveling thickness is not included in the structural design of the pavement.

OVERBANDING LONGITUDINAL JOINTS

Longitudinal joint construction in asphalt pavements is a critical phase of construction. This affects structural integrity and results in premature failure of the asphalt pavements. Overbanding makes joints less susceptible to deterioration from water and other external factors.

Longitudinal joints shall be overbanded using PG 64S-22 binder. Plan documents shall require a minimum of six (6) inches in width (three (3) inches on each side of the joint), centered over the joint, at a thickness of 1/16 inch, in accordance with Section 403.8 of the Specifications. Overbanding of constructed joints is a separate bid item and shall be included in the plans and quantities.

Projects meeting the criteria for Specifications Section 410 shall not require overbanding.

PERFORMANCE GRADED (PG) BINDER TYPE SELECTION

Binder Selection will be based on the design ESAL estimate for all projects.

Binder	ESALs
PG64S-22	<20 million
PG64H-22	20 million — 30 million
PG64E-22 (Polymer Modified Binder)	>30 million (See PMA Section)

While rare, for colder areas of the state, a lower binder grade of PG 58S-28 may be appropriate. If unsure, the designer can contact the Asphalt Section of Materials Control, Soils, and Testing Division at DOHasphalt@wv.gov.

The binder grade shall be provided on both the general notes sheet and the typical section sheet(s) showing the pavement details.

PG 64S-22 binder may be used in asphalt placed below the top two (2) lifts in any pavement section. Scratch course and patching and leveling are not identified as lifts. PG 64H-22 and PG64E-22 shall not be used in Marshall mix designs.

Polymer Modified Asphalts (PMA) or Non Standard Grade: The binder PG 64E-22, which is a polymer-modified binder, is required to be used in the following cases:

1. Projects estimating more than 30 million ESALs.
2. For the surface lift on roadways facilitating access to industrial parks, warehouses, production facilities, etc.
3. High Performance Thin Overlay (HPTO) asphalt pavement in accordance with Special Provision 496.

A binder grade associated with a higher ESAL count may be used, at the discretion of the Engineer, on projects where the pavement exhibits severe rutting or shoving problems due to heavy traffic conditions, such as:

1. Intersections with very heavy truck traffic
2. Truck climbing lanes and ramps

PMAs have shown great success as being a long-term solution to severe rutting problems. Due to the additional cost of a PMA, it shouldn't be used on any project without first repairing base failures and removing excessively rutted pavement. PMA shall generally be used only in the skid surface mix (preferably a 12.5 mm mix) but may also be used in the underlying courses depending on the severity of the traffic conditions. Always use the preferred thickness from the Superpave asphalt pavement recommended lift thickness tables as a minimum thickness when using PMA. Any mix design to be used as a scratch course shall not be specified to use PMA.

PMA Pavement quantities shall be used in increments of 400 tons due to minimum requirements necessary for ordering of material.

PAVEMENT STRUCTURE

Bottom Courses: When developing the overall pavement thickness, it is recommended the designer use 25 mm mix as the bottom lifts. When a 25mm mix is to be used on a Section 410 (PWL) project, acceptance of the 25mm layer(s) shall be in accordance with Section 401.

Intermediate Courses: On new construction or multi-lift projects a Superpave 19mm or Marshall Type 2 base mixture shall be utilized below the surface course to promote smoothness in the final pavement.

Surface Courses: The wearing course is a single constant thickness layer to be placed over the entire pavement surface. The wearing course is the riding surface on which traffic travels. A Superpave 4.75 mm, 9.5mm, or 12.5mm or Marshall Type 1 or Type 3 Wearing mixture is the mix type to be used as the surface course. PMA can also be used if traffic warrants. A Marshall Type 4 Wearing is intended for use in heavy truck traffic situations, note that a wearing 4 is a visually coarse mixture.

Section 402 shall be used for the surface course on projects with a current ADT of 3000 or more vehicles per day. Only Superpave 9.5mm and 12.5mm mixtures and Marshall Type 1 and Type 4 wearing mixtures shall be specified as a skid resistant mix.

A Wearing 3 or 4.75 mm mix shall only be used for pavement preservation applications or as a surface course over an intermediate course in multi-lift applications. High performance thin overlays shall be used for pavement preservation on roads with ADT of 3000 or more vehicles per day.

LIFT THICKNESS RECOMMENDATIONS

The following table provides a list of Mix Type recommendations for the designer to use when preparing pavement lift thicknesses for the typical section. Pavement designs provide an overall thickness of asphalt pavement and the designer is generally left to make the decision on bottom, intermediate, and surface course thickness. The designer should use recommendations found in the Pavement Structure section, as well as minimum and maximum thicknesses from the table.

For Marshall Base Courses, it is recommended that in multi-lift pavements when Type 1 Base Course is used, an intermediate course (the top lift of base course) be a Type 2 to improve the smoothness of the finished pavement. This would eliminate the use of a Scratch Course prior to placing the surface course.

Recommended Lift Thickness for Asphalt Pavement				
Marshall Mix Type	**Superpave Mix Type (mm)**	**Minimum (inches)**	**Maximum (inches)**	**Preferred[Note1] (inches)**
Wearing 3	4.75	5/8	1	5/8
Wearing 1	9.5	1.5	2.0	1.5[Note2]
-	12.5	2.0	2.5	2.0
Wearing 4/Base 2	19	2.25	3.5	2.5
-	25	3.0	4.0	3.5
Base 1	-	3.25	5.0	4.0

Note 1: Minimum Thickness with Polymer Modified Binders
Note 2: l½ inch thickness on resurfacing projects where the Wearing Course is the only asphalt pavement material being placed exclusive of Patching & Leveling and Scratch Courses.

PLAN REQUIREMENT

Projects will show the 20-year projected design ESALs on both the general notes sheet and the typical section sheet(s) showing the pavement details. This includes new construction, reconstruction, AND resurfacing projects (including ALL bridge replacement projects regardless of the length of pavement placed). The design ESALs shall be shown for the mainline and all other affected roadways where more than 500 feet of pavement is being placed.

The aggregate used in asphalt mixtures can be either primarily stone and gravel, or slag. The aggregate used is up to the Contractor, and typically depends on what the Contractor has readily available that also meets mix requirements. Mixes with the two (2) aggregate types have different densities; as such, estimated weight quantities will be different for mixes with each aggregate type. Alternates for these two shall be listed in the plans, and the Contractor will bid appropriately.

The following is an example of how to list alternate asphalt pavement items in plans:

BB1 401001-042 SUPERPAVE ASPHALT BASE CRSE, SG, TY 25, TN
BB2 401001-043 SUPERPAVE ASPHALT BASE CRSE, S, TY 25, TN

QUANTITY ESTIMATING

Asphalt Pavement: The quantity for asphalt pavement shall be estimated at 1.98 ton/cy for stone and gravel mixes, 1.89 ton/cy for slag mixes and 2.10 ton/cy for steel slag mixes.

Patching And Leveling: The quantity for Patching and Leveling Course shall be estimated by multiplying the nominal depth of the irregularity to be repaired plus 3/4 inch by the irregularity's surface area. Then the conversion rates of 1.98 ton/cy for stone and gravel mixes, 1.89 ton/cy for slag mixes and 2.10 ton/cy for steel slag mixes will be utilized.

Scratch Course: The quantity for Scratch Course shall be estimated at a thickness of 1/2 inch (0.028 ton/sy) for the entire area to be covered with Scratch Course. If the Specification allows, Scratch Course may alternatively be estimated by the square yard. Scratch Course shall not be used if there is Milling on the project, or if there are more than two lifts of asphalt being placed.

Asphalt Material (Tack Coat): The quantity for Asphalt Material (Tack Coat) shall be estimated using the undiluted rates as indicated in Table 408.11 in the Specifications. No application rate will be shown on the typical sections.

Smoothness: If a project meets the requirements of subsection 720.6 of the Specifications, smoothness testing shall be requested by the designer through the Request Form available at MCS&T's Tool Box at ~~https://transportation.wv.gov/highways/mcst/Pages/tbox.aspx~~ https://transportation.wv.gov/agencies/highways/divisions/materials-control-soils-and-testing-division/tool-box. If the test results are available, the results shall be included in the PS&E submittal. If not available, then the request for testing shall be included in the PS&E submittal. If the results arrive before letting, then the results shall be included in an amendment. If too late for an amendment, then the results shall be provided to the District Construction Engineer.

SPECIAL SITUATIONS

General: The Specifications have been written to account for the majority of the situations that would occur during construction. However, there are always special situations that require the designers' attention.

Specification requirements shall only be altered after careful consideration and when, in the opinion of the designer, there is no practical way for the work to be performed in accordance with the Specifications and a project specific special provision shall be developed as outlined in DD-105.

Compaction: The specification density requirement in the Specifications shall not be modified when asphalt pavement is placed at normal paving widths. It is possible that asphalt pavement will be placed in certain areas of the project where densities of this magnitude cannot be obtained. These areas usually have an irregular shape, which will not allow the proper use of compaction equipment. Listed below is a situation where the density specification may be modified by plan note and the plan note to be used.

Situation	Plan Note
Concrete pavement repair Note3	Compaction testing shall be in accordance with the Lot-by-Lot method and the rollerpass method shall not be used for acceptance testing for compaction. The Engineer may reduce the target density requirement if the Contractor has made every reasonable effort at obtaining the required density.

Note3: If the proper density is not obtained during placement, traffic will continue to compact the asphalt pavement in the pavement repair area, causing additional settlement. This will be very noticeable because the surrounding overlay will be placed on the existing concrete pavement, which is rigid and will not settle.

When overlaying Portland Cement Concrete Pavement (PCCP) the concrete is sometimes in need of repair. Whether this is an initial overlay or a subsequent overlay, the designer shall examine the extent of the needed PCCP repairs and evaluate whether to repair with Patch and Level, to perform proper concrete pavement repairs, or to remove the PCCP through rubblization or another process prior to the asphalt overlay. The use of Patch and Level is restricted to those projects with a few shallow repairs when the cost of mobilization for concrete repairs is high. PCCP removal should be considered only when the existing pavement is extremely distressed. In addition to compaction, consideration shall be given to smoothness, temporary traffic control, and long term impacts to the traveling public.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 701
CONTRACT PLAN PRESENTATION
Insert Approval Date~~*June 4, 2025*~~
Supersedes ~~*October 1, 2020*~~ *June 4, 2025*

This Design Directive describes the make-up and presentation of a complete set of contract plans to standardize the production of such plans throughout the Division of Highways. All directions contained herein will apply to contract plans developed by all Central Office Divisions, including plans developed by consultants, and all Districts. It should be noted that other Design Directives, the Drainage Manual, the Bridge Design Manual, and Traffic Engineering Directives are referenced in this document that pertain to similar subject matter and are more precise than these guidelines. Those manuals provide clearer understanding of what should be included in each set of contract plans.

This Design Directive prescribes the order that the different types of sheets required within the contract plans are to be placed, and generally prescribes the content of each type of sheet.

Not all sheets discussed herein are required for all projects. This determination will be made by the Division's Designer or Project Manager, and is dependent on the type, size, and complexity of the project.

All of the referenced publications are available on the Division's web site, at this URL: ~~https://transportation.wv.gov/highways/engineering/Pages/publications.aspx~~ https://transportation.wv.gov/publication-group. Other links are given for CADD Standards and plan presentation information described in this document.

I. GENERAL

The submission of digital plans meeting the below criteria is strongly encouraged and in many cases is required by the consultant agreement.

Contract plans are sheets or drawings which show the locations, character, and dimensions of the prescribed work, including layouts, profiles, cross sections, and other details.

Contract plan sheet originals shall be 22" x 34" including borders of 1" on the left and ½" for the other three. Preliminary submissions of Design Reports shall be assembled and bound into sets not to exceed 36" x 48". Roll plans or profiles will not be accepted.

When only a few sheets for a special purpose are submitted, they shall be folded to 8½" x 11" or 8½" x 14". Small paving projects may be submitted on 8½"x 11"

All plans including review plans shall be prepared in such a manner that they can be reduced to quarter size (¼ area and ½ scale – commonly referred to as "half-sizes") by the Division. Quarter-size prints may be submitted for review. When quarter-size prints are submitted, they are to be accompanied by at least one full-size set, unless waived by the Division of Highways.

The use of contract plan sheets with existing contours and topography 60% screened is required unless waived by the Division of Highways. This also applies to Right of Way Plans.

CADD standards developed by the Engineering Division shall be used in the development of all contract plans. These standards are available on the Division's website at: ~~https://transportation.wv.gov/highways/engineering/Pages/Details.aspx~~ https://transportation.wv.gov/agencies/highways/divisions/engineering/CADD .

II. ORDER OF SHEETS WITHIN THE CONTRACT PLANS

The order of the sheets within the contract plans will be as follows. A general description of information that is required on each type of sheet follows in Section IV of this Design Directive. Note that not all types of sheets shown and described below are required in each set of contract plans, dependent on the type, size, and complexity of each project. Also, some of the different types of sheets may be combined; for instance the Survey Reference Points sheet may be combined with the Geometric Layout sheet on smaller projects.

1. Title Sheet
2. Typical Sections and Details
3. Summary of Estimated Quantities
4. Quantity Tables
5. General Notes
6. Environmental Permit Impact Commitments (EPIC) Sheet
7. Special Details and Approved Special Details
8. Mass Haul Diagram
9. Survey Reference Points
10. Geometric Layout
11. Superelevation Tables and Diagrams
12. Interchange Grading Plans
13. Intersection Details
14. Temporary Traffic Control Plans
15. Plan and Profile Sheets
16. Drainage Detail Sheets
17. Utility Relocation Plans
18. Erosion And Sediment Control Plans
19. Environmental Mitigation Plans
20. Traffic Sketch Maps
21. Pavement Marking Plans
22. Signing Plans
23. Lighting Plans
24. Traffic Signal Plans
25. Ownership Index
26. Property Maps
27. Soil and Geologic Information Plans
28. Structure Plans per Order of Station
29. Cross Sections

III. DEFINITIONS

A. Contract Plans. Defined in Section IV. below.

B. Standard Details. Drawings approved for repetitive use showing details to be

used where appropriate. Included are Revised Standard Details that are to be referenced by revision date as appropriate.

C. **Special Details.** Modifications to a Standard Detail drawing, or any detail drawing required to describe an item of work not covered by a Standard Detail drawing.

D. **Approved Special Details,** Drawings approved by the Publications Committee and any other committee with authority, e.g. the Roadway Departure Task Force, and concurred with by the FHWA. Approved Special Details must be individually inserted into the plans.

E. **Standard Specifications.** A book of Specifications approved for general application and repetitive use. The base document upon which all contracts rely.

F **Supplemental Specifications.** Approved additions and revisions to the Standard Specifications.

G **Special Provisions.** Specifications for specific items or details applicable to the individual project and which are not covered in the Standard or Supplemental Specifications. All special provisions must be approved by the Specifications Committee of Contract Administration Division.

H **Temporary Traffic Control Plan**. A plan for handling traffic through a specific highway or street work zone or project.

IV. CONTRACT PLANS

A. **General.** Contract plans (hereinafter referred to as "plans" or "contract plans") are instructions using drawings containing engineering data and details pertaining to geometrics, drainage, structures, soils and pavements, and other appurtenances.

1. Plans should not encompass material that is properly a part of the Standard or Supplemental Specifications, Special Provisions, or Standard Details.
2. The original drawings should be on standard sheets conforming to modern, accepted drafting practices, current DOH CADD Standards, aerial photograph base maps, or other DOH accepted practices. See the description under the "GENERAL" heading above for more information.
3. Straight-line plans may be used provided they give sufficient information to properly complete the project.
    a. Straight-line plans are particularly adaptable to special types of projects such as those for minor emergency relief, safety improvements, resurfacing, restoration, and rehabilitation and pavement marking.

b. A typical set of straight-line plans consists of only that information necessary to describe the type of work and its limits, such as:
   1) General plan, sketch, or line drawing;
   2) Cross section, if appropriate;
   3) Estimate of quantities;
   4) Tabulation of construction items, providing station and offset, and elevation (if needed);
   5) General notes; and/or
   6) Special details.

B. Standard Details. Standard details are used to reduce the number of drawings required to be supplied for each project and provide uniformity of design and construction where the details are the same from project to project. When modifications to standard details are made and intended for use on most projects, Revised Standard Details will be issued by Engineering Division. When modifications to standard details are necessary for a specific project, special details should be prepared, properly describing the work, and included in the project plans.

C. Contract Plans. Contract plans show the details, dimensions, and other information that are necessary to construct a specific project and should be tailored to provide all information necessary to accomplish the work in an orderly manner.

1. Title Sheet. The Title Sheet should show in a convenient arrangement:
   a. Project Name and Construction Project Number(s);
   b. A location sketch with sufficient identifying information so that the project may be easily located on a county or state map;
   c. Project Length, split into roadway and bridge(s) lengths, and then totaled. Note that projects which do not contain any paving, such as Grading and Drainage projects, will have a zero Project Length, however mainline Begin and End Work stationing shall be tabulated;
   d. A project layout, showing the proposed centerlines, Begin and End Project and Work stationing, all Station Equations, and numerical designations of all roadways to be constructed in the project. The Project Length will be that of the mainline only, sideroads and ramps are not to be included in the Project Length;
   e. A detail or group index of the sheets in the set of plans;
   f. The conventional symbols employed;
   g. Design designation (average daily traffic for the year that the project is to be constructed and the design year (usually 20 years after the construction year); design hour volume, directional distribution, and percent trucks in the design year; and design speed);

h. Federal-aid project designation, if applicable;
i. A provision for the dates and signatures of the appropriate approving officials (See DD-702 for examples);
j. All approved design exceptions shall be noted on the title sheet.

2. Typical Sections and Details. Typical Sections are to be placed on the sheet(s) immediately following the Title Sheet, except that on combined roadway and bridge projects the cross section for the bridges may be shown with other bridge plan information.

a. Typical Sections should be included in plans for all projects. Typical Sections shall be provided for all roadways to be constructed in the project, including the mainline roadway, all sideroads, ramps, and driveways.

b. All functional elements should be shown to a convenient scale including:

1) All different slopes of cut and fill with references to the cross sections for slopes not shown;
2) The width of the roadway traveled way, shoulders, and median;
3) The shape of the finished surface and shoulders (cross slopes including breakovers, and ditch foreslopes and backslopes, according to DD-601);
4) Curb and gutter, if part of the design;
5) All integral parts of the surfacing and shoulders including, as appropriate, subbase, base course, and surface course.;
6) Limiting locations where each Typical Section is to be used;
7) Ultimate Typical Section for stage construction project;
8) Thickness of each lift for each element of the surfacing system;
   a) Where variations in surfacing or base thickness are proposed because of differing soil conditions or other reasons, such variations should be in tabular form, including station limits for each thickness,
   b) In instances in Subparagraph a) above, the typical section need show only that varying thicknesses are to be employed,
   c) See DD-644 for appropriate asphalt layer thicknesses.
9) Relation between either proposed or ultimate status and a control survey line and profile grade line;
10) Lateral location of profile grade line (grade point);
11) Typical Details required to properly describe any work that cannot be clearly depicted on the Typical Sections, such as HMA edge stepping details, median barrier details, shoulder breakover and pavement layer thinning

details, etc.

3. Summary of Estimated Quantities
   a. The Summary of Estimated Quantities for the entire project is to appear on separate sheets following the Typical Sections.
   b. If more than one category of funds is required for a project, the quantity of each item required for each category should be identified separately and then combined for bidding purposes.
      1) See DD-805 for guidance on quantities for projects which cross boundaries between municipal and non-municipal areas.
      2) A state-by-state breakdown is to be provided where a project crosses state lines using a manner similar to municipal boundaries as described in DD-805.
      3) Non-Federal-aid work included as part of a Federal-aid contract should be identified separately.

4. Quantity Tables
   a. These sheets will tabulate all construction items such as drainage, signing, guardrail, earthwork, pavement, underdrain, and all other items in a table format showing station and offset for the location of the item. This is desirable on projects to assist in identifying locations where the specific item is to be installed. The municipal/non-municipal, county-by-county, and state-by-state station locations are to be indicated in these Tabulation of Quantities tables, and quantities computed using these station as breakpoints. See DD-805. Earthwork will be computed by the cross sectioning method.

5. General Notes
   a. A table referencing Revised Standard Details will be included when necessary.
   b. See DD-704 for information concerning General Notes to be included in the contract plans.

6. Environmental Permit Impact Commitments (EPIC) Sheet:
   a. The EPIC Sheet serves a crucial role in the integration of environmental compliance into construction planning. By including the EPIC sheet in construction plans, project developers ensure that environmental commitments from the NEPA and permitting processes are properly tracked and incorporated into the project lifecycle.

7. Special Details
   a. Details not incorporated into the current approved Standard Details or Revised Standard Details are to be added to the

contract plan assembly as Special Details.

b. Special Details should be prepared and included, as necessary, to properly describe any items of the work not covered by an applicable Standard Detail or Revised Standard Detail.

8. Mass Haul Diagram Mass Haul Diagram

See DD-705 for information concerning the preparation of the Mass Haul Diagram.

9. Survey Reference Points Survey Reference Points

a. Aerial Photography Control: This sheet will show all Survey Reference Points which were set and utilized by the Designer to survey and set up the aerial photography control for the project. See DD-810 and the description in 8.b. below for more information concerning Survey Reference Points for aerial photography control.

b. Conventional Surveys: This sheet will show all Survey Reference Points utilized for conventional surveys and aerial photography surveys. These Reference Points shall be shown individually, with a description of the point shown (hub and tack, ¾" rebar with cap, etc.). Each Survey Reference Point is to be referenced from at least three other points for future recovery or resetting of the point. Distances to the references are to be obtained and shown, and the references described (RR spike in power pole, "X" cut on sidewalk, etc.). Also, coordinates in the North (N), East (E), and Elevation (Z) format are to be indicated for each Survey Reference Point. The West Virginia State Plane Coordinates System is to be utilized, when this information is available.

10. Geometric Layout Geometric Layout

a. A separate Geometric Layout sheet(s) shall be provided depicting the following:

1) Construction centerline of the mainline roadway, intersecting roads, side roads, and interchanges.
2) Description blocks coinciding with the project description.
3) Equalities with symbols similar to plan sheet symbols.
4) Horizontal curve data for all curves, to include PI station, delta angle, radius (note that degree of curvature is not necessary), length of curve, length of tangent, and superelevation on circular curves; and on spiraled curves, spiral angle and spiral length, tangent offset and tangent distance, spiral offset from tangent and spiral distance on tangent, long spiral tangent and short spiral tangent, and spiral length of chord.
5) Stationing and bearings. Typically, centerlines and bearings are to be shown running south to north and

west to east. However there are some existing roads in the State that run opposite from that convention as shown on the Straight Line Diagrams. In this case, the direction of the centerline stationing and bearings shall match that shown on these Diagrams.

6) Coordinates for all horizontal control points, such as Begin and End Project/Work stations; horizontal curve TS, SC, CS, ST, PC, PT, etc. points; intersecting centerlines and/or baselines points; or other pertinent points required to properly lay out the project by survey, shall be given, with North (N), East (E), and Elevation (Z) format. The West Virginia State Plane Coordinates System is to be utilized, when this information is available. This information can be shown in table format, if necessary.

11. Superelevation Tables and Diagrams

See DD-603 for information concerning superelevation tables and diagrams.

12. Interchange Grading Plans

See DD-623 for information concerning interchange grading plans.

13. Intersection Details

See DD-622 for information concerning the requirements for intersection details.

14. Temporary Traffic Control Plans

See DD-681 for guidance concerning the preparation of Temporary Traffic Control Plans.

15. Plan and Profile Sheets

a. General. Plan and profile sheets should be prepared at a scale adequate to show the necessary details as governed by the topography and the complexity of the work.

1) Plans should be drawn to one of the following horizontal scales: small - 1"=100', medium - 1"=50', large - 1"=20' or 1"=10', depending on the density of information to be shown on the plan sheets. The small scale of 1”=100’ is only to be used for design studies, and not for contract plans.

2) Profiles should be drawn to the same horizontal scale as the plan, but the vertical scale may be 10% or 20% of the horizontal scale.

b. Plans

1) The general highway plan should include:

a) The base line of the survey which, if practicable, should also be the centerline of the proposed

roadway;

i) When the centerline and the base line are not coincident, their relationship should be indicated,

ii) Divided highways, where independent base lines are used, may be treated as separate roadways indicating only the general relationship between the two,

iii) Special areas such as interchanges and safety rest areas should be shown with separate survey control lines, as necessary**.** Control lines on ramps are to run in the same direction as the centerline of the proposed roadway regardless of the direction of traffic flow,

iv) Bearings on all tangents based on the West Virginia Coordinates System, when this information is available.

b) Stationing reading from left to right including equations of stationing;

c) Design data of curves, to include PI station, delta angle, radius (note that degree of curvature is not necessary), length of curve, length of tangent, and superelevation on circular curves; and on spiraled curves, spiral angle and spiral length, tangent offset and tangent distance, spiral offset from tangent and spiral distance on tangent, long spiral tangent and short spiral tangent, and spiral length of chord;

d) Proposed and existing rights of way and access control lines, easements, and special-use areas;

e) North arrow and bar scale;

f) Proposed and existing edges of pavement and shoulders;

g) Proposed and existing drainage features such as pipes, culverts, headwalls, manholes, inlets, etc., with the elevations of the top and all inverts shown;

h) Topography, existing streams with direction of flow indicated, railroads with the valuation baseline and stations shown, and other features such as existing roads, streets, and airports on or near the right of way when these items influence the proposed construction. Adjacent roadway shall be shown for 1000' - 1500' on major projects

and for 500' - 1000' on minor projects at both the beginning and end of the project. Existing roadways and streets shall have a centerline with stationing established and shown on the plans, and the relationship of this centerline to any proposed centerlines is to be shown;

i) Incidental construction items such as erosion control provisions, guardrail, and retaining walls;

j) Amount and volume of materials available at known sources;

k) Existence of and disposition of all public utilities, buildings and appurtenant items, and any other obstruction or encroachment within the right of way or adjacent thereto if affecting the proposed construction. See DD-709 for information concerning buildings and appurtenant items disposition, DD-303 and DD-310 for information concerning railroad involvement and utility relocations, and DD-305 concerning water and sanitary sewer relocations;

i) If not part of the project, their disposition should be included in the project records,

ii) If part of the project, the plan should show the present and, if applicable, the proposed location including both horizontal and vertical positions and such additional details as may be needed to indicate the scope of work to be performed.

l) It is to be noted that on complex projects, a reference sheet showing the layout of the plan sheets and/or cross section sheets is desirable to facilitate the use of the plans.

c. Profiles

1) Profile grade represents the trace of the vertical plane intersecting the top surface of the wearing course, base course, or other surface along the designated profile grade line.

2) The existing ground line should represent the trace of a vertical plane intersecting the present traveled way or ground line along the designated centerline.

3) Profiles should show:

a) Proposed grade and existing ground lines;

i) When standard plan and profile sheets are used, surface elevations may be omitted and grade elevations shown at changes or gradient only,

ii) When plan sheets are used, grade and existing ground elevations should be shown,

b) Datum line;

c) Station ordinate lines;

d) Percentage of gradient;

e) Vertical and horizontal clearances and the cross section of the roadbed for railroads, highways, and stream beds under proposed and existing structures;

f) Identification of type and clearance under and over utility lines within the right of way;

g) Culverts, storm sewers, and underdrains.

h) Vertical curve data, to include the vertical PI station and elevation, vertical curve length, k value, and stopping sight distance available on crest vertical curves.

i) Cut/fill grading transition details. See DD-405, "Grading Transition Detail".

16. Drainage Detail Sheets

a. Minor Drainage Facilities - Minor drainage facilities shall be defined as straight culverts less than 36" in diameter, erosion control structures, headwalls, inlets, and manholes. Detail plans for minor drainage facilities shall include the following (refer to the most current edition of the WVDOH Drainage Manual for more guidance concerning information to be shown on the contract plans):

1) Sufficient stationing and offsets to show the location and orientation to centerline.

2) All necessary elevations.

3) The intersection of straight culverts less than 36" in diameter with the centerline and each station shall be shown on the profile sheets and each affected roadway cross section.

4) Separate cross sections for structures such as sediment dams or sediment ponds.

b. Major Drainage Facilities - Major drainage facilities shall be defined as any culvert which has bends, culverts 36" in diameter or greater, and channel changes. Detail plans for major drainage facilities shall include the following (refer to the most current approved edition of the WVDOH Drainage Manual for more

guidance concerning information to be shown on the contract plans):

1) Sufficient stationing and offsets to show the location and orientation to centerline.
2) All necessary elevations.
3) A profile along the centerline of the culvert or drainage structure showing the relationship between the existing ground line, proposed template, and the culvert or drainage structure, total length of the culvert or drainage structure, all necessary elevations, and utility locations.
4) The intersection of culverts or drainage structures with the centerline and each station shall be shown on the profile sheets and each affected roadway cross section.
5) Separate cross sections for culverts or drainage structures when the cost of excavation is not included in the cost of the culvert or drainage structure.

If all of the information listed above is shown elsewhere in the plans (plan sheets, profile sheets, standard details, etc.), separate detail plan sheets will not be required.

c. Storm Sewers – storm sewers are defined as a composite system of one or more sections of pipe or box culvert, or a combination thereof, generally connecting a series of inlets or manholes. Storm sewers are different from culverts in that they are usually longer and pick up additional water from inlets and intersecting storm sewers along its length. Refer to the most current edition of the WVDOH Drainage Manual for more information.

1) A profile of each storm sewer is required to be shown. This profile can be shown on its own profile sheet, or can be combined with the roadway profile sheets when the sewer runs along the centerline of the roadway (usually multilane divided roadways).
2) The hydraulic grade line developed in the drainage calculations should be shown on each storm sewer's profile.

17. Utility Relocation Plans

See DD-303, DD-305, and DD-310 for information concerning Utility Relocation Plans.

18. Erosion And Sediment Control Plans

See DD-250, "Dust Palliative" and DD-251, "Temporary Erosion Control".

19. Environmental Mitigation Plans

Commitments for environmental mitigation features which are contained in the environmental documentation should be detailed as necessary and included in the project plans as special details and/or

shown at the appropriate location in the plans. These plans will also include any necessary stream relocation plans, special planting plans, and any other plans deemed necessary to adhere to the environmental commitments made for the project. Also see DD-252, "Environmental Mitigation Items".

20. Traffic Sketch Maps
See DD-802, "Traffic Sketch Maps" for information.

21. Pavement Marking Plans
See the 300 series Traffic Engineering Directives for guidance concerning the preparation of Pavement Marking Plans.

22. Signing Plans
See Traffic Engineering Directive 103-3, "Preparation of Contract Sign Plans".

23. Lighting Plans
See Traffic Engineering Directives 101, "Guidelines for Highway Lighting" and 102-3, "Roadway Lighting Design".

24. Traffic Signal Plans.
See the 400 series Traffic Engineering Directives for guidance concerning the preparation of Traffic Signal Plans.

25. Ownership Index
See DD-301 for information concerning the preparation of the Ownership Index.

26. Property Maps
See DD-301 for information concerning the preparation of Property Maps.

27. Soil And Geologic Information Plans
    a. Location of borings, test pits, or other sites where subsurface investigations have been made are to be shown on the Soil and Geologic Information Plans; and
    b. Location and depth of subsurface borings or test pits shall be shown (actual log or test results need not be shown, but a reference should be included indicating where this material may be viewed).

    Also see DD-402 for more information concerning the preparation of Soil and Geologic Plans, and their inclusion into the contract plans..

28. Structure Plans per Order Of Station
Reference is made to Section 4, General Plan Presentation, of the latest approved edition of the West Virginia Division of Highways Bridge Design Manual and all addendums thereto, for guidance concerning

information required on each sheet of each set of structure plans.
The structure detail plans are to be placed in the contract plans in the order of stationing, with the structure at the lowest station first, and so on. Structure plans shall be placed in the following order: bridge(s) first, followed by retaining wall(s), with box culvert(s) last.

29. ~~2~~Cross Sections
    a. Cross sections shall be at a natural scale, i.e. the vertical scale will equal the horizontal scale.
    b. Cross sections should be taken every 50' for rural projects, every 20' for urban projects, and at major changes in the existing ground line to determine accurately the character and extent of the proposed work.
    c. Intersecting road cross sections, side road cross sections, and ramp cross sections shall be shown on mainline cross section sheets where possible. Where cross sections are provided on separate sheets, designers must check with mainline cross sections for accuracy. A quantity match line is to be placed on such cross sections to ensure quantity estimates are not duplicated or omitted.
    d. Cross sections shall be placed in the following order: mainline cross sections first, followed by ramp cross sections (if applicable), with side road cross sections last.
    e. See DD-705 for general information to be shown on the cross sections. Earthwork shall be computed by the average end area method. Additional information to be shown on the cross sections is as follows, but is not an all-inclusive listing: top and bottom of proposed surface (paved or otherwise) to include shoulders, free-draining base layer (if applicable), aggregate base layer (if applicable), bottom of subgrade layer (if applicable), drainage items such as culverts, wingwalls, ditches/linings, free-draining base trench if applicable, utility crossings and clearances, existing and proposed right-of-way limits, water bodies with edges of water shown, existing roadways with edges of pavement shown, existing structures within the proposed right-of-way, etc.

D. Contiguous Projects: A general plan or layout of contiguous construction projects that are to be constructed with either a different class of funds or by another agency should be included to show the location and effect of the work. (Such details and information necessary to establish their relationship to the project should be shown.) Also, smaller projects “broken out” of a larger design project should show enough information from the adjoining projects or any future project which will incorporate the work of the smaller project to establish their relationship with the work of the smaller project.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DESIGN DIRECTIVE 813
BICYCLE/PEDESTRIAN ACCOMMODATION
Insert Approval Date~~February 24, 2026~~
Supersedes ~~September 6, 2023~~ February 24, 2026

The goal of the West Virginia Division of Highways (WVDOH) is to plan, design, construct, maintain and operate a safe, efficient, and economical highway system for all users of the system. While motor vehicle traffic is the major concern in performing this task, bicyclists and pedestrians must also be given proper consideration.

In order to integrate the needs of the motorized and non-motorized users of our highway system, the WVDOH, in cooperation with the Federal Highway Administration (FHWA), adopted "The Statewide Plan for Accommodation of Bicycle Transportation and Pedestrian Walkways" dated September 1997. Based on this document it is the policy of the WVDOH that during the design of all highway construction projects, consideration will be given, as outlined herein, for the incorporation of facilities for the accommodation of bicyclists and pedestrians.

The designer's attention is directed to the following publication: "Guide For Development Of Bicycle Facilities 2012 (Fourth Edition)", AASHTO (hereinafter referred to as the 2012 AASHTO Bicycle Guide) or most current edition. Many of the definitions in this Design Directive are summarized from this resource, and it is the source of any design standards not described here in detail. It is to be used as a reference supplementing this Design Directive.

DEFINITIONS

Bicycle Facilities: A general term denoting improvements and provisions made by public agencies to accommodate or encourage bicycling, including parking and storage facilities, and shared roadways not specifically defined for bicycle use. This includes new or improved lanes, paths, or shoulders for use by bicyclists as well as traffic control devices, shelters, and parking facilities for bicycles.

Bikeway: A generic term for any road, street, path, or way which in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes. **NOTE:** All public highways in West Virginia are open to bicycle traffic; however, on facilities such as Interstate Highways, bicycles are prohibited except in some very limited circumstances, such as when a fully controlled access highway is the only link between two separate bikeway segments.

Bicycle Boulevard: A local street or series of contiguous street segments that have been modified to function as a through street for bicyclists, while discouraging automobile through travel. Local access is maintained.

Bicycle Network: A system of bikeways designated by the jurisdiction having authority. This system may include bike lanes, bicycle routes, shared use paths, and other identifiable bicycle facilities.

Bicycle Lane: A portion of the roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings. It is intended for one-way travel, usually in the same direction as the adjacent traffic lane, unless designed as a contra-flow lane.

Bicycle Route: A roadway or bikeway designated by the jurisdiction having authority, either with a unique route designation or with Bike Route signs, along which bicycle guide signs may provide directional and distance information. Signs that provide directional, distance, and destination information for bicyclists do not necessarily establish a bicycle route.

Category I Roadways: Any highway facility that is a partially controlled access facility or any highway facility that contains four (4) or more travel lanes with design speeds greater than 40 mph.

Category II Roadways: Any non-controlled highway facility or street not defined as being a Category I Roadway.

Pedestrian Walkway Facilities: A general term denoting improvements and provisions made by public agencies to accommodate or encourage walking. This includes new or improved lanes, paths or sidewalks.

Combined Facilities: A combined facility, for the purpose of this directive, is a facility designated for use by bicyclists and pedestrians.

Rural Areas: All parts of the highway system NOT within an urban area as described in "Urbanized Areas" below.

Shared Lane: A lane of a traveled way that is open to both bicycle and motor vehicle travel.

Shared Use Path: A bikeway physically separated from motor vehicle traffic by an open space or barrier and either within the highway right of way or within an independent right of way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other non-motorized users. Most shared use paths are designed for two way travel.

Trails: Facilities that may be used by, but not limited to, non-motorized vehicles, horseback riders, cross-country skiers, and pedestrians.

Urbanized Areas: All parts of the highway system within an urban area as shown on The West Virginia Urban Area maps maintained by the Information Technology Division. These maps are located on the Division's website at the following link:
~~https://transportation.wv.gov/IT/GIS/MAPS/Pages/default.aspx~~
https://transportation.wv.gov/agencies/highways/divisions/information-technology-division

BICYCLES

During the environmental review and/or planning process, the WVDOH will assess the need and potential for the development of bicycle facilities as a part of the project. The criteria in

the "Statewide Plan for Accommodation of Bicycle Transportation and Pedestrian Walkways", September 1997 will be considered. Reference is also made to the 2012 AASHTO Bicycle Guide or most current edition. It should be noted that the development of a bicycle facility may be combined with the development of a pedestrian walkway facility. The resulting combined facility would be designated for both bicycle and pedestrian use. The combined facility must meet the criteria for both bicycles and pedestrians while accounting for the required safe separation of these two transportation modes.

If it is determined that bicycle facilities are to be incorporated in the project, the environmental documents shall include recommendations as to the type of bicyclist(s), as well as the type of facility to be considered in the design process.

The designer shall use the following criteria when determining the need for bicycle facilities in new construction or reconstruction projects.

A. Urbanized Areas

- Bicycle facilities shall be established in all new construction or reconstruction projects that add a new highway or alter the functionality of an existing highway. Exceptions to this policy are described below.
- Bicycle facilities may not be required if one or more of the following conditions exist:
    - Bicycles are prohibited from using the roadway.
    - The cost of establishing a bikeway is greater than ten (10) percent of the estimated construction cost of the project.
    - Existing population conditions and other factors indicate an absence of need for bicycle facilities.
    - Development costs such as right-of-way, utility relocation, environmental mitigation, historical resource avoidance, and others may be considered when determining the need to establish a bicycle facility.

B. Rural Areas

- Designated bicycle facilities may be considered during the design phase of the project
- All new construction or reconstruction projects that add a new highway or alter the functionality of an existing highway, shall as a minimum, be designed as a Category II Roadway.
- The designer shall consider the continuity of bicycle facilities on highways where the classification of the highway changes from urban to rural in relatively short distances.

The final decision for inclusion of bicycle facilities in the project will be made during the design process utilizing the above criteria. If the designer proposes not to incorporate bicycle facilities in the proposed project, written approval must be obtained from the Deputy State Highway Engineer of Construction, Development, or Operations, as applicable.

Bicycle facilities will be accommodated by one or more of the following methods:

- Designation of the project as a Bikeway or a Bicycle Route;
- Inclusion of a Bicycle Lane in the design of the project in urban areas; or
- Designation of or the inclusion of a Shared Use Path in the design of the project.

Sidewalks should not be designated for bicycle use. Bicyclists may be encouraged, with appropriate signing, to use short segments of sidewalks. One example of this would be a bridge structure that provides a safer environment to traverse the bridge. This would only be considered if the bridge sidewalk is wide enough to accommodate both pedestrians and bicyclists, in which case the criteria for a "Combined Facility" would be utilized (see the 2012 AASHTO Bicycle Guide or most current edition).

Design Bicyclist: To address the needs of bicyclists of various skill levels, the WVDOH shall use a classification of bicyclists. This system is a modification of the existing classification system used by AASHTO. This system is described as follows (taken from the 2012 AASHTO Bicycle Guide):

Experienced and Confident: This group includes bicyclists who are comfortable riding on most types of bicycle facilities, including roads without any special treatments for bicyclists. This group also includes utilitarian and recreational rider of many ages who are confident enough to ride on busy roads and navigate in traffic. Such bicyclists may deviate from the most direct route to travel in their preferred riding conditions. Experienced bicyclists may include commuters, long distance road bicyclists, racers, and those who participate in rides organized by bicycle clubs.

Most experienced riders are comfortable riding with vehicles on streets. Some prefer on-street bike lanes, paved shoulders, or shared use paths. They prefer a more direct route to their destination and avoid riding on sidewalks.

Casual and Less Confident: This group includes a majority of the population, and includes a wide range of people: (1) Those who ride frequently for multiple purposes; (2) those who enjoy bicycling occasionally but may only ride on paths or low-traffic and/or low-speed streets in favorable conditions; (3) those who ride for recreation, perhaps with children and; (4) those for whom the bicycle is a necessary mode of transportation.

Casual riders prefer shared use paths, bicycle boulevards, or bike lanes along low volume, low speed roads and streets. They may have difficulty gauging traffic and may be unfamiliar with the rules-of-the-road for bicyclists. They may use less direct routes to avoid heavy traffic volumes and are more likely to ride on sidewalks.

PEDESTRIANS

During the environmental review and/or planning process, the WVDOH will assess the need and potential for the development of pedestrian walkway facilities as a part of the project. The criteria in the "Statewide Plan for Accommodation of Bicycle Transportation and Pedestrian Walkways", September 1997 will be considered. Reference is also made to the following publication: "Guide for the Planning, Design, and Operation of Pedestrian Facilities, July 2004, AASHTO. It should be noted that the development of a pedestrian walkway facility may be combined with the development of a bicycle facility. The resulting combined facility would be designated for both pedestrian and bicycle use. The combined facility must meet the criteria for both bicycles and pedestrians while accounting for the required safe separation of these two transportation modes.

If it is determined that pedestrian walkway facilities should be considered, the environmental documents would include recommendations as to the type of facility to be

constructed. Facilities to be considered are sidewalks, shoulders and/or separate paths.

Any pedestrian accommodation on a project must be in accordance with DD-811 (Accessibility Standards, Curb Ramps and Sidewalks) and be in accordance with the additional design standards noted below.

The designer shall use the following criteria when determining the need for pedestrian walkway facilities in new construction projects.

A. Urbanized Areas

- Pedestrian walkway facilities shall be established in all new construction or reconstruction projects that add a new highway or alter the functionality of an existing highway. Exceptions to this policy are described below.
- Pedestrian walkway facilities may not be required if one or more of the following conditions exist:
  - Pedestrians are prohibited by law from using the roadway.
  - The cost of establishing a pedestrian walkway is greater than ten (10) percent of the estimated construction cost of the project.
  - Existing population conditions and other factors indicate an absence of need for pedestrian walkway facilities. Development costs such as right-of-way, utility relocation, environmental mitigation, historical resource avoidance, and others may be considered when determining the need to establish a pedestrian walkway facility.

B. Rural Areas

- Designated pedestrian walkway facilities may be considered during the design phase of the project.
- All new construction or reconstruction projects that add a new highway or alter the functionality of an existing highway, shall as a minimum, be designed as a Category II Roadway.
- The designer shall consider the continuity of pedestrian walkway facilities on highways where the classification of the highway changes from urban to rural in relatively short distances.

On bridge construction projects, a sidewalk shall be designed as a part of the bridge if sufficient pedestrian activity exists and there is not a suitable pedestrian crossing reasonably close to the bridge. In the case of bridge replacement projects, a sidewalk shall be designed as a part of the bridge if the existing structure had a sidewalk or if sufficient pedestrian activity exists and there is not a suitable pedestrian crossing reasonably close to the bridge.

DESIGN STANDARDS

The following design standards have been developed for bicycle and pedestrian accommodation. These lists are not considered to be all-inclusive. The designer should consult the 2012 AASHTO Bicycle Guide (or most current edition) for further guidance, especially for design guidance for Shared Use Paths. The “Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way” (PROWAG), dated July 26, 2011, should be considered as minimum criteria for the design of any new or the replacement of any existing pedestrian facility.

A. General (Applicable to Pedestrian and Bicycle)

- The designer is cautioned to review sight distances carefully due to extra height of barriers as a design exception could be necessary for the extra height where a normal height barrier would not have needed one.
- All paved shoulders to accommodate both pedestrians and bicycles
- All structures shall have a combination of railings, fences or barriers with a minimum height of 42" for pedestrians and bicycles. A 48" railing shall be considered for the following conditions:
    - Where bicycle speeds are likely to be high (such as on a downgrade)
    - Where a bicycle could impact a barrier at a 25 degree angle or greater (such as in a curve)
    - Where significant bicycle traffic is anticipated
    - Where a bicycle falling over the rail could be catastrophic, such as a high drop off or into traffic.
- Drainage grates for bicycle routes shall be of a bicycle safe design.
- Reference is made to DD-645, Rumble Strips, to bicycle mitigation methods for rumble strips.

B. Category I Roadways

- Bicycle accommodations are to be designed for one way operation
- Bicycles to be encouraged to utilize right shoulder (with signing)
- Bicycles to be encouraged to use exit and entrance ramps shoulders (with signing)
- Minimum 5'-0" width of right shoulder (non-structure)* without rumble strip
- Minimum 6'-0"width of right shoulder (bridge structure)* without rumble strip
- Bridge expansion joints must be bicycle safe on the right shoulder (no exposed finger dams)

***NOTE:** The values for shoulder width shown in DD-601 shall supersede the values shown above if the values in DD-601 are greater.

C. Category II Roadways

- Bicycle accommodations are to be designed for one way operation
- When the ADT is greater than 1000 vpd, shoulders may be paved if bicycle and/or pedestrian walkway facilities are to be considered
- When the ADT is less than 1000 vpd, paved shoulder widths of 2'-0" should be considered; however, paved shoulder widths of 4'-0" or greater are encouraged. For pedestrian facilities, in absence of paved shoulders, a stabilized shoulder of 2'-0" minimum or 4'-0" preferred widths should be encouraged.
- All structures shall have a minimum shoulder width similar to the approach roadway shoulder width, but does not have to exceed 5'-0"
- Bridge expansion joints for bicycle facilities
    - If shoulder is 5'-0" or greater, no exposed finger dams on the right shoulder
    - If shoulder is less than 5'-0", no exposed finger dams on full roadway

- On curbed sections of roadways on bicycle routes, width of right lane shall be 14' - 0", including the gutter pan.
- Structures without sidewalk shall have minimum shoulder widths of 4'-0"
- Structures with sidewalks shall have 4' minimum sidewalk widths and right lane/shoulder combined width of 14'-0" (12'-0" lane/2'-0" shoulder)

D. Shared Use Paths

- Designed for 2 way operation
- Minimum Travel Width - 10' with 2'-0" graded shoulders
- Reduced width of 8' in very rare circumstances or for short distances due to physical constraints.
- Structure railing/fence/barrier must be at least 5'-0" from the edge of shoulder of parallel roadway or separated by a combination of railings, fence or barrier with a height as described above.
- Superelevation 2% (no crown)

WVDOH Manuals Committee Meeting

Meeting Time/Date: Tuesday, December 1, 2026 at 9:00AM (immediately following Standards Committee Meeting)
Meeting Location: MCS&T (Library Room), 190 Dry Branch Drive, Charleston, WV
Also, meeting virtually via Google Meet. Email distribution includes instruction.

Files are available: https://transportation.wv.gov/standards-and-manuals-committee

Approved Manual changes from the last Committee Meeting (10/06/26):

- *None*

Old Business:

ITEM	Champion
2nd time to Committee. • *NEPA Compliance and Permitting Manual* New manual establishing WVDOH guidance for compliance with the National Environmental Policy Act (NEPA) and related environmental permitting requirements. The manual provides procedures, references, toolkits, and flowcharts for preparing NEPA documentation and coordinating environmental reviews. There have been no updates since the last meeting. Item is up for a vote.	R. Epperly

New Business:

ITEM	Champion
1st time to Committee. • *Drainage Manual - Chapter 5: Storm Drainage Systems* • *Drainage Manual – Chapter 10: Bridges* Rewrites for Chapter 5 and Chapter 10. Highlighting technical updates, policy revisions, and procedural changes.	D. Holmes

Housekeeping:

Next Meeting – February 2, 2027
Deadline for Submissions – January 5, 2027
Comments for next meeting – January 26, 2027

Comments are requested as they help in the decision-making process. Please send comments by the deadline to Kristy.J.Huffman@wv.gov and Nicholas.S.Broyles@wv.gov.

West Virginia Department of Transportation
Division of Highways

NEPA Compliance and Permitting Manual



An electronic version can be found at
transportation.wv.gov/highways/TechnicalSupport/Pages/Manuals.aspx

MARKOSKY

NEPA COMPLIANCE AND PERMITTING MANUAL

West Virginia Department of Transportation

Division of Highways

July 2026

Prepared by the Markosky Engineering Group, Inc.

Electronic version available at
https://transportation.wv.gov/highways/TechnicalSupport/Pages/Manuals.aspx

CONTENTS

1. INTRODUCTION 1
1.1. Overview of the National Environmental Policy Act 1
1.2. Overview of the Permitting Process 1
2. ABBREVIATIONS AND ACRONYMS 2
3. CRITICAL PATH METHOD (CPM) 7
4. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) 8
4.1. Introduction to NEPA 8
4.1.1. NEPA Overview 8
4.1.2. The NEPA Umbrella and Related Regulations 11
4.1.3. Planning and Environment Linkages (PEL) 15
4.2. Document Types 17
4.2.1. Documented Programmatic Categorical Exclusion (PCE) Type 1 18
4.2.2. Documented Programmatic Categorical Exclusion (PCE) Type 2 19
4.2.3. Categorical Exclusion (CE) 20
4.2.4. Environmental Assessment (EA) 21
4.2.5. Finding of No Significant Impact (FONSI) 22
4.2.6. Environmental Impact Statement (EIS) 22
4.2.7. Record of Decision (ROD) 24
4.2.8. Reevaluations 24
4.3. Essential Elements of NEPA Decision-Making 25
4.3.1. Public Involvement 25
4.3.2. Interagency Coordination 26
4.3.3. Coordination: List of Federal, State, and Local Entities 28
4.3.4. Purpose and Need Statements 29
4.3.5. Alternatives Analysis 30
4.3.6. Remote effects 33
4.3.7. Mitigation 33
4.3.8. Mapping / Graphics / Exhibits 34
4.4. Specialized NEPA Clearances 34
4.4.1 Emergency Protocol 34
4.4.2 Utilities Clearances 38

5. SECTION 7 ENDANGERED SPECIES ACT (ESA) 39
5.1. Informal consultation 40
5.1.1. Information for Planning and Consultation (IPaC) 40
5.1.2. USFWS Simplified IPaC Output Guide for WVDOH 41
5.2. Formal Consultation 43
5.3. WVDNR/USFWS Survey Protocols and Time Periods 44
5.3.1. Bats 44
5.3.2. Freshwater Mussels 44
5.3.3. Crayfish 45
5.3.4. Cheat Mountain Salamander 45
5.3.5. Candy Darter and Diamond Darter 45
5.3.6. Flat-spired Three-toothed Land Snail 45
5.3.7. Madison Cave Isopod 45
5.3.8. Plants 45

6. SECTION 106 AND THE NATIONAL HISTORIC PRESERVATION ACT (NHPA) 46
6.1. Introduction 46
6.2. Governing Laws, Regulations, and Guidance Documents 46
6.2.1. The National Historic Preservation Act (NHPA) 46
6.2.2. Section 106 Programmatic Agreement Among FHWA, WVSHPO, ACHP, and WVDOH 47
6.2.3. Consulting Parties 48
6.2.4. Tribal Consultation Guidance for FHWA and WVDOH 48
6.2.5. West Virginia Guidelines for Phase I, II, and III Archaeological Investigations and Technical Report Preparation 50
6.2.6. West Virginia National Register and Architecture / History Survey Manual 50
6.3. Development of the Area of Potential Effects / Environmental Clearance Zone 50
6.3.1. Area of Potential Effects vs. Environmental Clearance Zone 51
6.3.2. Area of Potential Effects for Archaeological Properties 51
6.3.3. Area of Potential Effects for Aboveground Historic Properties 52
6.4. Environmental Screening 52
6.4.1. Appendix A 52
6.4.2. Appendix B 54

6.4.3. Appendix C 55
6.5. Identification and Evaluation 55
6.5.1. Archaeological Resources 56
6.5.2. Aboveground Historic Properties 57
6.6. Project-Specific Programmatic Agreements 58
6.7. Determination of Effects 58
6.7.1. Archaeological Resources 59
6.7.2. Aboveground Historic Properties 60
6.8. Consultation 62
6.9. Resolution of Adverse Effects 62
6.9.1. Memorandum of Agreement (MOA) 62
6.9.2. Mitigation for Archaeological Resources 63
6.9.3. Mitigation for Aboveground Historic Properties 63
6.10. Resolving Disagreement on the Determination of Effects 64
6.10.1. Disagreement with the Effect Finding Within the Review Period 64
6.10.2. Disagreement with the Effect Finding After the End of the Review Period 64
6.11. Construction Monitoring 65
6.12. Late Discoveries 65
6.13. Emergencies 66

7. AQUATIC RESOURCES 67
7.1. Guidance from USACE and WVDEP 67
7.2. Definition and Identification of Jurisdictional Aquatic Resources 67
7.2.1. Wetland Definition 67
7.2.2. Stream Definitions 68
7.2.3. Aquatic Resource Identification 68
7.3. Jurisdictional Determinations 69
7.3.1. Approved Jurisdictional Determination 69
7.3.2. Preliminary Jurisdictional Determination 69
7.3.3. No Jurisdictional Determination 69
7.4. Checklist of Information for Aquatic Resource Delineation Reports 70
7.5. Impact Assessment Methodology 71
7.6. West Virginia Wetland Rapid Assessment Method 72

7.7. West Virginia Stream and Wetland Valuation Metric 72

8. FARMLAND 74
8.1. Farmland Protection Policy Act (FPPA) 74
8.1.1. When Evaluations Are Required 74
8.1.2. When Evaluations Are Not Required 75
8.2. Process to Evaluate 76
8.3. Documentation Tools 81

9. PUBLIC INVOLVEMENT 82
9.1. WVDOH Design Directive 201 (DD-201) Guidance 82
9.2. Need for Public Involvement 82
9.3. Types of Public Involvement 83
9.4. Public Involvement Plan 84
9.4.1. Notification Processes 85
9.4.2. Environmental Documents 86
9.4.3. Meeting and/or Hearing Format 86
9.5. Public Hearing Transcript 87
9.6. Public Meeting / Hearing Summary Report 87

10. SECTION 4(F) 88
10.1. Introduction to Section 4(f) 88
10.2. Additional Section 4(f) Guidance 88
10.3. WVDOH and Section 4(f) 88
10.4. Section 4(f) Resources 89
10.5. Public Parks, Recreation Areas, and Wildlife/Waterfowl Refuges 89
10.6. Public Multi-use Properties 90
10.7. Historic Sites 90
10.8. Section 4(f) Use of a Resource 91
10.9. No Use and Temporary Occupancy 91
10.10. De Minimis Impacts 92
10.11. Programmatic Evaluations 92
10.12. Individual Section 4(f) Evaluation 94
10.13. Developing and Evaluating Avoidance Alternatives 95
10.14. Analysis Required When a Use Is Not De Minimis 95

10.15. Section 4(f) Exemption Criteria 96
10.16. Projects and Situations Where Section 4(f) Does Not Apply 96

11. SECTION 6(F) 98
11.1. Introduction to Section 6(f) of the Land and Water Conservation Fund (LWCF) 98
11.2. Additional Section 6(f) Guidance 99
11.3. Identifying Land and Water Conservation Fund Properties 99
11.4. Section 6(f) Property Impacts 100
11.5. What Is a Conversion 100
11.6. Temporary Uses of Section 6(f) Property 100
11.6.1. Temporary Uses of Six Months or Less 101
11.6.2. Temporary Uses of More Than Six Months 101
11.7. Identification of a New Replacement Recreation Area 102
11.8. Preparing the Conversion Proposal 103

12. NOISE 104
12.1. Coordination with FHWA 104
12.2. Project Types 104
12.3. Highway Noise Impact Study 105
12.4. Mitigation Measures 106
12.5. Documentation and Approval 106

13. AIR QUALITY 107
13.1. Analyses Needed by the Project 107
13.2. Regulations That Guide the Process 107
13.3. Consideration of Mobile Source Air Toxics in NEPA Documents 108
13.3.1. Class 1 Actions (Environmental Impact Statements) 108
13.3.2. Class 2 Actions (Categorical Exclusions) 109
13.3.3. Class 3 Actions (Environmental Assessments) 109

14. HAZARDOUS MATERIALS INVESTIGATION 110
14.1. Governing Regulations 110
14.2. When a Hazardous MATERIAL Investigation Is Warranted 110
14.3. Types of Hazardous MATERIAL Projects 111

14.4. WVDOH Guidance Documents 111
14.4.1. Design Directive 302 (DD-302) – Hazardous Waste 111
14.4.2. DESIGN DIRECTIVE 313 (DD-313) – ASBESTOS INSPECTION REPORTS 112
14.4.3. Lead Paint Inspections 115

15. COMMUNITY IMPACTS, HUMAN POPULATIONS, AND TITLE VI OF THE CIVIL RIGHTS ACT OF 1964 117
15.1 Guidance from the FHWA and USEPA 118
15.2 Community Impacts, Human Population, and Title VI Population Evaluation Procedures 119

16 PERMITTING 126
16.1 Introduction 126
16.2 Pre-Application Meeting / Jurisdictional Determinations 126
16.3 Section 404 Permit 126
16.3.1 Standard Permits 127
16.3.2 General Permits 127
16.4 USCG Permit 129
16.5 401 Water Quality Certification 130
16.6 National Pollutant Discharge Elimination System Permit (NPDES) 131
16.6.1 General Requirements 132
16.6.2 Pre-Construction Meeting 132
16.6.3 Design 132
16.6.4 Permit Issuance and Fees 133
16.6.5 Permit Application Checklist 133
16.6.6 Public Notice 135
16.6.7 Installation of Erosion and Sediment Controls 135
16.6.8 Notice of Termination (NOT) 135
16.6.9 Site Registration Form 136
16.6.10 Road Maintenance Areas 137
16.6.11 Resources 137
16.7 WVDEP Isolated Waters Permit 137
16.8 Stream Disturbance Permit 137
16.9 Air Permitting 138
16.9.1 Minor Source Permits 138

16.9.2 Major Source Permits 139
16.9.3 General Permits 140
16.9.4 Title V Permits 140
16.10 Underground Injection Control Permit 141
16.10.1 Underground Injection Wells 141
16.10.2 Stormwater Drainage Wells and Infiltration Systems 142
16.10.3 Underground Injection Control Program Requirements 142
16.10.4 Underground Injection Control Stormwater Application Requirements 142
16.11 Municipal Separate Storm Sewer Systems 144
16.12 National Park Service Coordination 145
16.12.1 Right of Way Permit 145
16.12.2 Special Use Permit 145
16.13 Floodplain Coordination 147
16.13.1 Identification of Flood Hazards within the Project Area 147
16.13.2 Floodplain Administrator Coordination 147
16.14 Fish Spawning Waiver 148
16.15 Section 408 program 149

17 ENVIRONMENTAL COMMITMENTS 152
17.1 Guidance from WVDOH Special Provision 107.27.3 152
17.2 Commitments 152
17.3 EPIC Sheet 152

18 GLOSSARY 154
18.1 National Environmental Policy Act 154
18.2 Section 7 of the Endangered Species Act 157
18.3 Section 106 of the National Historic Preservation Act 159
18.4 Aquatic Resources 162
18.5 Farmland 164
18.6 Public Involvement 165
18.7 Section 4(f) 166
18.8 Section 6(f) 170
18.9 Noise 171
18.10 Air Quality 173

18.11 Hazardous Materials Investigation 174
18.12 Community Impacts, Human Populations and Title VI of the Civil Rights Act of 1964 177
18.13 Permitting 179
18.14 Environmental Commitments 180

19 REFERENCES AND LINKS 181
19.1 National Environmental Policy Act 181
19.2 Section 7 of the Endangered Species Act 182
19.3 Section 106 of the National Historic Preservation Act 183
19.4 Aquatic Resources 184
19.5 Farmland 185
19.6 Public Involvement 186
19.7 Section 4(f) 186
19.8 Section 6(f) 187
19.9 Noise 187
19.10 Air Quality 188
19.11 Hazardous Materials Investigation 188
19.12 Community Impacts, Human Populations and Title VI of the Civil Rights Act of 1964 189
19.13 Permitting 190
19.14 Environmental Commitments 191

20 ATTACHMENTS / FORMS / EXAMPLES 192

21 FLOWCHARTS 193

FIGURE

Figure 1 NEPA Umbrella 12

TABLES

Table 5.1. Endangered, Threatened, or Proposed Species Associated with Specific Aquatic Habitats in West Virginia 41
Table 5.2. Survey Timeframes 44
Table 15.1. Sources of Data to Guide Community Demographic and Title VI Population Screenings 119
Table 15.2. Potential Example Indicators of Title VI Populations Based on Observational Data 120
Table 16.1. When to Apply for Large Construction Projects 134
Table 16.2. When to Apply for Minor Construction Projects 134

FLOWCHARTS

Flowchart 21.1. DOT NEPA, USACE & WVDEP Permitting Process 21-1
Flowchart 21.2. NEPA Process — Levels of Documentation 21-2
Flowchart 21.3. EA/FONSI Process 21-3
Flowchart 21.4. EIS/ROD Process 21-4
Flowchart 21.5. Section 106 Process Overview 21-5
Flowchart 21.6. Section 106 Architecture/History 21-6
Flowchart 21.7. Public Involvement 21-7
Flowchart 21.8. Hazardous Materials Investigation 21-8
Flowchart 21.9. Title VI 21-9
Flowchart 21.10. Section 404 Permitting Process 21-10
Flowchart 21.11. Section 401 Permitting Process 21-11
Flowchart 21.12. WV NPDES Construction Stormwater General Permit Process 21-12

1. INTRODUCTION

This manual is designed to provide the West Virginia Division of Highways (WVDOH) and the consultant community with a roadmap that shows how to meet the requirements of the National Environmental Policy Act (NEPA) of 1969 and other environmental permitting regulations relevant to WVDOH projects. Users will find references to the various federal and state acts and regulations, toolkits for guidance, and flowcharts showing the steps needed to complete NEPA documentation, the supporting resource studies required for NEPA, and the permitting process.

1.1. OVERVIEW OF THE NATIONAL ENVIRONMENTAL POLICY ACT

NEPA is a cornerstone of environmental law in the United States. It requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions. NEPA's basic policy is to ensure that all branches of government consider the environment before undertaking any major federal action that significantly affects the environment. This includes actions such as the construction of highways, buildings, and other federal activities. NEPA mandates the preparation of detailed statements assessing the environmental impact of and alternatives to major federal actions; these documents are commonly referred to as environmental impact statements, environmental assessments, and categorical exclusions.

1.2. OVERVIEW OF THE PERMITTING PROCESS

The environmental permitting process encompasses a wide range of tasks, including permits for the Clean Water Act, Clean Air Act, National Pollutant Discharge Elimination System, stream disturbances, special use permits, agency-specific use permits, air permitting, floodplain permitting, and other specific permits as needed. This manual provides an introduction to the permits potentially required for WVDOH projects and outlines the processes to obtain them. See Flowchart 21.1 DOT NEPA, USACE & WVDEP Permitting Process Overview.

2. ABBREVIATIONS AND ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
ACHP	Advisory Council on Historic Preservation
ADA	Americans with Disabilities Act
AJD	Approved Jurisdictional Determination
AOI	Area of Interest
APE	Area of Potential Effect
BA	Biological Assessment
BFE	Base Flood Elevation
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practice
C&G	Clearing and Grubbing
C&S	Compliance and Stewardship
CA	Controlled Access
CAA	Clean Air Act
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CSR	Code of State Regulations
CWA	Clean Water Act
DD	Design Directive
DEIS	Draft Environmental Impact Statement
DOI	Department of the Interior
DOT	Department of Transportation
E&S	Erosion and Sediment

EA	Environmental Assessment
ECZ	Environmental Clearance Zone
EIS	Environmental Impact Statement
EPIC	Environmental Permit Impact Commitments
ESA	Endangered Species Act
FCIR	Farmland Conversion Impact Rating
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FPPA	Farmland Protection Policy Act
FTA	Federal Transit Administration
GHG	Greenhouse Gases
GPP	Groundwater Protection Plan
H&H	Hydrologic and Hydraulic
HAP	Hazardous Air Pollutants
IPaC	Information for Planning and Consultation
IRT	Interagency Review Team
JD	Jurisdictional Determination
LCA	Large Construction Application
LEP	Limited English Proficiency
LMC	Latex Modified Concrete
LOD	Limit of Disturbance
LWCF	Land and Water Conservation Fund
MBTA	Migratory Bird Treaty Act
MCA	Minor Construction Application

MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
MPT	Maintenance and Protection of Traffic
MS4	Municipal Separate Storm Sewer System
MSAT	Mobile Source Air Toxics
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFCP	National Floodplain Coordination Plan
NFIP	National Floodplain Insurance Program
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NLAA	Not Likely to Adversely Affect
NLLAP	National Lead Laboratory Accreditation Program
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
OHWM	Ordinary High-Water Mark
PA	Programmatic Agreement
PCB	Printed Circuit Board
PCE	Programmatic Categorical Exclusion

PCN	Pre-Construction Notification
PEL	Planning and Environment Linkages
PJD	Preliminary Jurisdictional Determination
RCRA	Resource Conservation and Recovery Act
RGP	Regional General Permit
ROD	Record of Decision
ROW	Right of Way
RROW	Required Right of Way
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SF	Standard Form
SLO	State Liaison Officer
SOI	Secretary of the Interior
SP	Special Provision
SSURGO	Soil Survey Geographic Database
SUP	Special Use Permit
SWVM	West Virginia Stream and Wetland Valuation Metric
TIP	Transportation Improvement Programs
TSCA	Toxic Substance Control Act
UASFLA	Uniform Appraisal Standards for Federal Land Acquisitions
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency

USFWS	U.S. Fish and Wildlife Service
WSS	Web Soil Survey
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVDOH	West Virginia Department of Highways
WVDOT	West Virginia Department of Transportation
WVFO	West Virginia Field Office
WV HPI	West Virginia Historic Property Inventory
WVSHPO	West Virginia State Historic Preservation Office
WVWRAM	West Virginia Wetland Rapid Assessment Method

3. CRITICAL PATH METHOD (CPM)

The CPM is a vital project management tool used to identify the sequence of tasks that determine the minimum project duration. By focusing on the critical path, WVDOH Environmental Team Members can prioritize tasks that directly impact the project's completion time, ensuring that resources are allocated efficiently, and potential delays are minimized.

The reasoning behind using CPM lies in its ability to provide a clear roadmap for project execution. It helps in identifying the most crucial tasks that cannot be delayed without affecting the overall project timeline. This method allows WVDOH Environmental Team Members to foresee potential bottlenecks and allocate resources effectively to maintain the project's schedule. When implementing CPM, WVDOH or its consultants should consider CPM's key components:

- **Task Identification:** Listing all the tasks required to complete the project.
- **Task Sequencing:** Determining the order in which tasks must be performed.
- **Duration Estimation:** Estimating the time required to complete each task.
- **Critical Path Identification:** Identifying the longest sequence of tasks that dictates the project duration.
- **Resource Allocation:** Assigning resources to ensure that critical tasks are completed on time.

For highway projects, there are additional key criteria that must be evaluated during the initial project review. These criteria include:

- **Natural Resources:** Assessing impacts on wetlands, endangered species, and critical habitats.
- **Cultural Resources:** Evaluating archaeological sites and cultural artifacts.
- **Historic Resources:** Considering impacts on historic properties and structures.
- **Public Involvement:** Reflecting the complexity and level of public engagement required.
- **Other Environmental Factors:** Including considerations such as Section 4(f)/6(f) properties, hazardous materials, air quality and the Clean Water Act permits.

By understanding and applying these components and criteria, WVDOH Environmental Team Members can ensure that their projects are completed efficiently and on schedule.

4. NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

4.1. INTRODUCTION TO NEPA

4.1.1. NEPA OVERVIEW

Congress enacted NEPA in 1969, and President Nixon signed it into law on January 1, 1970. Among other things, NEPA establishes a national policy for the environment and provides for the establishment of the Council on Environmental Quality (CEQ). NEPA was the first major environmental law in the United States and is often called the "Magna Carta" of federal environmental laws. NEPA requires federal agencies to assess the environmental effects of proposed major federal actions prior to making decisions.

NEPA requires that, to the maximum extent feasible, federal government policies, regulations, and legislation should be implemented in a manner that aligns with environmental protection objectives. The environmental review process necessitates a collaborative approach across disciplines and agencies. The primary federal agency collaborates with other federal and state entities throughout this process. The environmental review encompasses contributions from the public and agencies, ensuring comprehensive consideration of environmental safeguards and related concerns.

NEPA ensures that agencies consider the significant environmental consequences of their proposed actions and inform the public about their decision-making. Countries and non-governmental organizations all over the globe have created their own environmental impact assessment programs modeled on NEPA, making NEPA an international catalyst in the field of environmental protection.

Section 101 of NEPA sets forth a national policy "to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans" (42 U.S. Code [USC] § 4331(a)).

Section 102 of NEPA establishes procedural requirements for applying NEPA to proposals for major federal actions that may significantly affect the quality of the human environment. The section requires federal agencies to prepare a detailed statement on (1) the environmental impact of the proposed action, (2) any adverse effects that cannot be avoided, (3) alternatives to the proposed action, (4) the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term

productivity, and (5) any irreversible and irretrievable commitments of resources that would be involved in the proposed action (42 USC § 4332 (C)).

Under NEPA, significance is a primary factor in determining the type of environmental document and process used for a particular project. NEPA requires an environmental impact statement (EIS) for major federal actions that significantly affect the quality of the human environment. To determine the appropriate class of action and the requisite level of documentation necessary to comply with NEPA, it is essential to understand the term "significance" and the process for its determination.

Previous CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500–1508), defined significance as a function of both context and intensity. Those definitions have historically guided the analysis of whether an EIS is required. However, the centralized "context and intensity" significance test in the 1500 series is no longer a federal requirement following the recission of the 1500 series. Following CEQ action in 2025, agencies should follow the CEQ Memorandum for Heads of Federal Departments and Agencies: Implementation of the National Environmental Policy Act (NEPA), the CE NEPA Implementation Guidance, and any subsequent updates or revisions to such guidance. CEQ's rescission of the 40 CFR 1500 series directed agencies to analyze only "reasonably foreseeable effects" that have a reasonably close causal relationship to the proposed action. Accordingly, agencies should apply the current guidance when determining the scope of effects to analyze rather than relying solely on the former centralized significance test.

The following explains the former CEQ approach, which remains useful as a reference for many practitioners and for understanding how agencies historically assessed significance:

- **Context** — This means that the significance of an action must be analyzed in several contexts, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the impacts in the locale rather than in the world as a whole. Both short- and long-term impacts are relevant.
- **Intensity** — This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about aspects of a major action. The following should be considered in evaluating intensity:
    - The pros and cons of impacts. Some impacts may be both beneficial and adverse. A significant effect may exist even if the federal agency believes the net effect will be beneficial.
    - The degree to which the proposed action affects public health or safety.

- Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
- The degree of potential controversy surrounding the impacts.
- The degree of uncertainty surrounding potential impacts including unique or unknown risks.
- The degree to which the action may establish a precedent for future actions with significant impacts or establish a principle for future concern.
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
- The degree to which the action may adversely affect an endangered or threatened species or critical habitat as listed under the Endangered Species Act (ESA) of 1973.
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment (42 USC 4331 et seq.).

Because the NEPA Implementing Regulations were rescinded and current CEQ guidance now governs scope, agencies should:

- Focus analyses on reasonably foreseeable effects that have a reasonably close relationship to the proposed action.
- Document the rationale used to determine which effects are within scope under the current CEQ guidance, including any consideration of context and intensity, where those concepts remain relevant to reestablishing reasonable foreseeability and causal connection.
- Continue to engage the public and cooperating agencies to identify reasonably foreseeable effects and to ensure that the scope of analysis is transparent and defensible.
- Use the former context and intensity factors as practical reference points when they help explain why particular effects are or are not reasonably foreseeable or causally connected to the proposed action.

4.1.1.1. NEPA and the FHWA

The Federal Highway Administration (FHWA) policy (23 CFR § 771.105) (References and Links #19.1.1) provides the following policy:

- To the maximum extent practicable and consistent with federal law, all environmental investigations, reviews, and consultations be coordinated as a single process, and compliance with all applicable environmental requirements be reflected in the environmental review document required by this part.
- Programmatic approaches should be developed for compliance with environmental requirements (including the requirements found at 23 USC § 139(3)) (References and Links #19.1.4), coordination among agencies and/or the public, or to otherwise enhance and accelerate project development.
- Alternative courses of action should be evaluated, and decisions should be made in the best overall public interest based upon a balanced consideration of the need for safe and efficient transportation, of the social, economic, and environmental impacts of the proposed transportation improvement; and of national, state, and local environmental protection goals.
- Public involvement and a systematic interdisciplinary approach should be essential parts of the development process for proposed actions.
- Measures necessary to mitigate adverse impacts should be incorporated into the action and are eligible for federal funding when the FHWA determines that:
    - The impacts for which the mitigation is proposed result from the FHWA action; and
    - The proposed mitigation represents a reasonable public expenditure after considering the impacts of the action and the benefits of the proposed mitigation measures. In making this determination, the FHWA will consider, among other factors, the extent to which the proposed measures would assist in complying with a federal statute, executive order, or FHWA regulation or policy.
- Costs incurred by the applicant for the preparation of environmental documents requested by the FHWA should be eligible for federal assistance.
- No person, because of handicap, age, race, color, sex, or national origin, may be excluded from participating in, or denied benefits of, or be subject to discrimination under any FHWA program or procedural activity required by or developed pursuant to this part.

4.1.2. THE NEPA UMBRELLA AND RELATED REGULATIONS

FHWA adopted the policy of managing the NEPA project development and decision-making process as an "umbrella," under which all applicable environmental laws, executive orders, and regulations are considered and addressed prior to the final project decision and document approval. Conclusion of the NEPA process results in a decision that addresses multiple concerns and requirements. The NEPA process allows

transportation officials to make project decisions that balance engineering and transportation needs with social, economic, and natural environmental factors. During the process, a wide range of partners including the public, businesses, interest groups, and agencies at all levels of government provide input into project and environmental decisions.

Figure 1, the NEPA Umbrella, illustrates the resources considered under NEPA. Each resource will be discussed in the respective sections of the manual.



Figure 1 NEPA Umbrella

4.1.2.1. Air Quality

Applicable Law: Clean Air Act (CAA)

The Clean Air Act (CAA) was passed to protect human health and the quality of air resources. A variety of programs under the CAA focus on reducing outdoor or ambient concentrations of air pollutants that cause smog, haze, acid rain, and other problems. Other programs under the CAA focus on phasing out production and use of chemicals that destroy stratospheric ozone.

4.1.2.2. Water Resources

Applicable Laws: Clean Water Act (CWA), Executive Order 11988, Executive Order 11990, Wild and Scenic Rivers, Safe Drinking Water Act (SDWA), and state and local requirements

The Clean Water Act (CWA) was enacted to control water pollution. If a federal action may discharge into or occur near the waters of the United States, a federal agency may need to consider the CWA and other water policies and regulations during the NEPA process.

4.1.2.3. Natural Environment

Applicable Laws: NEPA, Endangered Species Act (ESA)

For projects that could affect the natural environment, it is essential to guarantee that impacts on native vegetation, wildlife, and their habitats are either minimal or adequately mitigated at the location.

4.1.2.4. Endangered Species

Applicable Laws: ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act

The ESA protects species (fish, birds, mammals, insects, and plants) federally listed as threatened or endangered. A species is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

The Migratory Bird Treaty Act (MBTA) prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of the Interior, U.S. Fish and Wildlife Service (USFWS).

The Bald and Golden Eagle Protection Act (BGEPA) protects bald and golden eagles from being taken, possessed, sold, or transported without a permit. The Act also protects their nests, eggs, and feathers.

4.1.2.5. Historic Preservation

Applicable Law: National Historic Preservation Act (NHPA), Section 106

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation (ACHP) with a reasonable opportunity to comment.

4.1.2.6. Land Use

Applicable Laws: Local zoning and development ordinances

Zoning allows state, local, and tribal communities to guide local land-use patterns and future development. Parcels of land are typically divided into specified districts with measurable standards that specify conditions and restrictions on the developments permitted by counties, municipalities, and/or local authorities.

4.1.2.7. Human Population

Applicable Law: Title VI of the Civil Rights Act of 1964

Title VI of the Civil Rights Act of 1964 prohibits discrimination based on race, color, or national origin in programs that receive federal funds.

4.1.2.8. Noise

Applicable Laws: Noise Control Act of 1972, state and local noise regulations

The federal government established noise guidelines and regulations for the purpose of protecting citizens from potential hearing damage and from various other adverse physiological, psychological, and social effects associated with noise.

4.1.2.9. Energy

Applicable Law: The Energy Policy Act of 2005

The Energy Policy Act of 2005 addresses relevant topics of energy efficiency, vehicles and motor fuels, electricity, energy tax incentives, and climate change technology.

4.1.2.10. Geology, Topography, and Soils

Applicable Laws: Farmland Protection Policy Act (FPPA) and local ordinances

The Farmland Protection Policy Act (FPPA) is intended to minimize the unnecessary irreversible conversion of farmland to nonagricultural uses and to comply with state and local agencies, private programs, and policies to protect farmland.

4.1.2.11. Solid Waste Management

Applicable Laws: Resource Conservation and Recovery Act (RCRA), state hazardous waste programs

The Resource Conservation and Recovery Act (RCRA) gives the U.S. Environmental Protection Agency (USEPA) authority to control the generation, transportation, treatment, storage, and disposal of solid and hazardous waste from cradle to grave in order to protect human health and the environment.

4.1.2.12. Transportation

Applicable Laws: Bipartisan Infrastructure Law

The Bipartisan Infrastructure Law is the largest long-term investment in infrastructure and economy in our nation's history. It provides $550 billion over fiscal years 2022 through 2026 in new federal investments in infrastructure such as roads, bridges, mass transit, water infrastructure, resilience, and broadband technologies.

4.1.2.13. State Environmental Policies

Applicable Laws: West Virginia Code of State Rules, Title 47—Requirements Governing Water Quality Standards (47-02), National Pollutant Discharge Elimination System (NPDES) Program (47-10)

West Virginia Code of State Rules 47-02 establishes the standards for discharging sewage, industrial waste, and other pollutants into West Virginia's waters with the aim of maintaining reasonable water quality for public health, aquatic life, and other beneficial uses. This regulation is managed by the West Virginia Department of Environmental Protection (WVDEP). West Virginia Code of State Rules 47-10 regulates the discharge of pollutants from identifiable points like pipes or ditches into waterways with the aim of preventing water pollution. The NPDES program is established under the CWA. Although the federal government sets the standards, individual states like West Virginia implement the NPDES program through its own regulations.

4.1.2.14. Intergovernmental Review

Applicable Laws: NEPA, Executive Order 12372 Intergovernmental Review of Federal Programs

The lead federal agency must coordinate with other government agencies to assess any effects on other federal, state, or tribal agency projects or programs.

4.1.3. PLANNING AND ENVIRONMENT LINKAGES (PEL)

4.1.3.1. What is PEL?

The information presented in this section is from the FHWA Environmental Review Toolkit Planning and Environment Linkages Fact Sheet (References and Links #19.1.6). Planning and Environment Linkages (PEL) is a tool to help streamline efficiency in the development of transportation projects and help supporting agencies accelerate project delivery.

PEL encourages agencies to collaborate and take a holistic view of transportation decisions during the planning phase, factoring in how proposed projects could affect the environment, local communities, and the economy. By using PEL, agencies can

streamline project development by establishing the project's goals, narrowing down feasible alternatives, and starting public engagement and documentation early in the project development process. The approach is adaptable, allowing professionals to apply different regulatory frameworks and tailor PEL to fit their specific project's requirements.

4.1.3.2. Why Use PEL?

State and local agencies gain substantial advantages by integrating environmental and community priorities into transportation planning from the outset and maintaining this focus throughout project development.

Additionally, using PEL benefits project development through:

- Minimizing duplication of efforts – A PEL approach improves information sharing and early consultation among State Departments of Transportation (DOTs), Federal agencies, and resource agencies, resulting in reduced overlap of effort in planning and NEPA processes.
- Documentation – Taking a PEL approach can streamline documentation of planning and decisions for environmental review and NEPA processes.
- Decisions and analysis to inform NEPA – PEL uses transportation planning decisions and analysis to inform the NEPA process, including purpose and need, identification of preliminary alternatives, and elimination of less reasonable alternatives.
- Flexible approaches – PEL can be tailored to multiple approaches, making it a flexible and adaptable tool across states. States can employ PEL to supplement and enhance their existing processes.
- Enhanced community involvement – PEL can enhance accountability and responsiveness to community concerns by providing the public an early opportunity to assess the components of current and future projects.
- Improved relationships and coordination – the PEL approach often inspires increased information sharing and stronger communication between partner agencies, leading to improved relationships and more efficient coordination.

4.1.3.3. PEL Resources

Visit the PEL website through the FHWA Environmental Review Toolkit resources page (References and Links #19.1.8) to access these resources:

- Trainings and workshops – Watch pre-recorded webinars that provide a detailed overview of PEL, walk participants through using PEL for historic preservation, and provide guidance on corridor studies, among other topics.

- Guidance – Browse detailed guidance on a number of key initiatives that encourage the integration of planning and the environment in the transportation decision-making process. Topics include collaborative decision-making, corridor planning, freight, and land use, among others.
- PEL NHI Training Course – A two-day training. The National Highway Institute (NHI) training course covers what PEL is and how to use the PEL approach (References and Links #19.1.14).
- PEL Hypothetical Case Studies – Read four case studies that present examples of planning activities on the following topics:
    - Alternatives (References and Links #19.1.9)
    - Planning Analyses (References and Links #19.1.10)
    - Planning Studies (References and Links #19.1.11)
    - Purpose and Need (References and Links #19.1.12)

4.1.3.4. Funding Flexibility

PEL allows agencies to tap into a variety of funding sources, making it easier to support activities such as corridor and feasibility studies that can help move projects forward more quickly. Funds from programs like Metropolitan Planning, State Planning and Research, and Surface Transportation Program Block Grants are all eligible for use in PEL-related work. For a comprehensive overview of available funding mechanisms and guidance on eligibility, agencies can consult the FHWA's "A Guide to Federal-Aid Programs and Projects" (References and Links #19.1.7).

Several key project-delivery streamlining provisions were originally established under the Fixing America's Surface Transportation Act (2015), including:

- Efficient environmental reviews for project decision-making (Section 1304),
- Integration of planning and environmental review (Section 1305), and
- Development of programmatic mitigation plans (Section 1306)

For more information about the PEL program and opportunities to accelerate project delivery, FHWA offers assistance from a PEL Program Manager. Requests may be submitted online (References and Links #19.1.13).

4.2. DOCUMENT TYPES

On February 27, 2023, FHWA and the West Virginia Division of Highways (WVDOH) signed a Programmatic Agreement (PA) (also referred to as CE Delegation Agreement)

to approve actions classified as categorical exclusions (CEs) for Federal-Aid Highway Program projects. This agreement can be found in Section 20 of this manual. This agreement allows the WVDOH to decide on behalf of FHWA if a project qualifies for a CE as listed in 23 CFR § 771.117. It also empowers WVDOH to certify to FHWA that an action meeting the CE criteria in 23 CFR § 771.117(a) qualifies for a CE, provided no unusual circumstances necessitating an environmental assessment (EA) or EIS are present. Examples and templates for the documents can be found in Section 20 of the WVDOH NEPA Compliance and Permitting Manual. See Flowchart 21.2 for a breakdown of the NEPA process and levels of documentation.

4.2.1. DOCUMENTED PROGRAMMATIC CATEGORICAL EXCLUSION (PCE) TYPE 1

The documented programmatic categorical exclusion (PCE) Type 1 process can be used when the following conditions apply to a project:

- The project does not cross state lines.
- The project falls under one of the following types:
    - Roadway Resurfacing, Striping, Sealing, Raised Pavement Markers, High Friction Surface Treatment, Cold Mix Asphalt Paving
    - Lighting
    - Bridge Clean and Paint
    - Bridge Overlay / Latex Modified Concrete
    - Sign Installation / Renovation
    - Traffic Signal Installation / Renovation / Modification
    - Emergency Project (such as slide repair, debris removal, etc.) that does not involve work below the ordinary high-water mark of any stream, lake, or water body and not within a National Wildlife Refuge, National Park, National Forest, National River, or any other federally managed area
    - Railroad Betterments, Crossing Device Upgrades, Crossing Surface Replacements, Track Circuit Additions
    - Warning Flashers
    - Dynamic Message Signs
    - Project within existing right of way (ROW) with no additional land disturbance required beyond the currently disturbed areas and not within a National Wildlife Refuge, National Park, National Forest, National River, or any other federally operated area requiring work that exceeds regular maintenance

  - Utility Installations
- The project does not add through lanes that would add capacity to the roadway.
- The project does not propose to close a road, bridge, or ramp.
- The project does not involve ROW acquisition including temporary easements.
- The project does not involve any permanent change to access control that is not in compliance with the approved traffic report recommendations.
- No structures over 50 years old are within the project area.
- The only coordination needed consists of consultation with the West Virginia Division of Natural Resources (WVDNR) and informal consultation with the USFWS.
- An individual 404 permit is not required.
- The project does not entail more than 3 acres of ground disturbance.
- The project does not span a navigable waterway that is regulated by the U.S. Coast Guard (USCG).
- The project does not require a Special Use Permit (SUP) from a federal agency.
- The project does not increase the regulated floodplain (100-year floodplain) elevations of a waterway or lake.

If the above conditions are not met, the project will need to be processed as a PCE Exclusion Type 2 or will require a higher level of NEPA documentation as described below.

4.2.2. DOCUMENTED PROGRAMMATIC CATEGORICAL EXCLUSION (PCE) TYPE 2

The documented PCE Type 2 process can be used when the following conditions are met:

- No public controversy is associated with the project.
- No displacements of residences or businesses will be caused by the project.
- No adverse effects to any historic or archaeological resources will be caused by the project.
- No Wild and Scenic Rivers will be impacted by the project.
- No Section 4(f) impacts will be caused by the project.
- No conversion of Section 6(f) property (Land and Water Conservation Fund purchased property) will be needed by the project.
- No formal consultation under Section 7 of the ESA will be required for the project.

- No increase in the regulated surface water elevation (100-year floodplain) of a waterway or lake will be caused by the project.
- An individual U.S. Army Corps of Engineers (USACE) Section 404 permit is not required.
- A USCG Section 9 or Section 10 permit is not required.
- A federal SUP from the National Park Service (NPS), the U.S. Forest Service, or the USFWS is not required.
- If the project will have a noise impact, mitigation is not required.
- The project does not cross state lines.

If the above conditions are not met, the project will need to be processed as a CE requiring FHWA approval or a higher level of NEPA documentation as described below.

4.2.3. CATEGORICAL EXCLUSION (CE)

CEs are actions that based on past experience with similar actions, do not involve significant environmental impacts. CEs do not induce significant impacts to planned growth or land use for the area, do not require the relocation of significant numbers of people, do not have a significant impact on any natural, cultural, recreational, historic, or other resource; do not involve significant air, noise, or water quality impacts; do not have significant impacts on travel patterns; and do not otherwise have any significant environmental impacts (23 CFR § 771.117(a)). According to the CE Delegation Agreement, WVDOH will prepare a CE certification package for FHWA review if the action meets any of the following thresholds:

- Involves unusual circumstances described in 23 CFR § 771.117(b).
- Involves use of properties protected by Section 4(f) of the U.S. Department of Transportation Act (49 USC § 303).
- Results in a determination of “adverse effect” on historic properties pursuant to Section 106 of the NHPA (54 USC § 306108).
- May affect or is likely to adversely affect a federally listed species or its designated critical habitat, a jeopardy decision of a candidate species or its proposed critical habitat, or result in a take of a bald or golden eagle.
- Requires a USCG bridge permit (33 USC § 401).
- Requires a land transfer from a federal agency.
- Requires acquisition of lands protected under Section 6(f) of the Land and Water Conservation Act of 1965 (54 USC § 200305).
- Requires breaking the controlled access ROW.

- Crosses state lines.
- Results in displacements that are either residential or commercial.
- Entails public controversy.

If the above conditions are not met, the project will need to be processed as an EA or higher level of documentation as described below.

4.2.4. ENVIRONMENTAL ASSESSMENT (EA)

An agency shall prepare an EA for a proposed action that is not likely to have significant impacts or when the significance of the impacts is unknown, unless the agency finds that a CE is applicable or has decided to prepare an EIS. An agency may prepare an EA for any action to assist agency planning and decision-making. See Flowchart 21.3 for the EA/FONSI process.

An EA shall include the following information:

- Briefly provide sufficient evidence and analysis for determining whether to prepare an EIS or reach a finding of no significant impact (FONSI).
- Briefly discuss the following:
  - Purpose and need for the proposed agency action.
  - Alternatives as required by Section 102(2)(H) of NEPA.
  - Environmental impacts of the proposed action and alternatives.
- List the federal and state agencies and the state, tribal, and local governments and agencies consulted; include the name of the person consulted.
- Provide a unique identification number for tracking purposes, which the agency shall reference on all associated environmental review documents prepared for the proposed action and in any database or tracking system for such documents.
- For applications to the agency requiring an EA, the agency shall commence the EA as soon as practicable after receiving the application.
- If an agency publishes a draft EA, the agency shall invite public comment and consider those comments in preparing the final EA.

FHWA–RECOMMENDED EA FORMAT

Cover sheet
Purpose and need
Alternatives
Impacts and mitigation
Comments and coordination
Appendices

- Agencies shall involve the public as well as state, tribal, and local governments, relevant agencies, and any applicants, to the extent practicable, in preparing EAs.
- The text of an EA shall not exceed 75 pages, not including any citations or appendices.

4.2.5. FINDING OF NO SIGNIFICANT IMPACT (FONSI)

If the agency determines there will be no significant impacts, a FONSI will be prepared to conclude the process and document the decision. A FONSI is issued when environmental analysis and interagency review during the EA process determines that a project will have no significant impacts on the quality of the environment. The FONSI document is the EA modified to reflect all applicable comments and responses. If the WVDOH recommendation or selected alternative was not included in the EA, the FONSI must contain that information. No formal public circulation of the FONSI is required, but the state clearinghouse must be notified of the availability of the FONSI. In addition, FHWA recommends that the public should be informed through notices in local newspapers.

The FONSI shall include the EA or incorporate it by reference and shall note any other related environmental documents. If the EA is included, the FONSI need not repeat any of the discussion in the assessment but may incorporate it by reference.

The FONSI shall state the authority for any mitigation that the agency has adopted and any applicable monitoring or enforcement provisions. If the agency finds no significant impacts based on mitigation, the mitigated FONSI shall state the enforceable mitigation requirements or commitments that will be undertaken and the authority to enforce them, such as terms and conditions or other measures in a relevant permit, incidental take statement, or other agreement. The agency shall prepare a monitoring and compliance plan for that mitigation consistent with 42 USC § 4332(2)(C)(v) and (vi).

4.2.6. ENVIRONMENTAL IMPACT STATEMENT (EIS)

NEPA requires federal agencies to prepare EISs for major federal actions that significantly affect the quality of the human environment. An EIS is a full disclosure document that details the process through which a transportation project was developed, includes consideration of a range of reasonable alternatives, analyzes the potential impacts resulting from the alternatives, and demonstrates compliance with other applicable environmental laws and executive orders. The EIS process is completed in the

following ordered steps: (1) Notice of Intent, (2) draft EIS, (3) final EIS (FEIS), and (4) record of decision (ROD). See Flowchart 21.4 for the EIS/ROD process.

CEQ—RECOMMENDED EIS STANDARD FORMAT

- Cover sheet
- Summary
- Table of contents
- Purpose and need for action
- Alternatives including the proposed action
- Affected environment and environmental consequences
- Submitted alternatives, information, and analyses
- List of preparers
- Appendices

The Notice of Intent is published in the Federal Register by the lead federal agency and signals the initiation of the process. Scoping, an open process involving the public and federal, state, and local agencies, commences immediately to identify the important issues for consideration during the study. Public involvement and agency coordination continues throughout the process.

The draft EIS provides a detailed description of the proposal, the purpose and need, reasonable alternatives, and the affected environment and presents analyses of the anticipated beneficial and adverse environmental impacts of the alternatives. Following a formal comment period and receipt of comments from the public and other agencies, the FEIS will be developed and issued. The FEIS will address the comments on the draft and identify, based on analysis and comments, the "preferred alternative."

According to the CEQ, both the draft EIS and the FEIS must have a summary. The summary needs to be concise and comprehensible to the general public and technical reviewers. FHWA has prepared guidance on and a template for developing an EIS summary in a "reader-friendly" format. However, there is no required format for an EIS summary.

Consistent with 42 USC § 4337(e)(1), WVDOH shall ensure that the text of an EIS does not exceed 150 pages, or 300 pages for proposals of extraordinary complexity, excluding any citations or appendices. For proposed actions that have an unusual scope or complexity, WVDOH should limit the text of the draft EIS and FEIS to no more than 300 pages each. FHWA is responsible for determining whether a proposed action has unusual scope or complexity.

Pursuant to 42 USC § 4332(g), the 150 or 300-page limit applies to the core sections of the EIS, including the statement of purpose and need, alternatives analysis, affected environment, and environmental consequences. Consistent with FHWA's 2026 Updated NEPA Procedures, these page limits do not include the executive summary, appendices, citations, or materials incorporated by reference. In the case of a combined FEIS and ROD, the content specific to the ROD is excluded from the page count.

4.2.7. RECORD OF DECISION (ROD)

The ROD is the final step in the EIS process and may not be issued sooner than 30 days after the approved FEIS is distributed or sooner than 90 days after the draft EIS is circulated.

The ROD identifies the selected alternative, presents the basis for the decision, identifies all alternatives considered, specifies the "environmentally preferable alternative," and provides information on the adopted means to avoid, minimize, and compensate for environmental impacts.

4.2.8. REEVALUATIONS

Reevaluations should be thought of as a continuation of the NEPA project development process and are necessary at key points in the overall process to establish whether the NEPA document, determination, or final project decision remains valid for the subsequent federal action. During a reevaluation, attention is given to determining what changes have occurred in the project; this includes changes in the design or scope of a project, new or modified laws and regulations, circumstances or project area changes, or new information in general. The reevaluation will usually result in one of two conclusions: (1) the NEPA decision or documentation is valid or (2) additional analysis is required. A reevaluation provides information for the FHWA to determine whether the preparation of a new CE, EA, or supplemental EIS is necessary to advance the project (23 CFR § 771.129(c)).

The reevaluation of an approved NEPA document or decision is required prior to the request for FHWA action. The request for FHWA action might be a request for final design, ROW, or Plans, Specifications, and Estimates. Such requests generally arise when the study area has changed between the previous NEPA approval and the request for action, or a significant amount of time has passed.

The reevaluation will generally conclude with consultation between the project sponsor (WVDOH) and the FHWA regarding changes and other facts of the project, study area, and decision. The reevaluation will include discussion of any changes to the proposed project, new circumstances, new information (environmental, traffic, standards, etc.), final design or scope modifications; and new or revised environmental laws, regulations, or policies that have occurred since the CE, FONSI, or EIS/ROD was signed. The project files must document that consultation occurred, detail any changes, and include an assessment of the validity of the original NEPA decision. A written reevaluation may or may not be necessary. The need for a reevaluation will be determined through consultation between the lead federal agency and project sponsor.

In West Virginia, NEPA documents generally require reevaluation after three years from the WVDNR clearance letter date or when project modifications occur beyond the documented study area.

4.3. ESSENTIAL ELEMENTS OF NEPA DECISION-MAKING

The NEPA statute (42 USC §§ 4331 et seq.), as amended by the Fiscal Responsibility Act of 2023, addresses the basic decision-making framework and action-forcing provisions established in NEPA. The NEPA process allows transportation officials to make project decisions that balance engineering and transportation needs with social, economic, and natural environmental factors. During the process, a wide range of partners, including the public, businesses, interest groups, and agencies at all levels of government, provide input into project and environmental decisions.

The NEPA process encompasses but is not limited to:

- Public involvement
- Interagency coordination
- Agency and local coordination
- Purpose and need statements
- Alternatives analysis
- Impacts
- Mitigation
- Mapping/graphics/exhibits

NEPA documentation has three core principles:

1. Tell the story of the project. Make sure the reader can easily understand the purpose and need, how each alternative would meet the project goals, and the strengths and weaknesses of each alternative.
2. Keep it brief. Use clear and concise writing, an easy-to-follow format, effective graphics and visual elements, and discuss issues and impacts in proportion to their significance.
3. Meet all legal requirements. Ensure that the document meets all legal requirements in a way that is easy to follow for regulators and technical reviewers.

4.3.1. PUBLIC INVOLVEMENT

Engaging the public and local stakeholders in a systematic interdisciplinary approach is an essential part of the development process for proposed actions, as mandated by the NEPA statute (42 USC § 4332(a)). Each state must have procedures approved by the FHWA to carry out a public involvement / public hearing program pursuant to 23 USC § 128 and the FHWA's updated 2026 NEPA implementing procedures.

For more details on the specific WVDOH approach to public involvement see Section 9 of this manual.

4.3.2. INTERAGENCY COORDINATION

Interagency coordination plays a crucial role in making transportation decisions that are environmentally sound. The regulations set by the CEQ introduced the roles of "lead agency" and "cooperating agency" to simplify the environmental process; reduce redundancy in federal, state, and local procedures; and align NEPA requirements with other federal environmental review and consultation regulations.

A “lead agency” is a federal agency responsible for preparing a CE, EA, or EIS and ensuring compliance with NEPA requirements. The lead agency determines the appropriate environmental document and prepares it. When multiple federal agencies are involved in a proposed action, one agency is designated to oversee the preparation of the environmental review. Federal, state, tribal, or local agencies may also act as joint lead agencies.

A "cooperating agency" is a federal, state, tribal, or local agency with specific expertise related to an environmental issue or jurisdiction by law. The cooperating agency is invited by the lead agency to assist in the environmental review process by providing input and analysis on aspects of a proposed project within its area of expertise.

4.3.2.1. Lead Agency

A lead agency shall supervise the preparation of an EIS or EA if more than one federal agency does the following:

1. Proposes or is involved in the same action
2. Is involved in a group of actions directly related to each other because of their functional interdependence or geographical proximity

Under NEPA, when FHWA is the lead federal agency and "owner" of the resultant environmental document, FHWA assumes responsibility for the integrity of the NEPA process.

As the lead federal agency for NEPA, FHWA handles scoping, invites cooperating agencies, builds stakeholder consensus, resolves conflicts, and ensures transportation decisions are clearly detailed in environmental documents. These duties require FHWA to balance transportation needs, costs, environmental resources, safety, and public input to make sound decisions.

As the lead federal agency, FHWA takes the following actions:

- Pursues communication and collaboration with federal, state, and local partners in the transportation and environmental communities, including other modal administrations within the USDOT.
- Seeks new partnerships with tribal governments, businesses, transportation and environmental interest groups, resource and regulatory agencies, affected neighborhoods, and the public.
- Ensures that those historically underserved by the transportation system are included in outreach.
- Actively involves partners and all affected parties in an open, cooperative, and collaborative process, beginning at the earliest planning stages and continuing through project development, construction, and operations.
- Ensures the development of comprehensive and cooperative public involvement programs during statewide and metropolitan planning and project development activities.

With respect to cooperating agencies, the lead agency takes the following actions:

1. Requests the participation of each cooperating agency in the NEPA process at the earliest practicable time.
2. Considers any analysis or proposal created by a cooperating agency and, to the maximum extent practicable, uses the environmental analysis, proposal, and information provided by cooperating agencies.
3. Meets with a cooperating agency at the latter's request.
4. Determines the purpose and need and alternatives in consultation with any cooperating agency.

4.3.2.2. Cooperating Agencies

Upon request of the lead agency, any federal agency with jurisdiction by law can be a cooperating agency. In addition, upon the request of the lead agency, any federal agency with special expertise with respect to any environmental issue may be a cooperating agency. A state, tribal, or local agency of similar qualifications may become a cooperating agency by agreement with the lead agency.

Each cooperating agency shall do the following:

1. Participate in the NEPA process at the earliest practicable time.
2. Participate in the scoping process.

3. On request of the lead agency, assume responsibility for developing information and preparing environmental analyses, including portions of the EIS or EA that address the resources under the cooperating agency's area of expertise.
4. On request of the lead agency, make support staff available to enhance the lead agency's interdisciplinary capability.
5. Use its own funds (this is most common). To the extent permitted by available funds, the lead agency shall fund those major activities or analyses it requests from cooperating agencies. Potential lead agencies shall include such funding requirements in their budget requests.
6. Consult with the lead agency in developing and updating the schedule, meet the schedule, and elevate issues relating to the purpose and need, alternatives, or other issues that affect scheduling to the senior agency official of the lead agency as soon as practicable.
7. Meet the lead agency's schedule for providing comments.
8. To the maximum extent practicable, jointly issue environmental documents with the lead agency.

4.3.3. COORDINATION: LIST OF FEDERAL, STATE, AND LOCAL ENTITIES

Examples and templates of coordination letters and packets are available in Section 20. Under NEPA, coordination may be required with the following agencies:

Federal Agencies

- Advisory Council on Historic Preservation
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- U.S. Department of the Interior
- U.S. Environmental Protection Agency
- U.S. Department of Agriculture
- Native American Tribes

State Agencies

- West Virginia Department of Environmental Protection
- West Virginia Division of Natural Resources
- West Virginia State Historic Preservation Office
- Metropolitan Planning Organization

Local Government

- County officials
- City officials
- Local preservation groups

4.3.4. PURPOSE AND NEED STATEMENTS

The purpose of and need for a project is essential in establishing a basis for the development of the range of reasonable alternatives required in all NEPA documents. Development of the purpose also helps with the identification and eventual selection of a preferred alternative.

The following items may be listed and described in the purpose and need statement for a proposed action. Intended as a guide, these are by no means all-inclusive or applicable in every situation.

- **Project Status** — Briefly describe the action's history (including measures taken to date), other agencies and governmental units involved, spending, schedules, etc.
- **Capacity** — Discuss the capacity of the present facility and its ability to meet present and projected traffic demands. Discuss the capacity and performance goals for existing and proposed facilities and any recurring or non-recurring causes that may limit the capacity of the present facility or affect travel time reliability.
- **System Linkage** — Discuss whether the proposed action is a "connecting link" and how it fits into the transportation system. Such linkages may be physical or operational.
- **Transportation Demand** — Discuss the action's relationship to any statewide or regional transportation demand management plans or programs. Consider how transportation demand varies over the typical day or longer time periods. The objective is to support the safe and efficient management, operation, and development of surface transportation systems that meet the mobility needs of people and freight. This includes fostering economic growth and development within and between states and urbanized areas, connecting housing and employment, considering resiliency needs, and minimizing transportation-related fuel consumption and air pollution through metropolitan and statewide transportation planning processes. Additionally, it includes the aim of encouraging the ongoing improvement and evolution of these planning processes by metropolitan planning organizations, state departments of transportation, and public transit operators as shown in 23 USC §§ 134 and 135) (References and Links #19.1.3).

- **Legislation** — If there is a federal, state, or local mandate for the action, explain the mandate and its application to the project.
- **Social Demands or Economic Development** — Describe how the action will foster new employment and benefit schools, land-use plans, recreation facilities, etc. In addition, describe projected economic development / land-use changes that indicate the need to improve or add to the highway capacity.
- **Modal Interrelationships** — Explain how the proposed action will interface with and complement airports, rail and port facilities, mass transit services, etc.
- **Safety** — If the proposed action is necessary to correct an existing or potential safety hazard, explain the issue and how the project will address it. In addition, explain whether the existing accident rate is excessively high and why, and how the proposed action will improve safety.
- **Roadway Deficiencies** — Explain whether and how the proposed action is necessary to correct existing roadway deficiencies (e.g., substandard geometrics, load limits on structures, inadequate cross section, high maintenance costs, etc.) In addition, explain how the proposed action will correct the deficiencies.

4.3.5. ALTERNATIVES ANALYSIS

Identifying, considering, and analyzing alternatives are central to the NEPA process. Evaluating alternatives helps find a solution that meets transportation needs while protecting environmental and community resources. WVDOH often uses an environmental clearance zone to start the alternatives development and NEPA process. The environmental clearance zone should be used when the exact alternatives are not yet known. It should include enough area to cover all proposed alternatives, staging areas, and maintenance of traffic. The CEQ views this analysis as the core of NEPA documentation and mandates that agencies do the following:

- Evaluate all reasonable alternatives. For alternatives eliminated from detailed study, briefly discuss the reasons for their elimination.
- Devote substantial treatment to each alternative considered in detail, including the proposed action, so that reviewers may evaluate the comparative merits.
- Include reasonable alternatives not within the jurisdiction of the lead agency.
- Include the alternative of no action.
- Identify the agency's preferred alternative or alternative(s), in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.
- Include appropriate mitigation measures not already included in the proposed action or alternatives (References and Links #19.1.5).

Alternatives analysis should clearly indicate why and how the particular range of project alternatives was developed, including what kind of public and agency input was used. In addition, the alternatives analysis should explain why and how alternatives were eliminated from consideration. It must describe what criteria were used to eliminate alternatives, at what point in the process the alternatives were removed, who was involved in establishing the criteria for assessing alternatives, and the measures for assessing the alternatives' effectiveness.

When preparing NEPA documents, WVDOH needs to be transparent about the reasons for creating, assessing, and dismissing alternatives. Specificity is crucial. If an alternative is dismissed because it "does not meet the purpose and need," WVDOH must clearly explain how or why this alternative fails to fulfill those criteria.

In order to ensure meaningful evaluation of alternatives and to avoid commitments to transportation improvements before they are fully evaluated, the action evaluated in each CE, EA, or EIS shall do the following:

1. Connect logical termini and be of sufficient length to address environmental matters on a broad scope.
2. Have independent utility or independent significance—it should be usable and be a reasonable expenditure even if no additional transportation improvements in the area are made.
3. Not restrict consideration of alternatives for other reasonably foreseeable transportation improvements (23 CFR § 771.111(f)) (References and Links #19.1.2).

When developing a transportation project, WVDOH should consider how the end points of the action are determined, both for the improvement itself and for the scope of the environmental analysis. Whether the action has "logical termini" or not is also a concern. Logical termini for project development are defined as rational end points for both the transportation improvement and a review of the environmental impacts.

In developing a concept that can be advanced through the stages of planning, environmental review, design, and construction, WVDOH needs to consider a "whole" or integrated action. This action should satisfy an identified need, such as safety, rehabilitation, economic development, or capacity improvement. In addition, the action should be considered in the context of local socioeconomics and topography, future travel demand, and other infrastructure improvements. Without framing an action in this way, WVDOH may only peripherally meet project needs or may cause unexpected side effects that require additional corrective action. WVDOH should also be aware of the problem of "segmentation." Segmentation may occur when a transportation need extends throughout

an entire corridor, but WVDOH discusses the environmental issues and transportation needs of only a segment of the corridor.

4.3.5.1. Other Requirements Involving Alternatives Analysis

Beyond the CEQ requirement of evaluating all or a reasonable number of alternatives representative of the full spectrum of reasonable alternatives, there are other requirements for analyzing alternatives. These requirements fall under Section 4(f), the Executive Orders on Wetlands and Floodplains, and the Section 404(b)(1) guidelines. To address these requirements and conclusively demonstrate that some alternatives are not prudent or practicable, WVDOH must develop a well-justified purpose and need statement.

The use of land from a Section 4(f) protected property (such as a significant landmark, publicly owned park, recreation area, or wildlife and waterfowl refuge, or any significant historic site) may not be approved unless a determination is made that there is no feasible and prudent alternative for such use. Many factors exist that could render an alternative "not prudent," including cost and environmental impacts. If an alternative does not meet the action's purpose or need, then the alternative is deemed not prudent. More details on Section 4(f) resources can be found in Section 10 of this manual.

WVDOH will incorporate any community and human population impact evaluation findings early in the alternatives analysis development process to avoid the potential for adverse impacts.

If a proposed action is located in a wetland or significantly encroaches upon a floodplain, a finding must be made that there is no practicable alternative to the wetland impacts or floodplain encroachment. Any alternative that does not meet the need for the action is not practicable. If the action's purpose and need are not adequately addressed, specifically delineated, and properly justified, resource agencies, interest groups, the public, and others will be able to generate one or possibly several alternatives that avoid or limit the impact and appear practicable. A well-described justification of the action's purpose and need may prevent long and involved negotiations or additional analyses demonstrating that an alternative is not practicable.

Generally, if an alternative does not satisfy the purpose and need for the action, it should not be included in the analysis. However, there are times when an alternative that is not reasonable should be included, such as when another agency requests inclusion due to public expectation. In such cases, it should be clearly explained why the alternative is not reasonable (or prudent or practicable), why it is being analyzed in detail, and why it will not be selected.

4.3.6. REMOTE EFFECTS

Pursuant to 42 USC § 4332(2)(c), as amended by the Fiscal Responsibility Act of 2023, NEPA reviews must focus on the "reasonably foreseeable" environmental effects of the proposed agency action. In accordance with recent judicial clarification in Seven County Infrastructure Coalition v. Eagle County, Colorado (2025), agencies are generally not required to analyze effects that are remote in time or geography, or those resulting from separate projects over which the agency lacks regulatory authority.

4.3.7. MITIGATION

The NEPA process is intended to help public officials make decisions that are based on an understanding of environmental consequences and take actions that protect, restore, and enhance the environment.

In 2025, the U.S. Department of Transportation (USDOT) updated its specific procedures to streamline environmental reviews following the rescission of the centralized CEQ regulations. The USDOT's current framework for mitigation is primarily governed by USDOT Order 5610.1D, effective July 1, 2025. It includes the following elements:

- Avoiding the impact altogether by not taking a certain action or parts of an action.
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifying the impact by repairing, rehabilitating, or restoring the affected resource.
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation Sequencing:

Avoid → Minimize → Repair or restore → Reduce over time → Compensate

This ordered approach to mitigation is known as "sequencing" and involves understanding the affected environment and assessing transportation impacts throughout project development. Effective mitigation starts at the beginning of the NEPA process, and must be included as an integral part of the alternatives development and analysis process.

Further details about WVDOH specific mitigation and environmental commitments can be found in Section 17 of this manual.

4.3.8. MAPPING / GRAPHICS / EXHIBITS

Each environmental document must contain a highway map, a topographical map, and an aerial map. These maps should clearly indicate the project location, project coordinates (in decimal degrees), the north arrow, project name, state or federal project number, county, and the environmental clearance zone.

4.4. SPECIALIZED NEPA CLEARANCES

4.4.1 EMERGENCY PROTOCOL

The Emergency Protocol defines an emergency as any situation involving acts of God, disasters, casualties, national defense or security events, or other circumstances necessitating response actions on the state transportation system to prevent imminent loss of life or property. For example, when damage to a roadway prevents emergency responders from accessing a specific area, such a scenario qualifies as an emergency under this protocol. It should be noted that the onset of an emergency is marked by the date of the disaster itself, not the date on which an official declaration is made.

4.4.1.1. NEPA Clearance

Actions taken by the WVDOH in response to emergency situations may impact resources protected under NEPA when conditions preclude the implementation of standard screening or consultation procedures. The protocol delineates the appropriate process for immediate WVDOH response to emergencies, as well as the subsequent recovery phase following such events. Adherence to this protocol is essential to maintain legal compliance and to ensure eligibility for reimbursement of expenditures related to federally aided emergencies. The protocol is applicable to projects commencing physical work within 60 days of an emergency situation; projects initiated beyond this timeframe will adhere to standard NEPA clearance procedures.

4.4.1.2. Windshield Survey

When applicable, the Maintenance Engineer or Maintenance Manager will prepare a windshield survey containing essential project details and submit it to the WVDOH Statewide Disaster Coordinator. The coordinator will then forward this information to the WVDOH State Secretary's Office and other relevant WVDOH personnel. Subsequently, the State Secretary's Office will transmit both the windshield survey and the Letter of Intent to the FHWA Division Director. FHWA will ensure that all pertinent information is appropriately distributed to external agencies.

The windshield survey should include the following:

- Route number
- Route type (e.g., federal-aid highway or non-federal-aid highway)
- Funding authorizing agency (FEMA or FHWA)
- Stream name
- Beginning and ending mileposts
- Total length of the affected area
- Beginning and ending location coordinates
- Description of damage and required repairs
- Preliminary cost estimate
- Subject line of notification email must read: WVDOH Emergency Event (date)

4.4.1.3. Initial Contact to Federal Agencies

When the WVDOH identifies an emergency, it must promptly notify relevant state and federal agencies about the affected areas. If a potential ER event is identified, the WVDOH should inform FHWA as soon as possible by sending a Letter of Intent with a preliminary windshield survey; a complete survey will follow later. Agencies need not be contacted if repairs are outside their jurisdiction.

An FHWA representative will be responsible for doing the notification. The agencies to be notified are:

- Federal Emergency Management Agency (FEMA)
- US Fish and Wildlife Service (USFWS)
- US Army Corps of Engineers (USACE) Regulatory Project Manager
- United States Coast Guard (USCG)
- National Forest WVDOT Liaison
- National Park Service Park Superintendent
- State Historic Preservation Office (SHPO) Deputy State Historic Preservation Officer
- West Virginia Division of Natural Resources (WVDNR) Natural Resources Program Manager, 1-Coordination Program

- West Virginia Department of Environmental Protection (WVDEP) Environmental Resources Program Manager

The notification will provide details regarding the affected areas, date, scope, and cause of the emergency, as well as information gathered from the "windshield survey" of damages, if available. The District will submit the windshield survey to the WVDOH Statewide Disaster Coordinator, who will forward it to the State Secretary's Office for distribution to the FHWA Division Director, accompanied by a Letter of Intent. This documentation will be submitted to the relevant state and federal agencies by the FHWA as soon as it becomes available, with all necessary WVDOH personnel copied.

4.4.1.4. Documentation

Each WVDOH District is responsible for completing Sections 1–4 of the Emergency Project NEPA Form (Attachment 2), including damage details, maps, and photos, and submitting the package to the Environmental Section of the Engineering Division for approval. The Engineering Division then completes the remaining sections and returns the NEPA clearance packet to the District. All required NEPA documentation must be completed and submitted within 60 days of the emergency. The emergency NEPA form may only be used for projects that begin within this 60-day window; projects not started within that timeframe must follow the standard NEPA clearance process.

4.4.1.5. Response Action Taken

Immediate emergency repairs should be undertaken to restore transportation access for emergency responders while minimizing environmental impacts. During initial repairs, sediment and erosion control measures should be used to the greatest extent practical, following WVDEP and USFWS best management practices.

Work should minimize the following:

- equipment use and fill within normal stream pools,
- avoid stream straightening,
- ensure culverts and bridges allow aquatic passage,
- and limit disturbance to already affected areas.

For safety-related emergency repairs, state and federally listed species surveys may be waived, but all details of the repair actions, including the extent, duration, and method of disturbance, must be documented.

4.4.1.6. Section 7 Consultation

When emergency response actions do not allow time for standard consultation, the USFWS provides emergency consultation procedures under Chapter 8 of its Endangered Species Consultation Handbook. Even in emergencies, actions must minimize take and include an evaluation of impacts on affected species and habitats. After the fact, USFWS issues an emergency biological opinion analyzing effects, determining jeopardy, and documenting incidental take, conservation measures used to minimize impacts, the agency's success in implementing them, and the resulting effects on listed species and critical habitat.

4.4.1.7. Section 106 Clearance

Section 106 Clearance will follow the process laid out in the current Programmatic Agreement (PA) between FHWA, SHPO, the Advisory Council on Historic Preservation (ACHP), and WVDOH. The agreement is available on the WVDOH Highways Through History website. Section VIII – Emergency Situations of the PA addresses the Federal Aid Highway Program, as required by Section 106 of the National Historic Preservation Act of 1966 and its regulations, 36 CFR 800 (References and Links #19.3.2). If a project is not covered by the PA guidelines, coordination with SHPO will be necessary.

4.4.1.8. Permitting

The U.S. Army Corps of Engineers Nationwide Permit #3 and Regional General Permit B authorize the repair, rehabilitation, or replacement of structures or fill damaged or destroyed by discrete events such as storms, floods, or fires, provided work begins or is under contract within two years of the damage. In catastrophic events like hurricanes or tornadoes, this two-year limit may be waived by the District Engineer if WVDOH can demonstrate funding, contract, or similar delays, although individual Section 404 and/or 401 permits may still be required under certain conditions.

The following conditions will require the District Engineer to submit a Pre-Construction Notification (PCN) to the USCG District Engineer prior to commencing the activity.

- For all regulated activities in the Ohio River and the Kanawha River;
- For temporary structures, work, and discharges (including cofferdams) necessary for access fills or dewatering of construction sites occurring in, and regulated under, Section 10 waters when the primary activity is otherwise authorized by the USACE. The PCN must include a restoration plan showing how all temporary fills and structures will be removed, and the area restored to pre-project conditions;
- for temporary discharges of fill material that would exceed one year.

WVDEP 401 Water Quality Certification is pre-certified for this activity; however, will require written notification if a PCN is required by the USACE.

Generally, registration under the National Pollutant Discharge Elimination System Construction Stormwater General Permit (NPDES CSW Permit) is not required for activities involving removal of mud, debris, and similar materials resulting from natural disasters or isolated events. Sediment and erosion Best Management Practices (BMPs) should be implemented whenever feasible to mitigate further environmental impacts; reference the WVDEP E&S Control BMP Manual for guidance. If recovery operations transition into construction activities—such as rebuilding bridges or other infrastructure, a NPDES Permit must be obtained within 30 calendar days following the initiation of earth-disturbing activities covering one acre or more, thereby meeting eligibility requirements for the NPDES CSW Permit.

4.4.2 UTILITIES CLEARANCES

The utility company/project proponent completes a Utilities Project Form for submittal to WVDOH. If any question on the Utilities Project Form is answered with yes, the project proceeds normally with NEPA documentation on the PCE Type 1 form. If all answers are no, WVDOH responds to the project proponent stating no further coordination is necessary.

5. SECTION 7 ENDANGERED SPECIES ACT (ESA)

The ESA, 16 USC §§ 1531–1544 (1973), (References and Links #19.2.1) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing the ESA are the USFWS and the U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries.

The USFWS maintains a worldwide list of endangered species, including birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees.

The ESA requires federal agencies, in consultation with the USFWS and/or the NOAA Fisheries, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The law also prohibits any action that causes a "take" of any listed species. “Take” is defined as performing or attempting to perform the following activities: “to harass, hunt, shoot, capture, trap, kill, collect, wound, harm, or pursue any ESA-listed species.” Likewise, import, export, interstate, and foreign commerce of listed species are all generally prohibited.

The WVDOH, on behalf of the FHWA, must determine the possible effects that its project will have on any endangered, threatened or proposed species. For each proposed project, WVDOH must assess the following types of potential effects on ESA-listed species, focusing strictly on those that are reasonably foreseeable and have a reasonably close causal relationship to the project:

1. Direct Effects: Immediate and readily identifiable impacts on a species or habitat caused directly by the proposed action, like habitat destruction from construction.
2. Reasonably Foreseeable Effects: Impacts that occur later in time or are an effect of the action but are not immediate construction impacts (e.g., altered water quality impacting species downstream). These must be clearly linked to the project.

WVDOH can make one of the following determinations on behalf of FHWA after possible impacts are taken into consideration:

- **No effect determination** — When a proposed action is deemed to have no negative or positive impacts on listed species or critical habitat. No further consultation is required.
- **May affect, but not likely to adversely affect** — When a proposed action may have minor, beneficial, or insignificant effects on listed species or habitat. Full consultation is not required.

- **May affect, likely to adversely affect** — When a proposed action is likely to have negative impacts on listed species or critical habitat. This triggers formal consultation with the relevant agency.

5.1. INFORMAL CONSULTATION

Informal consultation is an optional process that includes all discussions, correspondence, etc., between the USFWS and WVDOH (the designated non-federal representative) and is designed to assist the federal agency in determining whether formal consultation or a conference is required. The goal of informal consultation is to minimize the impact of a project on listed species and critical habitats. The process can help identify potential problems early in the project development stage.

During informal consultation, the USFWS may suggest modifications that WVDOH could implement to decrease the likelihood of adverse effects to listed species or critical habitat. If during informal consultation it is determined by the WVDOH, with the written concurrence of the USFWS, that the action is not likely to adversely affect listed species or critical habitat, the consultation process is terminated, and no further action is necessary.

5.1.1. INFORMATION FOR PLANNING AND CONSULTATION (IPAC)

Information for Planning and Consultation (IPaC) (References and Links #19.2.4) is a project planning tool that streamlines the USFWS environmental review process. With projects that could potentially affect USFWS protected resources, such as migratory birds, ESA-listed species or critical habitat, interjurisdictional fishes, wetlands, or National Wildlife Refuge lands, IPaC can help determine what impacts are likely to occur from the project and provide suggestions for addressing them.

By obtaining this information early in the project development process, it can be easier to incorporate measures to minimize or avoid impacts, thereby avoiding potential project delays and saving time and money. IPaC is also designed to assist the USFWS with evaluating proposed impacts.

WVDOH will coordinate with the WVDNR Wildlife Diversity Division to determine whether any known bat hibernacula or records of state or federally listed species are within the project environmental clearance zone prior to completing the necessary determination keys on IPaC. WVDOH is responsible for completing the most recent set of determination keys provided on IPaC to determine potential project effects to ESA-listed species and their habitats.

5.1.2. USFWS SIMPLIFIED IPAC OUTPUT GUIDE FOR WVDOH

Early coordination and project planning can often expedite the environmental review process for federally listed species and their habitats. Table 5.1 lists threatened and endangered species found in West Virginia that are relevant to WVDOH projects. This guide provides general recommendations for transportation engineers to consider when planning and designing projects so that potential effects to federally listed species are avoided and/or minimized.

Table 5.1. Endangered, Threatened, or Proposed Species Associated with Specific Aquatic Habitats in West Virginia

Common Name	Scientific Name	Status	Critical Habitat in WV
Freshwater Mussels[1]			
Clubshell	*Pleurobema clava*	Endangered	No
Fanshell	*Cyprogenia stegaria*	Endangered	No
James spinymussel	*Pleurobema collina*	Endangered	No
Long-solid	*Fusconaia subrotunda*	Threatened	Yes
Northern riffleshell	*Epioblasma rangiana*	Endangered	No
Pink mucket	*Lampsilis abrupta*	Endangered	No
Rayed bean	*Villosa fabalis*	Endangered	No
Round hickorynut	*Obovaria subrotunda*	Threatened	Yes
Sheepnose	*Plethobasus cyphyus*	Endangered	No
Snuffbox	*Epioblasma triquetra*	Endangered	No
Spectaclecase	*Cumberlandia monodonta*	Endangered	No
Plants			
Harperella	*Ptilimnium nodosum*	Endangered	No
Northeastern bulrush	*Scirpus ancistrochaetus*	Endangered	No
Virginia spiraea	*Spiraea virginiana*	Threatened	No
Crustaceans			
Big Sandy crayfish	*Cambarus callainus*	Threatened	Yes
Guyandotte River crayfish	*Cambarus veteranus*	Endangered	Yes
Madison Cave isopod	*Antrolana lira*	Threatened	No
Fishes			
Candy darter	*Etheostoma osburni*	Endangered	Yes
Diamond darter	*Crystallaria cincotta*	Endangered	Yes

Note: Information from the complete July 2023 document can be found at the link found in Section 19 of this Guidance (References and Links #19.2.2).[1] Freshwater mussels that are not federally listed are protected and managed by the West Virginia Division of Natural Resources (WVDNR). For information on the distribution of freshwater mussel species and their protections, please contact the WVDNR.

By applying the guidance in the bullet lists below for each protected species during the early planning stages, the environmental screening process for federally listed species and their habitats will be streamlined.

Indiana bat / northern long-eared bat / tricolored bat

- If the project is in a known use area (per coordination with the WVDNR):
  - Avoid/limit tree clearing
  - Clear trees seasonally (November 15–March 31)
  - Avoid clearing trees >3 inches in diameter at breast height
- If the project is in potential habitat (forested areas) but not in a known use area:
  - Avoid/limit tree clearing

Plant species (harperella, northeastern bulrush, shale barren rock cress, small whorled pogonia, Virginia spiraea)

- Avoid work outside the right of way / previously disturbed areas

Madison Cave isopod

- Avoid work outside the right of way / previously disturbed areas
- Implement erosion and sediment (E&S) best management practices (BMPs) to minimize erosion and sedimentation from the project

Cheat Mountain salamander, flat-spired three-toothed land snail, rusty patched bumble bee

- Avoid work outside the right of way / previously disturbed areas

Freshwater mussels (snuffbox, clubshell, spectaclecase, fanshell, pink mucket, James spinymussel, tubercled pearlyblossom, rayed bean, sheepnose, purple cat's paw, northern riffleshel, green floaterl)

- Implement E&S BMPs to minimize erosion and sedimentation from project
- Avoid working below the ordinary high-water mark (OHWM)
- Avoid or minimize instream work
- Keep stream channel open during instream work
- Avoid permanent impacts to stream bottom or stream hydrology

Candy darter / diamond darter

- Implement E&S BMPs to minimize erosion and sedimentation from project
- Avoid work below the OHWM

- Avoid or minimize instream work
- Keep stream channel open during instream work
- Avoid permanent impacts to stream bottom or stream hydrology
- Avoid and/or minimize impacts to the riparian area (especially the vegetation)

Big Sandy crayfish / Guyandotte River crayfish

- Implement E&S BMPs to minimize erosion and sedimentation from project
- Avoid work below the OHWM
- Avoid or minimize instream work
- Keep stream channel open during instream work
- Avoid permanent impacts to stream bottom or stream hydrology
- Use impervious materials to construct unavoidable instream structure exteriors

5.2. FORMAL CONSULTATION

Formal consultation under the ESA is a mandatory process where a federal agency seeking to undertake a project that may affect a listed endangered or threatened species must formally request input from the USFWS to assess the potential impacts on the species and determine whether the project is likely to jeopardize the species' continued existence or adversely modify its critical habitat. This process culminates in a "biological opinion" issued by the USFWS outlining its findings and any required mitigation measures.

FHWA initiates formal consultation by submitting a written request to USFWS detailing the proposed project and its potential effects on listed species. The information is provided to USFWS in a biological assessment (BA). The preparation of the BA should follow the most recent BA checklist approved by FHWA/USFWS. The BA checklist can be found in the attachments, forms, and examples section of this manual. A BA evaluates the potential effects of an action on listed or proposed species or designated or proposed designated critical habitat to determine whether they are likely to be adversely affected by the project. Formal consultations determine whether a proposed agency's action(s) is likely to jeopardize the continued existence of a listed species (jeopardy) or destroy or adversely modify designated critical habitat (adverse modification).

The USFWS will analyze the proposed action, including its potential impacts on listed species and critical habitat. The USFWS may request additional information from the project proponent.

The formal consultation process concludes with the issuance of a "biological opinion" from the USFWS, which states whether the proposed action is likely to jeopardize the

continued existence of listed species or adversely modify critical habitat. If the biological opinion finds potential adverse impacts, the USFWS may recommend mitigation measures to minimize harm to the listed species.

In cases where a project is likely to jeopardize a listed species, the USFWS may suggest "reasonable and prudent alternatives" that could avoid or minimize the adverse impacts.

5.3. WVDNR/USFWS SURVEY PROTOCOLS AND TIME PERIODS

Table 5.2 lists survey timeframes for relevant West Virginia species. Links and discussions of specific animal and plant survey protocols for West Virginia are provided in the sections below.

Table 5.2. Survey Timeframes

Survey/Restriction	Start Date	End Date
Freshwater mussel survey	May 1	September 30
Bats—mist net survey	May 15	August 15
Bats—portal survey	September 15	October 31
Time-of-year tree-clearing restriction	November 15	March 31
Bald eagle survey	February 15	April 15
Madison Cave isopod survey	No survey time limits	
Candy darter—spawn survey	April 15	June 30
Flat-spired three-toothed land snail survey	March 1	June 30
Cheat Mountain salamander survey	April 1	October 31
*Northeastern bulrush survey	August 1	September 30
Harperella survey	July 1	September 30
*Shale barren rockcress survey	August 1	September 30
Virginia spiraea survey	June 1	September
Small whorled pogonia survey	May 1	September 30
Crayfish surveys	October 1	July 10

*Species USFWS has proposed to delist.

5.3.1. BATS

The survey protocol for bats can be found on the USFWS West Virginia Field Office (WVFO) website (References and Links #19.2.3).

5.3.2. FRESHWATER MUSSELS

The survey protocol for freshwater mussels can be found on the WVDNR website (References and Links #19.2.6).

5.3.3. CRAYFISH

The survey protocol for threatened and endangered crayfish can be found in the attachments, forms, and examples section of this manual. Check with the USFWS WVFO, Transportation Liaison, for any recent changes prior to submitting a study plan for approval.

5.3.4. CHEAT MOUNTAIN SALAMANDER

The Cheat Mountain salamander Presence/Probable Absence Protocol can be found in the attachments, forms, and examples section of this manual. It is still in the piloting phase, and USFWS continues to solicit feedback from those who implement the protocol each season to see whether changes to the protocol are advised. USFWS typically sends out the revised protocol to the approved surveyors in May of each year for that year's survey season. Check with the USFWS WVFO, Transportation Liaison, for any recent changes.

5.3.5. CANDY DARTER AND DIAMOND DARTER

The USFWS WVFO does not have a formal protocol for surveying for candy or diamond darter. If the project falls within known use areas for either of these species, contact the WVFO for next steps.

5.3.6. FLAT-SPIRED THREE-TOOTHED LAND SNAIL

The snail Presence/Probable Absence Protocol is available in the attachments, forms, and examples section of this manual. Please consult with the WVFO and the WVDNR endangered species section to determine whether any amendments to the protocol are recommended prior to implementation.

5.3.7. MADISON CAVE ISOPOD

The USFWS WVFO does not have a standardized survey protocol in place for this species. Therefore, it is recommended that surveyors submit their proposed survey protocols to the WVFO for review and approval prior to implementation. Surveyors are advised to consult with the WVDNR, the WVDEP, or other relevant academic resources that document previously conducted surveys for this species or similar species to obtain example protocols or guidelines upon which to base their protocols.

5.3.8. PLANTS

The survey protocol for threatened and endangered plants can be found on the USFWS WVFO website (References and Links #19.2.5).

6. SECTION 106 AND THE NATIONAL HISTORIC PRESERVATION ACT (NHPA)

6.1. INTRODUCTION

This section outlines the principles and procedures for considering cultural resources during the development of transportation improvement projects by WVDOH. It is WVDOH's policy to create timely transportation projects that also address social, economic, and environmental concerns, including those associated with historic properties, in a balanced manner. While striving to enhance safety, access, mobility, and efficient movement of people and goods, WVDOH also aims to execute projects that elevate the quality of life in West Virginia and promote sustainable and livable communities. West Virginia's historic towns, buildings, farms, and bridges are integral to the state's identity and quality of life for many residents. Consequently, WVDOH must consider protecting West Virginia's heritage and endeavor to avoid impacting historic properties that are listed, or eligible for listing, on the National Register of Historic Places (NRHP). See Flowchart 21.5 for the Section 106 Process Overview.

6.2. GOVERNING LAWS, REGULATIONS, AND GUIDANCE DOCUMENTS

6.2.1. THE NATIONAL HISTORIC PRESERVATION ACT (NHPA)

The NHPA, established in 1966 and subsequently amended, requires the federal government to promote a balance between the purpose and needs of modern development (federal undertakings) with historic resources. A federal undertaking is defined as, "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency, those carried out with federal financial assistance, and those requiring a federal permit, license, or approval" (36 CFR § 800.16(y)).

The spirit of the NHPA broadly mandates the need for leadership and guidance in preservation, established through a partnership between the federal government and state, tribal, and local governments. The NHPA established a framework to accomplish this effort and created the ACHP, which created the federal process (36 CFR Part 800) to be followed and ultimately established the State Historic Preservation Offices that provide technical leadership in each state.

Section 106 of the NHPA requires federal agencies to consider the impact of their actions on historic properties and provide the ACHP with an opportunity to comment on projects before implementation. The process for fulfilling Section 106 is outlined in regulations issued by the ACHP, entitled "Protection of Historic Properties" (36 CFR Part 800)

(References and Links #19.3.2). ACHP additionally offers a user-friendly digital educational portal to host and explain 36 CFR Part 800 (References and Links #19.3.3)

The FHWA and USACE are responsible for fulfilling the requirements of Section 106 on all the projects that they assist, fund, permit, license, or approve in West Virginia. For FHWA, this includes traditional highway development and improvement projects. For USACE, this includes permits issued pursuant to Section 404 of the Clean Water Act. FHWA has, in turn, delegated some of the process for implementing the requirements of Section 106 to WVDOH through a PA executed on February 3, 2016, discussed in Section 6.2.2.

Section 110 of the NHPA specifies the obligations of federal agencies, which includes the establishment of preservation programs, and it designates Federal Preservation Offices to coordinate their historic preservation activities. Section 110 also provides protection for National Historic Landmarks. Section 110 specifies that,

> Prior to the approval of any Federal undertaking which may directly and adversely affect any National Historic Landmark, the head of the responsible Federal agency shall, to the maximum extent possible, undertake such planning and actions as may be necessary to minimize harm to such landmark, and shall afford the Advisory Council on Historic Preservation a reasonable opportunity to comment on the undertaking.

Since its original passage, the NHPA has been amended and expanded a number of times, the most substantial of which occurred in 2004. Most recently in 2014, Public Law 13-287 moved its provisions from Title 16 of the U.S. Code to Title 54, with minimal changes to the text and a reordering of some of its provisions.

The State of West Virginia also created state-level regulations that implement standards and procedures regarding historic preservation, entitled “West Virginia Code of State Rules, Title 82, Legislative Rule Division of Culture and History” (References and Links #19.3.8).

6.2.2. SECTION 106 PROGRAMMATIC AGREEMENT AMONG FHWA, WVSHPO, ACHP, AND WVDOH

FHWA, the West Virginia State Historic Preservation Office (WVSHPO), the ACHP, and WVDOH came to an agreement on stipulations that take into account the effects of the Federal-aid Highway Program on historic properties in West Virginia and agreed that these stipulations shall govern compliance of the Federal-aid Highway Program with Section 106 of the NHPA, all of which is outlined within the program-wide Section 106 “Programmatic Agreement (PA) Among the Federal Highway Administration, the West

Virginia Division of Culture and History, the ACHP, and the West Virginia Division of Highways Regarding the Federal Aid Highway Program in West Virginia" (References and Links #19.3.11).

Broadly, the Section 106 PA streamlines the methods by which FHWA and WVDOH review individual undertakings on minor transportation projects processed as CEs under NEPA. Any projects that require an EA or EIS for compliance with NEPA will follow the procedures outlined in 36 CFR Part 800. Similarly, any project that affects a property identified by a federally recognized Tribe or Nation as possessing traditional religious and cultural significance shall not be governed by the agreement but instead shall be reviewed by FHWA. See additional details regarding tribal consultation below in Section 6.2.3.

Apart from tribal consultation, the Section 106 PA provides guidance on the participation of other consulting parties and the general public. In short, any individuals and organizations with a demonstrated historic, economic, or legal interest in the undertaking shall be invited by WVDOH, in consultation with FHWA, to participate in the Section 106 process. Additionally, WVDOH will seek and consider the views of the public in a manner that reflects the nature and complexity of the undertaking, its effects on historic properties, and the interest of the public in the effects on historic properties. Further detail regarding WVDOH's public involvement plan can be found in Section 9, Public Involvement.

The Section 106 PA also establishes two tiers of projects (Appendix A: Projects with No Potential to Cause Effects and Screened Projects) that require different levels of review and consultation with the WVSHPO under this agreement. Additional details regarding these two tiers are discussed in Section 6.4 below.

Cultural resources will be evaluated independently for each undertaking and will follow the processes outlined in Appendix B (Historic Resources) and Appendix C (Archaeological Resources) found within the Section 106 PA.

6.2.3. CONSULTING PARTIES

Placeholder

6.2.4. TRIBAL CONSULTATION GUIDANCE FOR FHWA AND WVDOH

Some Tribes and Nations are recognized as having their own federal government status (25 CFR § 83) and are identified as a Section 106 consulting party. Federal agencies, including FHWA, have legal requirements to solicit comments from federally recognized Tribes and Nations and provide meaningful opportunities for consultation (References and Links #19.3.5). State agencies navigating this process frequently rely on standard procedural frameworks to ensure compliance with federal preservation law during project

development (References and Links #19.3.4). Relevant legislation, regulations, and references include the following:

- Section 101(d)(6)(B) of the NHPA
- The United States Department of Transportation Order 5301.1 (2017)
- Archaeological Resources Protection Act (16 USC § 470aa et seq.)
- Native American Graves Protection and Repatriation Act (43 CFR Part 10)
- Executive Order 12875 ("Enhancing the Intergovernmental Partnership")
- Executive Order 13007 ("Indian Sacred Sites")
- Executive Order 13084 ("Consultation and Coordination With Indian Tribal Governments")
- Executive Order 13175 ("Consultation and Coordination With Indian Tribal Governments")
- Executive Memorandum (2004) Government-to-Government Relationship with Tribal Governments
- Presidential Memorandum (2009) Tribal Consultation
- Presidential Memorandum (2021) on Tribal Consultation and Strengthening Nation-to-Nation Relationships
- American Indian Religious Freedom Act of 1978 (42 USC Chapter 21 Subchapter 1 § 1996)

As a result of these laws and regulations, tribal consultation must occur with Tribes and Nations when the Tribe or Nation attaches religious and/or cultural significance to historic properties regardless of whether they are on or off tribal land. Although tribal lands are not located within West Virginia, historic properties significant to Tribes and Nations may be present throughout the state and could be affected by WVDOH projects.

Consultation is a formal two-way federal government to federal government dialogue between official representatives of tribes and federal agencies, and the consultation must occur throughout the process. WVDOH, on behalf of FHWA and with the consent of Tribes and Nations, will solicit interest in consultation, transmit project documentation, and perform routine coordination with the Tribes and Nations. FHWA at its discretion or through a request of a Tribe or Nation may take control of coordination at any time.

The WVDOH procedures for tribal consultation, in addition to the Tribes and Nation Contact Matrix (WVDOH 2016b), are outlined and found within the "Tribal Consultation Guidance for the Federal Highway Administration, West Virginia Division and the West

Virginia Department of Transportation, Division of Highways" (References and Links #19.3.12).

6.2.5. WEST VIRGINIA GUIDELINES FOR PHASE I, II, AND III ARCHAEOLOGICAL INVESTIGATIONS AND TECHNICAL REPORT PREPARATION

The WVSHPO developed a set of guidelines to complete archaeological investigations within the state boundaries, entitled "Guidelines for Phase I, II, and III Archaeological Investigations and Technical Report Preparation" (References and Links #19.3.13). Included within the guidelines are professional qualifications for an archaeological principal investigator that follows (or matches) the Secretary of the Interior standards (36 CFR Part 61), a guide for conducting literature reviews and file searches, direction on phased field methods, guidance on how to record and document archaeological sites, guidance on how to evaluate NRHP eligibility, report preparation outlines, and curation guidelines.

6.2.6. WEST VIRGINIA NATIONAL REGISTER AND ARCHITECTURE / HISTORY SURVEY MANUAL

The WVSHPO developed a set of guidelines to complete aboveground historic properties investigations within the state boundaries, entitled "West Virginia National Register and Architecture / History Survey Manual" (References and Links #19.3.14).

In Part 1 of the manual, guidance is provided to specialists conducting architectural and historical surveys that will become part of the West Virginia Historic Property Inventory (WV HPI). In addition to survey standards, this section provides information about fieldwork, photography, mapping, reporting, and cataloging. Part 2 of the manual provides standards for state and federal agencies to comply with Section 106 of the NHPA and Title 82 of the West Virginia Code of State Rules. The standards include the development of the area of potential effects (APE), the identification of historic resources, NRHP eligibility evaluation, effect determination, and the resolution of adverse effects. Part 3 of the manual provides guidance for the preparation of NRHP nominations.

6.3. DEVELOPMENT OF THE AREA OF POTENTIAL EFFECTS / ENVIRONMENTAL CLEARANCE ZONE

One of the early goals of a project is to establish the APE, which is the area within which the project may have an effect on historic properties. The APE for archaeological properties can sometimes be delineated in the same way as an APE for aboveground historic properties; however, often the two APEs are very different. WVDOH also uses an environmental clearance zone (ECZ) early in its project development process.

6.3.1. AREA OF POTENTIAL EFFECTS VS. ENVIRONMENTAL CLEARANCE ZONE

The ACHP defines an APE in 36 CFR § 800.16(d) as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

The APE is always specific to the project, and it can be defined, at least preliminarily, when project alternatives have been developed conceptually. The APE can then be redefined as project design progresses.

Often two separate APEs are needed. The first is defined as an archaeology APE that considers direct effects, and the second is defined as an aboveground historic properties APE that also considers indirect effects within a broader area.

Often, WVDOH also uses an ECZ. The ECZ is initiated by the NEPA Compliance and Permitting Section to use when pre-screening projects, long before alternative designs or a preferred alternative are available. The ECZ is used to initiate the NEPA process and alternatives analysis and should be delineated over a large enough area to confidently include all of the potential alternatives and associated activities, including Required Rights of Way (RROW), Temporary Construction Easements, and any Maintenance and Protection of Traffic (MPT).

6.3.2. AREA OF POTENTIAL EFFECTS FOR ARCHAEOLOGICAL PROPERTIES

Archaeological investigations for WVDOH will typically be conducted within the Limits of Disturbance (LOD) as defined by the limits of project-specific cuts and fills, RROW, temporary construction easements, and MPT found within the Preliminary Field Review plan set. In these cases, the APE for archaeology corresponds to the LOD.

On projects where the LOD is yet undetermined, archaeological investigations may instead be conducted within the broader ECZ, which would be considered as an earlier preliminary archaeology APE. When this occurs, the APE is more likely to be redefined as project design progresses. Reasons for using the ECZ as the APE vary but may include assisting with an alternatives analysis to better understand potential impacts per alignment, which often occurs on large corridor projects. Other considerations are project specific and may include project schedules, anticipated alignment preferences, and anticipated survey costs. The use of an LOD or an ECZ as the archaeology APE is determined by the WVDOH archaeology professional.

6.3.3. AREA OF POTENTIAL EFFECTS FOR ABOVEGROUND HISTORIC PROPERTIES

The APE for aboveground historic properties should be coordinated with the WVDOH historic structures professional. It may correspond to the project's ECZ, or it may need to cover a larger area to appropriately account for possible indirect effects of the project, including visual, auditory, and/or atmospheric effects. The extent of the APE will be influenced by the project area (for instance, whether there is a broad riparian area separating historic farm fields from the project area or a dense tree cover screening views from surrounding buildings) and by the anticipated project activities (for instance, a simple culvert repair project likely would not require as extensive an APE as new highway construction may).

6.4. ENVIRONMENTAL SCREENING

6.4.1. APPENDIX A

See Section 6.2.2 for a link to the Section 106 PA between FHWA, WVSHPO, ACHP, and the WVDOH. See Flowchart 21.6 for Section 106 Architecture and History consultation process.

6.4.1.1. Projects with No Potential to Cause Effects

Section VII of West Virginia's Section 106 PA provides this explanation of projects with no potential to cause effects:

1. Certain projects have no appreciable potential to affect historic properties, whether or not there may be historic properties in the project area. The signatories to this Agreement agree that minor projects limited to the activities listed in Appendix A will require no further coordination pursuant to 36 CFR § 800.3(a). Projects comprising additional activities not included in Appendix A will be subject to screening as provided for in stipulation VII.B of this agreement.
2. WVDOH may add additional activities to the list in Appendix A upon written notice to and concurrence from all parties to this agreement
3. For projects that are limited to the activities listed in Appendix A, WVDOH will document its finding that the action has no potential to cause effects and maintain that documentation in its project files

Appendix A describes 13 project types that are recognized as having no potential to cause effects, including activities such as general highway maintenance and repair, guardrail replacement where no new bank stabilization is required, and the installation and maintenance of highway signs, among others.

6.4.1.2. Screened Projects with Potential to Affect Historic Properties

The Section 106 PA also provides a procedure for the initial screening of projects by the WVDOH cultural resource staff to consider new projects and the level of effort of cultural resource investigations that will be needed. The first stipulation explains the steps taken by WVDOH cultural staff to initiate project screening. Stipulations 2 and 3 explain the different conditions under which a project may be exempted from Section 106. The fourth stipulation outlines the process to follow when resources are identified within the APE:

1. WVDOH cultural resource staff will evaluate each undertaking for potential effects to historic properties. These evaluations shall include a review of the state's cultural resource records and a review of aerial photography and mapping records. Field investigations will be performed at the discretion of WVDOH's cultural resource staff. WVDOH will document each project with the forms contained in Appendices B, C, and D.
2. If an undertaking is limited to the activities listed in Appendix A, is not located within or adjacent to historic properties, and has no known public controversy related to historic properties, then no further coordination pursuant to Section 106 shall be required.
3. For those undertakings in which there are (a) no previously recorded historic properties within the APE, and (b) no newly identified historic properties within the APE, WVDOH's cultural resource staff will document the review on the Review Exempt form in Appendix D.
4. If there are resources identified within the APE:
    a. WVDOH's cultural resource staff will apply the National Register Evaluation Criteria in coordination with the WVSHPO and, if appropriate, other consulting parties to assess the need for any additional investigation and determine National Register eligibility in accordance with 36 CFR § 800.4.
    b. If the APE may contain properties of traditional cultural and religious significance to Tribes and Nations, or identified properties within the APE may be of interest to Tribes and Nations, FHWA will initiate consultation with such groups.
    c. WVDOH will apply the criteria of adverse effect to any historic properties in consultation with the WVSHPO and, if appropriate, other consulting parties, in accordance with 36 CFR § 800.5.
    d. WVDOH shall include the following documentation in the project file:
        i. Any records on consultation.
        ii. Any records on efforts to identify historic properties.

iii. Any findings of eligibility.

iv. Any findings of effect.

v. Any records on resolving adverse effects.

5. For all undertakings requiring the preparation of an EA or EIS under NEPA; or for undertakings in which adverse effects to historic properties cannot be avoided, WVDOH's cultural resource staff will notify FHWA, and FHWA will notify ACHP of the finding of adverse effect. WVDOH, on behalf of FHWA, shall consult with the WVSHPO and other consulting parties in order to resolve adverse effects and conclude the Section 106 process in accordance with 36 CFR § 800.6.

Appendix B of the Section 106 PA includes a Historical Pre-Screening Checklist, which can be used by WVDOH staff, as warranted, to document and evaluate the degree of involvement for cultural resources in a project (References and Links #19.3.11).

Appendix C has a similar document that acts as an Archaeology Pre-Screening Checklist. Appendix D provides a Review Exempt Form for Screened Projects. These forms will be used to guide whatever additional cultural resource efforts may be necessary for a given project, and they will be added to the project's files for documentation.

6.4.2. APPENDIX B

See Section 6.2.2 for a link to the Section 106 PA between FHWA, WVSHPO, ACHP, and the WVDOH.

6.4.2.1. No Historic Resources Present

No Historic Resources Present is one possible outcome from applying the Pre-Screening Checklist. If no historic resources are present, then the PA applies, and the WVDOH cultural resources staff historian completes the State Review Exempt Form (Appendix D) to finalize NHPA Section 106 Review.

6.4.2.2. Historic Resources Potentially Present

If the Pre-Screening reveals that historic resources are potentially present, then the project needs additional review and assessment by a historian. The historian can be a member of the WVDOH cultural resources staff with the proper qualifications or a consultant(s) who meets or exceeds the Secretary of the Interior (SOI) Professional Qualifications Standards (published in 48 Federal Register 44738–44739). This stage can have two possible outcomes. Either the additional investigation completed by the historian determines that no historic resources are present and the Section 106 exemption applies (complete and file the State Review Exempt Form from Appendix D and save it with project files), or those resources will need to be formally evaluated for their eligibility for listing in the NRHP. If the resource is determined to be NRHP eligible, then the potential

effects associated with the proposed project will also need to be determined. In this scenario, it will be necessary to consult with the WVSHPO and consulting parties.

6.4.3. APPENDIX C

Appendix C can be used when projects meet the stipulations outlined in Appendix A of the PA.

WVDOH will complete the initial environmental screening for archaeological resources. WVDOH will then apply the Archaeology Pre-Screening Checklist (References and Links #19.3.11).

6.4.3.1. No Potential for Archaeological Resources to Be Present

If there is no potential for archaeological resources to be present within the APE/ECZ, then the PA applies. The WVDOH archaeologist will complete a State Review Exempt Form (Appendix D) to finalize the NHPA Section 106 Review (References and Links #19.3.11).

6.4.3.2. Archaeological Resources Potentially Present

If WVDOH identifies archaeological resources within the APE/ECZ (see Section 6.3.1 and Section 6.5), then WVDOH will also then evaluate the NRHP eligibility of the archaeological resource and develop an effect finding associated with the proposed project (see Section 6.7). The WVDOH archaeologist will submit the Phase I archaeological resources report to the WVSHPO; the report will include the NRHP eligibility determination for concurrence or recommendations for further work.

WVDOH will then coordinate the eligibility of the archaeological resource and the effect finding with WVSHPO.

6.5. IDENTIFICATION AND EVALUATION

To be consistent with 36 CFR § 800.4, WVDOH will make a reasonable and good faith effort to identify historic properties (i.e., historic properties that are eligible for or listed in the NRHP), which may include background research, consultation, oral history interviews, sample field investigation, and/or field survey. The level of effort will take into account the magnitude and nature of the project, prior studies completed in the vicinity, and the nature and extent of potential effects to archaeological and aboveground historic resources. The SOI “Standards and Guidelines for Archaeology and Historic Preservation” provide some guidance on this process (References and Links #19.3.6). (Please note that these are guidelines and are not regulatory.)

The NPS also provides detailed guidance in its “National Park Service Bulletin: How to Apply the National Register Criteria for Evaluation” regarding the evaluation of a historic

property, whether that property is an archaeological resource, an aboveground historic resource, or both. (References and Links #19.3.7.)

To evaluate the historic property for NRHP eligibility, it must have three qualities or meet a special criteria consideration. Those three qualities include age, significance, and integrity.

The age requirement is typically 50 years old (or sometimes 45 years for compliance projects as stated above), but there is a Criteria Consideration (G) that allows for the consideration of "Properties that Have Achieved Significance Within the Past Fifty Years," if they are of exceptional importance. An example would include the Flight 93 National Memorial in Somerset County, Pennsylvania.

The significance requirement is divided into four broad criteria:

- Criterion A — Event
- Criterion B — Person
- Criterion C — Design/Construction
- Criterion D — Information Potential

The requirement of integrity is measured by seven aspects (location, setting, design, materials, workmanship, feeling, and association) to determine whether a historic property remains intact enough to convey its significance. A historic property can be significant in more than one area, and it does not need to retain all of the aspects of integrity. WVDOH makes an eligibility recommendation for the historic property and coordinates with the WVSHPO for confirmation.

6.5.1. ARCHAEOLOGICAL RESOURCES

The WVSHPO's "Guidelines for Phase I, II, and III Archaeological Investigations and Technical Report Preparation" provides guidance on the identification and evaluation of below-ground archaeological resources (References and Links #19.3.13). The guidelines represent minimum standards and do not preclude innovative strategies.

Included within the guidelines are professional qualifications for principal investigators (36 CFR Part 61), a guide for conducting literature reviews and site-file searches, current curation regulations, and provisions for encountering human skeletal remains.

Phase I archaeological investigations is a phased method to identify whether precontact or subsurface historic resources are present within the APE. Phase I surveys consist of a combination of background research and fieldwork designed to identify resources and define site boundaries within an archaeological APE.

Phase II archaeological investigations are conducted to evaluate an archaeological site's eligibility for inclusion in the NRHP. How the archaeological site is evaluated varies widely from one site type to another and should be determined by the SOI qualified (36 CFR Part 61) archaeologist and through consultation between WVDOH and WVSHPO.

On a majority of projects, archaeological sites have their eligibility assessed based on the site's information potential (Criterion D). Although much more uncommon, archaeological sites also can be separately eligible based upon one of the other three criteria, or a combination of criteria that may or may not include Criterion D. Each eligibility evaluation is resource specific.

6.5.2. ABOVEGROUND HISTORIC PROPERTIES

The WVSHPO's "West Virginia National Register and Architecture / History Survey Manual" provides detailed guidance on the identification and evaluation of aboveground historic properties (References and Links #19.3.14).

A WV HPI form is used to record and evaluate individual historic resources. A historic resource (or aboveground historic property or historic structure) means any historic district, site, building, structure, or object that is listed in or eligible to be listed in the NRHP.

Once the aboveground historic properties APE has been developed, the APE can be surveyed for resources that are at least 45–50 years old. Fifty years is the typical threshold for NRHP eligibility, but 45 years is often used to acknowledge that project development may extend over several years. Once a potential historic property is identified, it should be documented in a WV HPI form. An abbreviated version of the form may be used if the resource has an apparent lack of integrity and/or significance. For instance, if a building has undergone substantial alterations (the replacement of its cladding materials or a change in its window/fenestration patterns or an altered profile from a large addition), it may have an apparent lack of integrity. If it is necessary to conduct research to determine whether a historic resource may be eligible for NRHP listing, it will be necessary to supplement the WV HPI form with additional pages that establish the condition and context of the resource and evaluate its integrity and significance (References and Links #19.3.9).

Information on the form should include the property's address, common and historic name, date of construction, style, materials, property use or function, a narrative physical description, and a statement of significance. The form should be illustrated with current maps and photographs.

6.6. PROJECT-SPECIFIC PROGRAMMATIC AGREEMENTS

A project-specific PA may be used under certain circumstances, such as when effects to historic properties are not known prior to the approval of the NEPA document (36 CFR § 800.14(b)(1)). While uncommon, a PA may be used on larger projects, for example, where archaeological testing may not be completed prior to the approval of the NEPA document.

The content of a PA will be specific to the project and, therefore, will vary. The introductory section consists of "whereas" clauses, which provide a history of the project and how the Section 106 portion of the project developed to need a PA. Stipulations then follow that detail and commit the WVDOH to completing project-specific tasks. For example, although an adverse effect may not yet be determined, a PA may include a stipulation that states WVDOH will complete mitigation to resolve an adverse effect, if such an adverse effect is determined. A PA is different from a Memorandum of Agreement (MOA), which is discussed in Section 6.9.1.

Signatories on the PA will include, at minimum, the applicant (WVDOH), the lead federal agency (FHWA), and the lead consulting agency (WVSHPO). In most cases, the ACHP will not be involved. If the ACHP has elected to participate as a signatory, FHWA will be responsible for coordination with the ACHP.

Signatories have the authority to execute, amend, or terminate the agreement (36 CFR § 800.6(c)(1)).

Consulting parties will be invited to participate in the development of the measures that will be included within the PA. As a result, they will be invited as concurring parties to the PA. Concurring parties are not required to sign the PA for its execution, and the agreement may proceed without their signatures. Concurring parties do not have the authority to execute, amend, or terminate the PA.

The PA, once executed, is a legally binding agreement between the signatories.

6.7. DETERMINATION OF EFFECTS

Once an eligibility determination has been made, and when eligible or listed historic properties are located within the APE, the potential effects of the project on these properties need to be evaluated.

The WVDOH cultural resources staff will determine whether the project will have an effect on historic properties. A project is considered to have an effect when the characteristics of the property qualifying it for inclusion in the NRHP are altered (36 CFR § 800.16(i)).

If it is determined that historic properties are affected, then the criteria of adverse effect (36 CFR § 800.5(a)(1)) must be applied. The outcome will either be a determination of no adverse effect or adverse effect.

An adverse effect exists when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify it for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, design, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the NRHP. Adverse effects include those caused by the undertaking, specifically excluding effects from other projects separate in time or place. Examples of adverse effects are given at 36 CFR § 800.5(a)(2).

If the outcome of the evaluation is no adverse effect, WVDOH shall maintain a record of the finding and provide information on the finding to the public on request, which is consistent with the confidentiality provisions of 36 CFR § 800.11(c). Implementation of the undertaking in accordance with the finding, as documented, fulfills the FHWA's responsibilities under Section 106 and 36 CFR § 800.11. If WVDOH will not conduct the undertaking as proposed in the finding, it shall reopen consultation under 36 CFR § 800.5(a).

If the outcome is an adverse effect, WVDOH shall consult further to resolve the adverse effect pursuant to 36 CFR § 800.6 following these procedures:

- Continuing consultation with FHWA, WVDOH, WVSHPO, and consulting parties (36 CFR § 800.6(a))
- Resolve adverse effects (36 CFR § 800.6(b))
- Prepare an MOA (36 CFR § 800.6(c)); see Section 6.9.1

6.7.1. ARCHAEOLOGICAL RESOURCES

When an eligible archaeological site is identified within the archaeological APE, the WVDOH archaeologist will consult internally to determine whether the site can be avoided if effects on the site are anticipated. A site may be avoided through project redesign so that the site is no longer within the APE.

6.7.1.1. No Historic Properties Affected

The WVDOH archaeologist will make a finding of no historic properties affected under the following conditions:

- Archaeological sites are not identified within the archaeological APE/ECZ at the conclusion of a Phase I archaeological survey.

- Archaeological sites are recorded within the APE/ECZ; however, the site(s) have been determined to be not eligible for the NRHP.
- A portion of an archaeological site is present within the APE/ECZ; however, that portion of the site has been determined to not contribute to the overall eligibility of the larger archaeological site that extends outside of the APE/ECZ.

The WVDOH archaeologist will then create a determination of effect finding and will seek concurrence from the WVSHPO and will notify the Section 106 consulting parties, including the Tribes and Nations.

6.7.1.2. No Adverse Effect and Adverse Effect

The WVDOH archaeologist will propose a finding of no adverse effect when an archaeological site can be effectively avoided. WVDOH prefers complete avoidance as opposed to timber matting, geotextile and fill, archaeological site encapsulation, or other temporary protective measures.

The WVDOH archaeologist will then create a determination of no adverse effect and will seek concurrence from the WVSHPO and will notify the Section 106 consulting parties, which will include the Tribes and Nations.

The WVDOH archaeologist will make a finding of adverse effect when an eligible archaeological site cannot be avoided and will be impacted by project activities. The WVDOH archaeologist will enter into consultation with FHWA, the WVSHPO, and consulting parties, which includes Tribes and Nations, to resolve the adverse effect.

A draft mitigation plan may be prepared as part of an MOA (see Section 6.9.1).

6.7.2. ABOVEGROUND HISTORIC PROPERTIES

If a project's aboveground historic properties APE contains historic resources that are eligible for or listed in the NRHP, then the potential effect(s) of the project on those resources must be considered. Either preliminary to or in conjunction with this step, there may be opportunities to incorporate measures that avoid or minimize project effects into the project design. Often these measures are identified as part of the ongoing coordination with consulting parties and the WVSHPO.

Guidance for preparing a determination of effect is found in the WVSHPO's "West Virginia National Register and Architecture / History Survey Manual" (see Section 6.2.5 for a link to the manual). The first step is to apply the definition of effect to determine whether no historic properties are affected or whether there is an effect. If there is an effect, one applies the criteria of adverse effect to determine whether there is no adverse effect or an adverse effect. The effect finding will account for the views of consulting parties and the public.

6.7.2.1. No Historic Properties Affected and Historic Properties Affected

An effect is defined as an alteration to the characteristics of a historic property that qualify the historic property for listing in or eligibility for the NRHP. The two possible results of applying this definition of effect are: no historic properties affected or historic properties affected. With no historic properties affected, if WVDOH finds that either there are no historic properties present or that there are historic properties present but the undertaking will have no effect upon them as defined in 36 CFR § 800.16(i), WVDOH shall provide documentation of this finding, as set forth in 36 CFR § 800.11(d), to the WVSHPO. WVDOH shall notify all consulting parties and make the documentation available for public inspection prior to approving the undertaking. If the WVSHPO or the ACHP does not object within 30 days of receipt of an adequately documented finding, the FHWA's responsibilities under Section 106 are fulfilled.

If WVDOH or its consultant makes a determination of historic properties affected by the undertaking, or the WVSHPO or the ACHP objects to the agency official's finding under paragraph 36 CFR § 800.11(d)(1), WVDOH shall notify all consulting parties and invite their views on the effects and assess adverse effects, if any, in accordance with 36 CFR § 800.5. The criteria of adverse effect are then applied with possible outcomes of either no adverse effect or adverse effect.

6.7.2.2. No Adverse Effect and Adverse Effect

For no adverse effect, there is an effect to the historic property, but that effect does not compromise the resource's historic character. There are many different possible situations that might lead to a determination of no adverse effect, including a sliver take from a farm property that does not impact cultivated fields or an impact to a noncontributing element in a historic district. If the outcome of the evaluation is no adverse effect, WVDOH shall coordinate with the WVSHPO and consulting parties to obtain their agreement or revisit the finding. Once agreed upon, the no adverse effect finding fulfills the FHWA's responsibilities under Section 106 and 36 CFR § 800.11.

If it is determined through the application of the criteria of adverse effect that the project will have an adverse effect upon a historic resource, then steps must be taken to avoid, minimize, or mitigate (resolve) the adverse effect. This finding also needs to be coordinated with the WVSHPO and the consulting parties to obtain their agreement and develop meaningful mitigation measures to resolve the adverse effect. If one or more parties disagree about the effect, then the ACHP may be involved to arbitrate.

If a project has an anticipated adverse effect on an aboveground historic property, WVDOH will likely require that an e106 form (References and Links #19.3.1) be filled out to notify the ACHP of the Adverse Effect and invite them to participate in consultation for the project.

An e106 form is the standardized Electronic Section 106 Documentation Submittal System Form that the ACHP uses to track projects. It includes basic information about the project including a description of the nature of the undertaking, the APE, the steps taken to identify historic properties, project effects, and the results of project consultation. It also provides supporting maps, photographs, and correspondence. Upon receipt of the e106 form, the ACHP will decide whether to participate in the project's continued consultation to resolve the adverse effect.

6.8. CONSULTATION

Consultation with the WVSHPO, consulting parties, and the public is a central tenet of the Section 106 process. When it is determined that historic properties may be located within the project APE, likely as a result of WVDOH's pre-screening of the project, the WVDOH will reach out to potential consulting parties to invite them to participate in the project. Consulting parties can be any individual(s) and/or organization(s) with a demonstrated historic, economic, or legal interest in the project. Tribes and Nations, historical societies, and other history-focused organizations are common examples of consulting parties.

The consultation may consist of written or emailed communications or virtual or in-person meetings as long as the consulting parties receive important information about project development and contribute to the discussion of how historic properties involved in the project should be handled. The intent of consultation is so the federal agency and its representatives can consider the impact their project will have on historic properties.

6.9. RESOLUTION OF ADVERSE EFFECTS

When WVDOH determines that the project will have an adverse effect on historic properties, the WVDOH cultural resources staff will enter into consultation to resolve the adverse effect. Consultation may occur in any number of ways, including but not limited to emails, letters, phone calls, interagency meetings, and consulting party meetings or workgroups.

6.9.1. MEMORANDUM OF AGREEMENT (MOA)

When WVDOH, FHWA, and WVSHPO agree on a project's adverse effect and how it will be resolved, the applicant (WVDOH) will develop and execute an MOA. An MOA is a legal agreement that stipulates the measures that will be taken to mitigate the adverse effect. Those measures will be project specific and are commensurate to the impact.

Signatories on the MOA will include at minimum the applicant (WVDOH), the lead federal agency (FHWA), and the lead consulting agency (WVSHPO). In most cases, the ACHP will not be involved. If the ACHP has elected to participate as a signatory, FHWA will be responsible for coordination with the ACHP. When the ACHP is not a signatory, the

federal agency, consistent with 36 CFR § 800.6(b)(1) will submit a copy of the signed MOA and documentation specified in 36 CFR § 800.11(f) to the ACHP.

Signatories have the authority to execute, amend, or terminate the agreement (36 CFR § 800.6(c)(1)).

Consulting parties will be invited to participate in the development of the measures that will be included within the MOA. As a result, they will be invited as concurring parties to the MOA. Concurring parties are not required to sign the MOA for its execution, and the agreement may proceed without their signatures. Concurring parties do not have the authority to execute, amend, or terminate the MOA.

The MOA, once executed, is a legally binding agreement between the signatories.

6.9.2. MITIGATION FOR ARCHAEOLOGICAL RESOURCES

A majority of archaeological sites are eligible for the NRHP under Criterion D for their information potential (see Section 6.5). As a result, the traditional mitigation to resolve the adverse effect on an archaeological site is to complete Phase III data recovery excavations. The research design, excavation strategy, artifact and feature analyses, research, and reporting are specific to the archaeological resource recorded within the archaeological APE/ECZ.

In some cases, an alternative to traditional data recovery excavations may be a more appropriate mitigation to resolve the adverse effect on the archaeological site. The decision to complete an alternative form of mitigation must be applied on a case-by-case basis and is not appropriate on all projects or resource types.

Public education is a part of every project where mitigation is necessary for an archaeological resource. Again, the framework for how to complete the public education component is project specific and resource specific.

6.9.3. MITIGATION FOR ABOVEGROUND HISTORIC PROPERTIES

The mitigation measures that will be undertaken to resolve an adverse effect to a historic resource should be proportional, or commensurate, to the severity of the adverse effect and the scale of the project itself. WVDOH strives for mitigation measures that are customized to the adverse effect resolution needs of individual projects, developed through discussion with consulting parties and the WVSHPO. WVDOH will work with entities that come forward to coordinate mitigation ideas.

Mitigation measures that have been undertaken successfully in the past include documentation packages or formal recordations of affected properties, as well as contributions to the “Highways through History” website (References and Links #19.3.10).

6.10. RESOLVING DISAGREEMENT ON THE DETERMINATION OF EFFECTS

6.10.1. DISAGREEMENT WITH THE EFFECT FINDING WITHIN THE REVIEW PERIOD

If the WVSHPO, a Tribe or Nation, or another consulting party provides written disagreement specifying reasons for their disagreement with the determination of effects or efforts to avoid, minimize, or resolve effects within the review period, WVDOH will discuss the issue with the objecting party in an attempt to resolve it. If the disagreement remains unresolved, WVDOH will notify FHWA, which will then consult with the objecting party to find a resolution.

In cases where an agreement with Tribes or Nations or other consulting parties cannot be achieved, but the WVSHPO has concurred with the determinations, FHWA may proceed to the next step in the process.

When an agreement on effects cannot be achieved with the WVSHPO, FHWA will ask the ACHP to comment. The ACHP will provide its opinion within 30 days of receiving the documented effects finding. FHWA will take the ACHP's comments into consideration when deciding on the project's effects finding.

Please note that any Section 106 consulting party may independently, and at any time, ask ACHP to participate in consultation.

Pursuant to 36 CFR § 800.4(d)(1) and 36 CFR § 800.5(a), if a member of the public objects in writing to a finding within the review period, WVDOH will take their comments into consideration. Note that the term "consider" is different from "consult" under the regulations. There is no requirement for WVDOH to elevate the objection to FHWA or the ACHP. If the objecting party feels that the objection is unresolved, they may appeal to FHWA or the ACHP or, for projects subject to Title 82 of the West Virginia Code of State Rules, to the WVSHPO.

6.10.2. DISAGREEMENT WITH THE EFFECT FINDING AFTER THE END OF THE REVIEW PERIOD

If the WVSHPO, Tribe or Nation, or another consulting party responds after the end of the review period, WVDOH is not required to reconsider the determination of effects. The WVDOH cultural resource professional should discuss the response with the project manager or environmental manager, as appropriate, and recommend a course of action. The decision will then be documented in the project file.

6.11. CONSTRUCTION MONITORING

Archaeological monitoring during construction is typically a method to ensure avoidance of a subsurface cultural resource. Archaeological monitoring is not a substitute for completing archaeological identification or evaluation testing. Monitoring is often a mitigation commitment in which an archaeologist who meets or exceeds the SOI Standards for Archaeology (36 CFR Part 61) is stationed on a construction site and visually surveys for evidence of archaeological remains as construction proceeds. If archaeological artifacts or cultural features are identified by the monitor, construction must stop in the area of discovery, at which time a predetermined plan for discovery must be followed or the resource will be treated as a late discovery. Depending on the resource and nature of the discovery, additional testing or removal may be required that could result in project delays.

If WVDOH anticipates the possibility that a historic property may be discovered during construction, WVDOH will include in any contract, project specifications, or environmental document a plan for discovery (36 CFR § 800.13(a)) of such properties. Implementation of the plan as originally proposed, or modified as necessary owing to the nature and extent of the properties discovered, will be in accordance with 36 CFR §§ 800.4–800.6.

If an unanticipated archaeological resource is identified during the construction monitoring, the WVDOH staff archaeologist will follow the procedures for late discoveries.

6.12. LATE DISCOVERIES

Late discoveries are most commonly associated with archaeological resources, and they are unanticipated. According to 36 CFR § 800.13(b), if historic properties are discovered after the Section 106 process is complete, or if unanticipated effects to historic properties occur during construction, work on that portion of the project will stop immediately and the WVDOH will promptly notify FHWA and the WVSHPO. Further construction in the area of the discovery will not proceed until the requirements of 36 CFR § 800.13 are satisfied. This effort includes consultation with Tribes and Nations who may attach traditional cultural and religious significance to the discovered property.

WVDOH will consult with the WVSHPO to record, document, and evaluate NRHP eligibility of the historic property, as well as the project's effects on the property. If feasible, WVDOH will also coordinate a plan for avoiding or minimizing any effects on the cultural resource. In instances where the effect has already occurred or is unavoidable, WVDOH will develop a plan to resolve the adverse effect on the eligible property. If, then, the WVSHPO does not file any objection within 72 hours of WVDOH's plan for addressing the late discovery, WVDOH will carry out the requirements of 36 CFR § 800.13 on behalf of FHWA, and the ACHP will not need to be notified.

6.13. EMERGENCIES

If an emergency project has the potential to affect historic properties, WVDOH's cultural resource staff shall notify FHWA and the WVSHPO prior to any work taking place. The WVSHPO will then have 72 hours to respond to the notification.

For projects where the repair must occur within 30 days of the emergency event, WVDOH will comply with the procedures in Stipulation VII of the Section 106 PA to the extent possible; however, the Section 106 reviews may take place after the emergency work is completed. For projects that may extend longer than 30 days, WVDOH will comply with the procedures in Stipulation VII of the Section 106 PA.

An emergency situation will follow the NEPA process as outlined in Section 4.4.1, NEPA, Emergency Protocol.

7. AQUATIC RESOURCES

7.1. GUIDANCE FROM USACE AND WVDEP

The waters of the United States are protected under federal and state regulations including the Rivers and Harbors Act of 1899, the CWA, and the Food Security Act of 1985. Jurisdictional waters include all surface waters with a direct connection to navigable waters, including associated tributaries and wetlands. In addition to potentially influencing navigable waters, wetlands are protected because they trap particulates and chemicals before they enter streams, serve as water sources for terrestrial organisms, enrich ecosystem diversity, and provide a transitional area between terrestrial and aquatic environments. Regulations protecting the waters of the United States give legal backing to the state and federal goal of "no net loss" of the country's aquatic resources.

In this section, the waters of the United States are referred to as aquatic resources, categorized as either wetlands or streams. Jurisdictional wetlands and streams are those with overland connection to navigable waters, and jurisdictional status is ultimately determined by USACE. All wetland boundaries and stream channels should be assessed and delineated within a proposed project impact area and surrounding buffer zone. This section provides guidance for aquatic resource delineation, determining resource values and characteristics, and mitigating impacts.

7.2. DEFINITION AND IDENTIFICATION OF JURISDICTIONAL AQUATIC RESOURCES

7.2.1. WETLAND DEFINITION

USACE and WVDEP define wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions." Wetland identification and delineation is based on assessing three criteria: hydrology, vegetation, and soils. Wetlands are areas that meet the hydrophytic standards for all three criteria, as detailed in the USACE Wetland Delineation Manual (References and Links #19.4.3) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0) (References and Links #19.4.4).

7.2.2. STREAM DEFINITIONS

Streams are classified according to the definitions set forth in the West Virginia Code of State Regulations (CSR) Chapters 22 and 47, which define perennial, intermittent, and ephemeral streams as follows:

Perennial Streams (22 CSR § 6A-4) — Streams or a portion of a stream that flows year-round, is considered a permanent stream, and for which base flow is maintained by groundwater discharge to the streambed due to the groundwater elevation adjacent to the stream being higher than the elevation of the streambed.

Intermittent Streams (47 CSR § 2-2.9) — Streams that have no flow during sustained periods without precipitation and that do not support aquatic life whose life history requires residence in flowing waters for a continuous period of at least six months.

Ephemeral Streams (47 CSR § 2-2.24) — These are also known as “wet weather streams,” and are streams that flow only in direct response to precipitation or whose channels are always above the water table.

7.2.3. AQUATIC RESOURCE IDENTIFICATION

The study area for wetland and stream identification should include anywhere ground disturbance is expected, with an additional buffer as a conservative measure and to accommodate the risk of future design changes. To the extent feasible, wetland identification and delineation should be conducted by a resource specialist during the growing season for accurate determination of wetland boundaries. The growing season for wetland plants in West Virginia is the time between the last frost in spring and the first frost in fall. The length of the growing season varies by location. All wetlands should be mapped and classified according to type, acreage, and functions. All streams should be mapped and classified according to type, linear feet, and functions. Following the completion of fieldwork, an aquatic resources report and map must be submitted to USACE for approval, and jurisdictional status of wetlands should be determined in consultation with USACE.

The appropriate USACE District Office must make the final determination of whether the proposed activity requires permit authorization. Because this can be a lengthy process, aquatic resource delineations should be completed as early as possible in the project schedule.

Wetland identification and delineation should be conducted in accordance with the methods described in the in the USACE Wetland Delineation Manual (References and Links #19.4.3) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0) (References and Links #19.4.4) and classified using the U.S. Fish and Wildlife Service Classification

of Wetlands and Deepwater Habitats of the United States (References and Links #19.4.2).

Stream identification and delineation should be conducted in accordance with the definitions laid out in the Rapid Bioassessment Protocols: Habitat Assessment and Physicochemical Parameters and methods described in the USACE Operational Draft Regional Guidebook for the Functional Assessment of High-Gradient Headwater Streams and Low-Gradient Perennial Streams in Appalachia (ERDC/EL TR-17-1) (References and Links #19.4.1 and #19.4.6). Field investigations of streams should include documentation of physical characteristics of surface waters, the presence or absence of fish species, and a cursory review of macroinvertebrates present, if applicable.

7.3. JURISDICTIONAL DETERMINATIONS

Following aquatic resource investigations, USACE ultimately must approve wetland boundaries, and if applicable, perform a Jurisdictional Determination (JD) to determine whether a permit authorization is required for the proposed project. Jurisdictional inquiries may be addressed using an Approved JD (AJD) or a Preliminary JD (PJD), and in some cases, they can be resolved without a JD.

7.3.1. APPROVED JURISDICTIONAL DETERMINATION

AJDs, defined in 33 CFR § 331.2, are official determinations that there are, or are not, jurisdictional aquatic resources present. Additionally, AJDs define the limits of each jurisdictional resource and are typically valid for five years.

7.3.2. PRELIMINARY JURISDICTIONAL DETERMINATION

PJDs, defined in 33 CFR § 331.2, do not make any legally binding determinations regarding the jurisdictional nature of aquatic resources present. PJDs often include delineation limits of all aquatic resources present without determining the jurisdictional status of each resource. Requestors of PJDs can later obtain an AJD if appropriate.

7.3.3. NO JURISDICTIONAL DETERMINATION

A JD may not be necessary where proposed activities are not regulated or are exempt under Section 404(f) of the CWA, or in other circumstances where a “no permit required” letter may be appropriate instead. More information on JDs can be found in USACE’s Regulatory Guidance Letter No. 16-01 (References and Links #19.4.7).

7.4. CHECKLIST OF INFORMATION FOR AQUATIC RESOURCE DELINEATION REPORTS

Aquatic resource delineation reports are a key tool in project planning and for receiving a JD from USACE. Aquatic resource delineation reports should contain the pertinent information gathered during the aquatic resource field and desktop investigations. At a minimum, reports should include the information detailed in this section.

- Cover Page:
  - Report name and date (month, year)
  - Project name and location (municipality, county, state)
  - Name and address of the organization or individuals proposing the project
  - Name and address of the organization completing the aquatic resource investigations and report
- Introduction:
  - Name of the organization or individuals completing the aquatic resources investigations and report
  - Date of the aquatic resource investigations
  - Location of the project (municipality, county, state)
  - Overview of the project purpose and need
- Background Information:
  - Review of the National Wetlands Inventory wetlands within the project study area
  - Watershed information including the following:
    - Name of the watershed(s) associated with the project
    - WVDEP Tier 3 listed streams, if applicable
    - WVDNR High Quality and State Mussel Streams, if applicable
    - West Virginia's 2016 Integrated Water Quality Monitoring and Assessment Report Section 303 listings, if applicable
- Wetlands:
  - Summary of methods used for wetland identification and delineation
  - Number, type (Cowardin classification), and characteristics of wetlands identified in the project study area
- Streams:
  - Summary of methods used for stream identification and delineation

  - Summary of investigation results, including the number of streams identified, stream types, characteristics, and aquatic life observed

- Attachments:
  - Project map(s) should demonstrate the following:
    - Project location and project study area boundaries
    - National Wetlands Inventory resource boundaries within the project study area
    - Location of each wetland and stream within the project study area
  - Data forms should accompany the report, including the following:
    - USACE Wetland Determination Data Forms for all wetland and upland data points (References and Links #19.4.5)
    - Appropriate stream or surface water survey forms for each stream
  - Photos of each resource

7.5. IMPACT ASSESSMENT METHODOLOGY

Project impacts on wetlands and streams can be assessed once WVDOH and/or USACE has approved the aquatic resources report. Impacts are classified as either permanent or temporary and analyzed based on their causal relationship to the project.

Direct Impacts: These are best determined by overlaying project alternatives with mapped locations of aquatic resources to identify physical loss or discharge.

Reasonably Foreseeable Effects (Secondary/Indirect): These effects occur outside the immediate footprint, such as those resulting from surface runoff, erosion, or chemical contaminants. Consistent with 42 USC § 4332, these must have a reasonably close causal relationship to the project and be determined by overlaying project alternatives with topography and drainage patterns.

Pursuant to 47 CSR § 5A-2.11, permanent impacts are defined as an unavoidable loss of aquatic resources from a permanent structure or activities that cause physical stream loss.

Where impacts are anticipated, it is recommended that additional investigations be conducted to assess and quantify the functions and values of impacted resources. The state developed noncompulsory guidelines for assessing the functions and values of wetlands; these are detailed in Sections 7.6 and 7.7.

7.6. WEST VIRGINIA WETLAND RAPID ASSESSMENT METHOD

The state and federal goal of "no net loss" of wetlands applies not only to the area of a resource, but also to the functions and services the resource provides within the ecosystem. To quantify these functions and services, WVDEP in conjunction with WVDNR, established a noncompulsory standardized protocol for quickly assessing wetlands' functions, services, values, and conditions. The standardized protocol, known as the West Virginia Wetland Rapid Assessment Method (WVWRAM), produces a regulatory score for impact assessment and compensatory mitigation, consistent with standards for CWA permitting. The WVWRAM consists of a rapid field assessment and a GIS desktop assessment following the methods laid out in the User Manual for the West Virginia Wetland Rapid Assessment Method (Version 1.24) (References and Links #19.4.8). Where wetland impacts are anticipated, a WVWRAM assessment can be completed for each resource. At the discretion of WVDOH, the WVWRAM investigations can be done concurrently with initial aquatic resource investigations and delineations or after impact plans have been established. Field investigations should be completed by at least one environmental professional who is qualified to perform wetland delineations, as a knowledge of wetland hydrology, vegetation, and soil is required.

WVWRAM investigations provide a scientific framework for determining the "value" of aquatic resources that will be impacted by a project. The "value" or score of the WVWRAM can then be used in conjunction with tools in Section 7.7 to systematically assign a score for compensatory mitigation for each impacted resource.

7.7. WEST VIRGINIA STREAM AND WETLAND VALUATION METRIC

An Interagency Review Team (IRT) was established in accordance with USACE regulations 33 CFR § 332.8(b) to review documentation for the establishment and management of mitigation banks and in-lieu fee programs associated with wetland and stream impacts. The IRT includes federal and state agencies such as the USACE Huntington and Pittsburgh Districts, USEPA, USFWS, U.S. Department of Agriculture's Natural Resources Conservation Service, WVDEP, and WVDNR. The USACE Huntington District (Regulatory Branch) is the lead district for the State of West Virginia and chairs the West Virginia IRT.

Tasked with developing an appropriate assessment method to consistently correlate levels of proposed aquatic resource impacts with all forms of compensatory mitigation, the IRT developed the West Virginia Stream and Wetland Valuation Metric (SWVM). The SWVM synthesizes multiple established assessment methodologies including the USEPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, A Stream Condition Index for West Virginia Wadeable Streams, and water quality data used by WVDEP (Water Quality Data Sheet). Together these assessments are used to describe the physical, chemical, and biological integrity of aquatic resources. Each of

these three indicators are given equal weight in generating an index score for each resource, ranging from 0 (poor condition) to 1.0 (best condition), which is used to quantify the resource's condition. The index score is multiplied by linear feet (streams) or area (wetlands) to produce a unit score for each resource. The unit score can be used to determine the appropriate mitigation fees associated with each impacted resource.

8. FARMLAND

8.1. FARMLAND PROTECTION POLICY ACT (FPPA)

WVDOH's procedures for farmland evaluations outline guidance for avoiding, minimizing, and mitigating for the permanent (direct or indirect) conversion of land from agricultural to nonagricultural use as a result of a proposed federal action. The FPPA (Public Law 97-98, 7 USC § 4201 et seq.) has three general purposes:

- Minimize the permanent conversion of farmland.
- Encourage consideration for alternative actions.
- Ensure consistency among federal, state, and local programs related to farmland protection.

This section identifies the FPPA procedures applicable to West Virginia transportation projects, including improvements to existing facilities and construction of new facilities. This section also describes exclusionary conditions when FPPA procedures are not necessary for environmental clearance. Primary documentation tools summarized in this section include the Farmland Conversion Impact Rating (FCIR) Form AD-1006 and Form NRCS-CPA-106 for FPPA evaluations (References and Links #19.5.1 and #19.5.2).

8.1.1. WHEN EVALUATIONS ARE REQUIRED

WVDOH projects subject to FPPA requirements include federally sponsored or federally aided actions that may irreversibly convert farmland, as defined in 7 CFR Part 658 (see below for the definition), to nonagricultural use:

> **Farmland** means prime or unique farmlands as defined in section 1540(c)(1) of the Act or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary to be farmland of statewide or local importance.

PROJECTS REQUIRE EVALUATIONS FOR FPPA COMPLIANCE WHEN THEY HAVE ANY OF THESE CHARACTERISTICS:

- Involve federal aid
- Are expected to involve permanent right of way acquisition
- Do not have applicable FPPA exemptions

Assistance from a federal agency includes any of the following:

- Acquiring or disposing of land
- Providing financing or loans

- Managing property
- Providing technical assistance

An irreversible conversion occurs if the farmland is no longer usable for agriculture and the conversion is permanent (i.e., it cannot be restored without significant time and expense). This is a determination made by the federal funding agency. The U.S. Department of Agriculture / Natural Resources Conservation Service (USDA/NRCS) can provide input when determining whether an irreversible conversion is possible, however, it is not required to do so.

The conversion may be direct or indirect. Direct conversions are those that result in the permanent acquisition of farmland or agricultural resources protected under the FPPA. Indirect conversions are those that do not necessarily involve direct impacts but may alter the resource in a way that makes agricultural use impossible or impractical after the project is constructed. For example, if the project affects access or the shape of the property in a negative way, it may be considered an indirect conversion.

8.1.2. WHEN EVALUATIONS ARE NOT REQUIRED

FPPA compliance is fulfilled and completion of the FCIR Form NRCS-AD-1006 or Form NRCS-CPA-106 is not necessary for federally funded or federally aided actions that meet any of the conditions described below.

- If a project is not sponsored by a federal agency, or if it does not otherwise involve any federal money or aid, the proposed action is not subject to FPPA requirements, and an evaluation is not necessary.
- Projects planned and completed prior to submitting an application for federal assistance.
- If “farmland” is not present in the area of potential irreversible conversion (e.g., prime or unique farmland soils or farmland soils of statewide importance are absent within the proposed required right of way).
- According to 7 CFR Part 658, “farmland” may not be present if the entire project area includes land already in or committed to water storage or urban development. Land is considered in or committed to urban development if any of the following conditions are met:
    - Land with a density of 30 structures per 40-acre area.
    - Lands identified as “urbanized area” on the Census Bureau Map.
    - Lands identified as urban area mapped with a tint overprint on the U.S. Geological Survey topographical maps.

  - Lands identified as "urban-built-up" on the USDA Important Farmland Maps. Areas shown as white on the USDA Important Farmland Maps are not "farmland" and, therefore, are not subject to the FPPA.

- On-alignment bridge replacement projects (including culverts).
- Small acreage requirement projects, (i.e., 10 acres or less per linear mile or 3 acres where there is a project for an existing bridge or interchange) where a statewide, local, or tribal Land Evaluation Site Assessment system has been approved by the state conservationist. Acreage includes both direct and indirect conversions. These exemptions are to avoid new construction and encourage improvements to existing linear projects, such as highways.
- Highway or bridge projects where all activities will occur within the existing right of way.
- Construction impacts are temporary and will not result in an irreversible conversion of prime or unique farmland soils or farmland soils of statewide or local importance.
- Transportation projects specifically authorized for national defense purposes. This includes projects such as access roads or bridges that serve a national defense purpose or facility. The National System of Interstate and Defense Highways are not included under this condition.

It is the federal agency's responsibility to determine whether a project is exempt from FPPA requirements. The USDA/NRCS may be contacted to confirm an exemption.

8.2. PROCESS TO EVALUATE

The first step in meeting FPPA requirements is to determine the applicability of the FPPA. As described in Section 8.1.1, projects are subject to FPPA requirements if they irreversibly convert farmland as defined in 7 CFR § 658.2, (directly or indirectly) to nonagricultural use and are completed by or with assistance from a federal agency. The FPPA process must be used whenever a federal program is involved in undertaking, financing, or assisting in construction or improvement projects or acquiring, managing, or disposing of federal lands and facilities. It is the responsibility of the federal agency assisting the project to decide whether farmland will be converted to nonagricultural uses. The federal agency may ask the NRCS to make the farmland determination. If no irreversible conversion of farmland to nonagricultural uses will take place, the activity is not subject to FPPA.

Official data sources to confirm the applicability of FPPA and to complete FPPA procedures when required include:

- Soil Survey Geographic Database (SSURGO) data (USDA/NRCS Web Soil Survey application) soil unit classifications (References and Links #19.5.8)

- West Virginia's Field Office Technical Guide (References and Links #19.5.6)
- State and local land evaluation values (References and Links #19.5.4)

The Web Soil Survey (WSS) application is particularly helpful for identifying the presence of FPPA soils. This tool is managed and operated by USDA/NRCS and provides soil data and information collected as part of the National Cooperative Soil Survey. Soil series units are mapped and categorized based on common characteristics (e.g., textural class, slope, drainage characteristics, depth of topsoil, and pH, among other inherent features).

One of the many soil metrics included in the SSURGO dataset (References and Links #19.5.8) includes Farmland Classification. This metric identifies soil map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. The presence of these soil types within a project area determines the potential applicability of FPPA. To access the Farmland Classification dataset, the steps listed below may be taken within the WSS application. SSURGO data is alternatively available for download at the county level and may be reviewed for farmland soils using GIS mapping software.

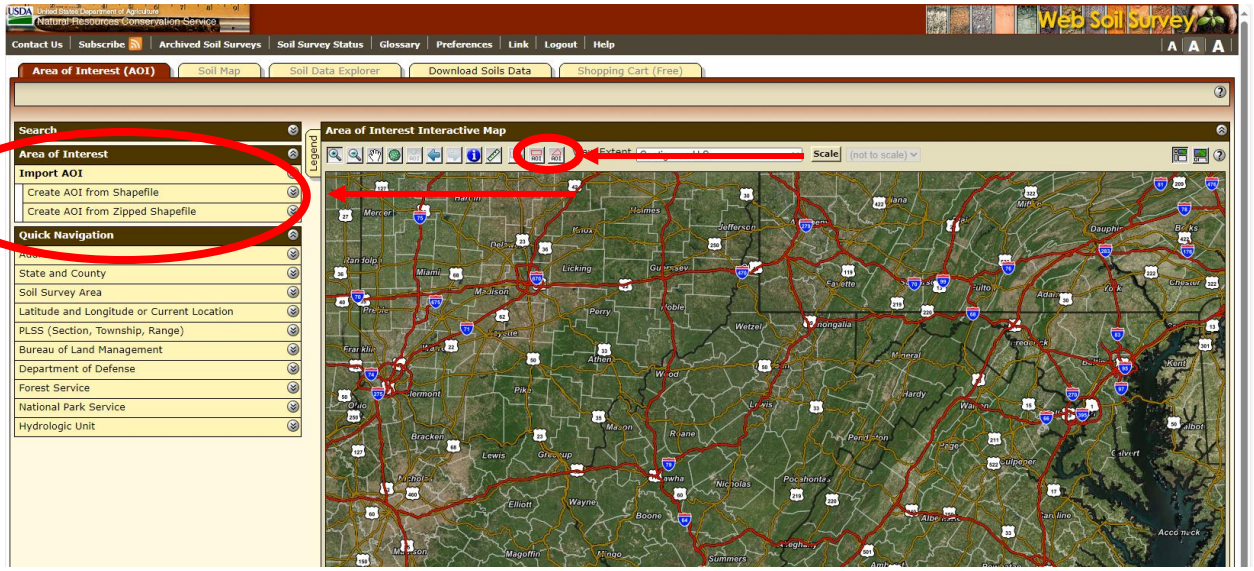
Follow the steps below to use the WSS to determine farmland classifications:

Step 1. Access the WSS website (References and Links #19.5.7).

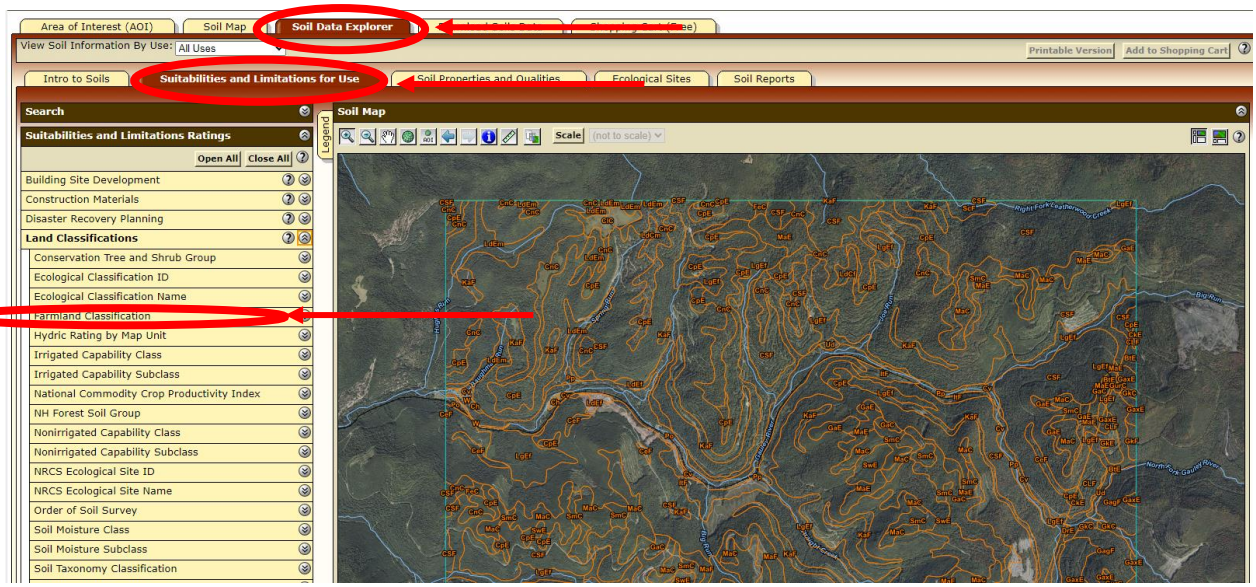
Step 2. Click the "Start WSS" link.



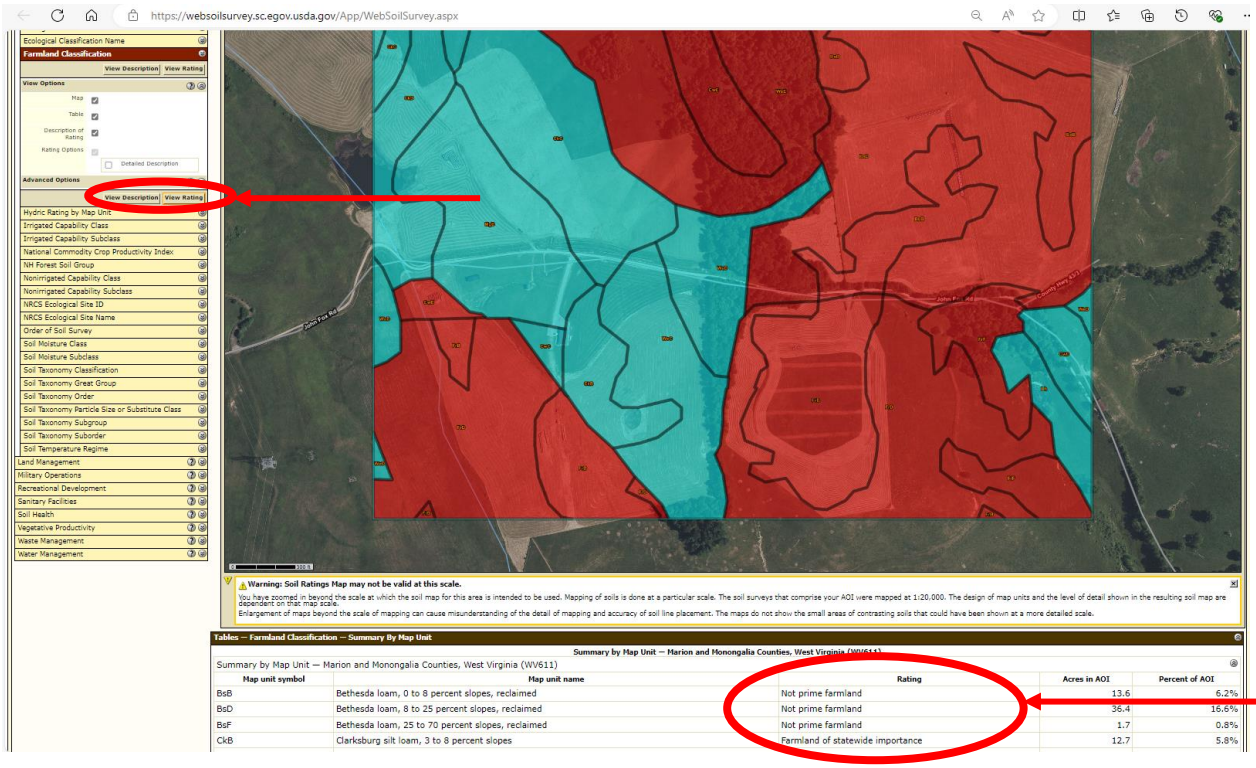
Step 3. Set your "Area of Interest" (AOI) associated with the project. This may be a general study area polygon or anticipated permanent right of way polygon (if available). The AOI may be drawn within the online map using the polygon tools above the viewer or imported using the "Import AOI" features (from zipped or unzipped shapefiles) in the pane to the left of the viewer.



Step 4. Once the AOI is set, select the "Soil Data Explorer" and "Suitabilities and Limitations for Use" tabs. The "Farmland Classification" data is available under the "Land Classifications" tab in the left pane.



Step 5. Select "View Rating." The map will update with Farmland Ratings, and a table will populate under the map frame. A printable version of the map and table is available by clicking the button in the top right corner of the application.



After a project is determined to require an FPPA evaluation through review of the exemption conditions described in Section 8.1.1, the FPPA process is accomplished through completion of an AD-1006 form or, if a corridor project, a CPA-106 form. AD-1006 and CPA-106 forms are used as correspondence as a basis for a decision on FPPA impacts (References and Links #19.5.1 and #19.5.2). These forms (and potential future updates to them) may be accessed from the USDA/NRCS's FPPA website (References and Links #19.5.3).

The AD-1006 and CPA-106 forms represent the implementing procedures associated with 7 CFR Part 658 and established the FCIR system, which evaluates the impacts federal programs have on the conversion of farmland to nonagricultural uses. Detailed directions for completion are included on the back side of each form.

When FPPA review is required, the federal agency must complete Parts I, III, and VI of the applicable form. The USDA/NRCS completes the remaining sections of the form if necessary. In addition to the AD-1006 or CPA-106 form with appropriate sections completed by the federal agency, additional materials are required to be prepared and submitted to the USDA/NRCS, as detailed in Section 8.3 Documentation Tools.

If Part VI of the form results in a score of less than or equal to 60 points, submittal to USDA/NRCS is unnecessary, FPPA compliance is met, and the findings may be summarized in the NEPA document. If the Part VI score is greater than 60 points, the documents described in Section 8.2 are compiled and submitted to the local USDA/NRCS office.

The USDA/NRCS requires a response window of 10 business days for standard projects, or a maximum of 30 business days if a site visit is required or if a land evaluation is necessary (in which case the applicant will be informed). If responses are not provided in the appropriate window, the project may be considered compliant with FPPA for the purposes of the environmental review process, and the results of coordination efforts should be summarized in the NEPA decision document, along with findings from the FPPA evaluation.

Once the USDA/NRCS responds to the request, Part VII of Form AD-1006 or CPA-106 must be completed by the federal agency. If the Part VII review results in a score of less than or equal to 160 points, FPPA compliance is met, and the findings should be summarized in the NEPA document.

If the Part VII analysis results in a score of greater than 160 points, the project team must consider other alternatives or measures to minimize or avoid permanent conversion of FPPA farmland. The preferred alternative is to be indicated on the AD-1006 or CPA-106 form, and the information must be submitted to USDA/NRCS. In cases where no other alternatives or design modifications would result in a Part VII score of less than 160 points, the NEPA document must clearly summarize reasons why and determine measures to be implemented to minimize and/or mitigate for all adverse impacts to FPPA farmland.

Any project FPPA correspondence should be initiated by the federal agency that is involved (or, when applicable, the state agency on behalf of the federal agency), rather than directly from a private consulting party. If more than one federal agency is involved with a project on the site, only one agency should initiate the FPPA correspondence. This allows the USDA/NRCS to easily verify that there is federal money involved and FPPA holds the potential to apply (depending also on other exclusionary conditions).

Federal or state agencies may request NRCS assistance by sending all required information to the West Virginia State Soil Scientist (who may be identified on the USDA/NRCS website) (References and Links #19.5.5) provided they are the federal agency funding or assisting the project or the state agency facilitating the project (acting for the federal agency) where federal dollars are provided to states for use in state fund pools. Consulting firms or other groups must work through the federal or state entity for assistance.

Findings from the FPPA evaluation, or reasons for exemption, if applicable, are expected to be summarized in the final NEPA document as a last step of the FPPA documentation process.

8.3. DOCUMENTATION TOOLS

The USDA/NRCS requires the following materials to be submitted as part of the FPPA review process when Part VI scores exceed 60 points:

- Form AD-1006 or, for corridor-type projects, Form CPA-106, with Parts I, III, and VI completed.
- Maps that show the project area and location of features to be constructed:
    - Use points and lines on U.S. Geological Survey 7.5-minute topographic quadrangle maps or recent aerial with the project area accurately delineated and scaled no smaller than 1:24,000.
    - Provide dimensions of the area to be converted or, if the project extends along a corridor, the width and length of each segment of the project.
    - Provide a location map with labels or other helpful information.
    - Provide a soil map overlay on the project site.
    - Provide a soil map with soil legend and map unit acres from the WSS.
- Digital data / electronic submittal alternatives to maps as described in the bullet above are permissible. The project area shapefile should be included in the submittal.
- A cover letter describing project details, including the following:
    - The address and name of the project location.
    - The type of structure (if applicable) and dimensions of areas to be converted.
    - Contact information for the federal agency employee point of contact.
    - The source of federal funding/assistance.
    - Methods and rationale for each site assessment score.

Engineering drawings, copies of other agencies' comments, environmental review information, and pictures of the project are not required to be submitted as part of the FPPA compliance procedures.

9. PUBLIC INVOLVEMENT

9.1. WVDOH DESIGN DIRECTIVE 201 (DD-201) GUIDANCE

WVDOH's procedures for public involvement were established to maximize citizen input on location and design while following environmental requirements, including:

- FHWA policy and regulations
- NEPA
- Section 404 of the CWA
- Section 106 of the NHPA
- Section 7 of the ESA
- Title VI of the Civil Rights Act
- Various executive orders, including 11988 (Floodplains) and 11990 (Wetlands)

WVDOH Design Directive 201 (DD-201) addresses the WVDOH policy for the public involvement process. The public involvement process is for projects that require a NEPA environmental document and presents a formal path for communication between the agency and the public. See Flowchart 21.7 for the Public Involvement Process.

9.2. NEED FOR PUBLIC INVOLVEMENT

The NEPA process mandates public involvement for projects with significant environmental impacts. These usually require an EIS, an EA, or a CE. Significant impacts include major right of way acquisition, complex detours, substantial changes to road layouts, or significant effects on adjacent properties and broader social, economic, or environmental factors.

Additional public involvement opportunities may be initiated when the WVDOH believes there is a substantial change in the project, an unusually long lapse of time since the last public involvement, or the identification of a substantial social, economic, or environmental issue not previously considered at earlier public involvement opportunities.

An EIS requires at least two public involvement opportunities. The first is for project scoping, and the second is after the draft EIS (DEIS) has been approved by FHWA.

An EA requires at least two public involvement opportunities. The first is for project scoping, and the second is after the EA has been approved by FHWA.

A CE normally does not require public involvement; however, public involvement may be conducted if WVDOH believes it is warranted or it is requested by the public or FHWA.

WVDOH may determine that public involvement is necessary if a community has been identified as having a Title VI population, requiring additional outreach methods beyond public workshops. This may include distributing project information and comment forms door to door for citizens to complete and return to WVDOH. Depending on the demographic makeup of the community and the potential presence of individuals with Limited English Proficiency, it may be necessary to have an interpreter available at public workshops.

9.3. TYPES OF PUBLIC INVOLVEMENT

Public involvement can be accomplished via a variety of methods of engagement. The most widely recognized form is a workshop meeting. Other forms such as newspaper notices, mail, radio, television, billboards, road signs, and online platforms can also be effective. These channels facilitate public participation in the project development process and provide WVDOH with essential feedback.

Public meetings enable direct interaction between the concerned citizens and WVDOH. There are four distinct types of public meetings: a public informational workshop, a public hearing, a combination of public informational workshop and public hearing and a virtual public meeting.

- A public informational workshop is a forum for the free interchange of ideas and may or may not include a formal presentation. Although general notes on the issues discussed are considered during project development, written comments are encouraged and included in the public record. A public informational workshop can also be held virtually.
- A public hearing is the most formal type of public involvement, where a formal presentation is given and verbal comments, or testimony, are recorded after the presentation. A transcript of the presentation and testimony is prepared for the public record. Additionally, written comments are encouraged and included in the public record.
- The combination type will have a public information workshop that begins prior to a formal presentation and testimony will be recorded following the presentation. A transcript of the presentation and testimony is prepared for the public record along with written comments.
- A virtual public meeting encourages public participation through virtual avenues. Virtual links can also provide participants with access to project details, maps, plan sheets, and other relevant documents, and can allow for citizens to interact with the project team. Citizens are given the chance to ask questions and talk directly with the project team members through a virtual platform.

Public involvement methods like newspaper ads, mail, radio, TV, billboards, road signs, and the internet can be as effective as public meetings, depending on the information needed. These methods can stand alone or complement a public meeting. For gauging public concern about a highway project, distributing a project informational flyer might suffice. If significant public concern is evident, a public meeting with various advertising methods would be more suitable.

Some projects may require a public hearing due to the type of environmental document being prepared. Due to the amount of public concern, the WVDOH or FHWA may require a public hearing. A public hearing is generally required when the public is asked to comment on an approved draft EIS or on an approved EA.

9.4. PUBLIC INVOLVEMENT PLAN

When WVDOH and the FHWA determine that formal public involvement is necessary for a Federal-aid Highway Program project, WVDOH will develop a public involvement plan in consultation with the FHWA division office. WVDOH will submit the draft public involvement plan to WVDOH Transportation Civil Rights Compliance Division Manager (References and Links #19.6.1) for review prior to forwarding it to the FHWA for approval.

The public involvement plan should encompass a summary of the agency and public involvement strategies for the entire NEPA process, as well as an information distribution list for the project. Furthermore, the public involvement strategy must consider how to engage affected individuals who qualify under Title VI of the Civil Rights Act or the Americans with Disabilities Act of 1990.

COMPONENTS OF A PUBLIC INVOLVEMENT PLAN:

- A clear description of the goals and objectives of the plan.
  - What you are trying to communicate.
  - What information you need from the public.
- A list of stakeholders and public groups that you are trying to reach.
- Description of the outreach techniques that you intend to use.
- A schedule for the different types of outreach.

The distribution list should include federal, state, and local agencies; federal, state, and county elected officials; local/municipal officials; historic preservation groups active within the project area; and individuals who have requested information on project development. The FHWA division office will approve the public involvement plan before any public engagement occurs.

9.4.1. NOTIFICATION PROCESSES

When WVDOH determines that it has reached a stage in the development process at which a public meeting is recommended, the WVDOH Public Relations Division will be notified by the section responsible for conducting the meeting. When a public meeting is scheduled, a notice in the form of a legal advertisement will be published in newspapers having general circulation in the vicinity of the proposed project. The newspaper notice shall contain the following information:

- Date and time of the meeting.
- Location of the meeting.
- A description of the project.
- A link to a website where additional project information can be found.
- A statement that a hearing may be requested.
- A statement regarding the NHPA Section 106 consultation process and/or Section 4(f) determinations, if applicable.
- If a formal presentation will be conducted, the time it will begin.
- If a hearing will be conducted, the time it will begin.
- If a NEPA document is being presented for comment, the notice will indicate that an electronic copy can be obtained on WVDOH's website and that a hard copy will be available at the local library.
- A statement regarding accommodation for individuals with disabilities to access information and/or provide comments shall be included with the legal advertisement. The statement will read as follows:
    - "The West Virginia Department of Transportation will, upon request, provide reasonable accommodations including auxiliary aids and services necessary to afford an individual with a disability and equal opportunity to participate in our services, programs, and activities. Please contact us at (304) 558-3931. Persons with hearing or speech impairments can reach all state agencies by calling (800) 982-8772 (voice to TDD) or (800) 982-8771 (TDD to voice), toll free."
    - Add the name, phone number, and email address of the current Director of the Office of Communications to complete the statement.

In addition to the legal advertisement, a project flyer will be distributed containing the same information as the legal advertisement. An example project flyer is included in Section 20: Attachments / Forms / Examples.

A copy of the public notice will be sent to federal and state elected officials, as well as local and municipal officials serving the project area. Additionally, the notice will be provided to the respective County Commission and historic preservation groups active within the project area.

The West Virginia Department of Transportation (WVDOT), Office of Communications keeps an updated list of newspapers for placing advertisements according to the project's location. All public meeting notices should be published in the newspaper and posted on the WVDOH's website at least 14 days prior to the meeting. To ensure that the public near the project area is aware of the meeting, a secondary advertisement is typically created to reach the local target audience. This secondary advertisement should be distributed and/or posted seven days prior to the meeting. The secondary advertisement can include, but is not limited to, the following information:

- Meeting advertisement fliers to be sent to the property owners and/or residents in the project vicinity
- Fliers placed in local stores and gathering areas
- A road sign to inform the traveling public about the meeting
- A paid advertisement in the local paper in addition to the notice in the legal section that is required
- A billboard

9.4.2. ENVIRONMENTAL DOCUMENTS

When a DEIS or EA is provided to the public and agencies for comment as part of the public involvement process, the deadline for comments will be 30 days after the public meeting. Additionally, for DEIS documents, the comment deadline will be at least 45 days from the Notice of Availability for the document that is published in the Federal Register.

For EA documents, the deadline for comments should be no less than 30 days from the date the document was mailed to the agencies or placed on the WVDOH's website. WVDOH shall post the comment deadline and show where applicable documents are available for public review. WVDOH will work with FHWA to approve written requests to extend the deadline for comments, if they are received prior to the advertised deadline.

9.4.3. MEETING AND/OR HEARING FORMAT

Meetings and/or hearings will be moderated by an official from WVDOH. The developing division will provide an individual knowledgeable about the project to address questions from citizens. Additionally, the FHWA may choose to speak about the project.

WVDOH's presentation will encompass a project description, its purpose and need, alternatives considered, as well as environmental and other potential impacts. Provisions will be made for the submission of written statements and other exhibits, in addition to oral statements at meetings or hearings.

At each public meeting and/or hearing, where appropriate, WVDOH will explain its right of way acquisition process, relocation assistance program, and relocation assistance payments. Relevant WVDOH and consultant staff will be invited to attend the meeting, depending on the specific project requirements. This may include personnel from the Right of Way Department, environmental section, engineering, legal affairs, and district staff, among others. Name tags for all WVDOT/WVDOH, FHWA, and consultant staff should be available for the meeting.

9.5. PUBLIC HEARING TRANSCRIPT

A court reporter will create a verbatim transcript of the proceedings for each public hearing. The designated individual within WVDOH will arrange for the court reporter's attendance. Copies and certification will be sent to the relevant WVDOH division for appropriate action and forwarded to the FHWA, if the project is federally funded, eligible for federal funds, or if the FHWA has agreed to be the lead federal agency. Copies of the transcript and appendices will be available for public inspection and included in the summary report.

9.6. PUBLIC MEETING / HEARING SUMMARY REPORT

The developing division will be responsible for preparing a summary report of the meeting. The report should include the approximate number of attendees, participation from state and federal representatives, distribution of meeting handouts or flyers, advertisement methods used, copies of all written comments received, and if applicable, a copy of the public hearing transcript. Additionally, the summary report should contain an analysis of the comments received and should highlight the topics of greatest interest to respondents, as well as the WVDOH's responses to those comments.

10. SECTION 4(F)

10.1. INTRODUCTION TO SECTION 4(F)

Section 4(f) refers to the original section within the U.S. Department of Transportation Act of 1966, which provides for consideration of public park and recreation lands, wildlife and waterfowl refuges, and historic sites during transportation project development. The law, now codified in 49 USC § 303(c) and 23 USC § 138 (References and Links #19.7.4 and #19.7.2), applies to all agencies within the USDOT. It is implemented by the FHWA and the Federal Transit Administration (FTA) through 23 CFR Part 774 (References and Links #19.7.1). Section 4(f) applies to projects that receive funding from or require approval by an agency of the USDOT. WVDOH reviews all projects to consider whether Section 4(f) applies.

Before approving a project that uses one or more Section 4(f) properties, FHWA must determine that there is no feasible and prudent alternative that avoids the Section 4(f) properties and that the project includes all possible planning to minimize harm to the Section 4(f) properties; alternatively, FHWA must make a finding that the project has a *de minimis* impact on the Section 4(f) property (see discussion below).

Many environmental laws, including NEPA, are procedural, establishing actions that must be followed before a decision is made. Section 4(f) is different; it prohibits certain types of decisions from being made at all. This type of law is known as a substantive requirement because it focuses on the substance of an agency's decision and includes an obligation to make a specific finding or determination. Substantive laws can block an agency from taking an action regardless of how thoroughly the action has been studied.

Section 4(f) properties include significant publicly owned public parks, recreation areas, and wildlife or waterfowl refuges, as well as any publicly or privately owned historic sites listed or eligible for listing in the NRHP.

10.2. ADDITIONAL SECTION 4(F) GUIDANCE

Guidance for understanding and implementing Section 4(f) is provided by the FHWA and by the American Association of State Highway and Transportation Officials (AASHTO) on their websites: FHWA (References and Links #19.7.6 and #19.7.7) and AASHTO (References and Links #19.7.5).

10.3. WVDOH AND SECTION 4(F)

The WVDOH Environmental Unit directs the implementation and review of Section 4(f) for WVDOH projects with oversight and review by the FHWA, West Virginia Division. WVDOH has developed its own approved forms and checklists to standardize the

documentation and evaluation of Section 4(f) uses by its projects. Whether conducted internally or with consultant support, the analysis of how Section 4(f) applies to a project begins with the same steps. Essentially, one must determine whether Section 4(f) resources are present and whether the project will require a Section 4(f) use of the resource(s). If the answers are yes, then it will be necessary to document and evaluate the impact of the use on the Section 4(f) resource. The documentation and evaluation may take many different forms and may also involve the consideration of alternatives to minimize or mitigate the effects of the project on the resources.

During the project initiation and scoping phase, the WVDOH Environmental Unit will confirm whether the project is subject to Section 4(f). During this phase, either WVDOH or a consultant will identify any Section 4(f) resources within the project area. For some resources, it may be necessary to conduct research and analysis in an early phase to determine whether a resource will be classified under Section 4(f). For instance, a community green space may need to be investigated to determine whether it fulfills the requirements of a public park, or an older building may need to be evaluated to determine whether it is eligible for listing in the NRHP and what its boundary should be. WVDOH will determine or confirm what type(s) of Section 4(f) documentation and evaluation are necessary for a given project.

10.4. SECTION 4(F) RESOURCES

Section 4(f) properties or resources fall into three primary categories:

1. Publicly owned public parks, recreation areas, and wildlife and waterfowl refuges
2. Parts of public multi-use properties that are significant for park, recreation area, or wildlife and waterfowl refuge purposes
3. Historic sites

10.5. PUBLIC PARKS, RECREATION AREAS, AND WILDLIFE/WATERFOWL REFUGES

Section 4(f) applies to parks, recreation areas, or wildlife and waterfowl refuges only if certain criteria are met:

- **Public Ownership** — The property is publicly owned through fee simple ownership, public easement, or a long-term lease agreement.
- **Designation** — The property must be designated as a public park, recreation area, or wildlife and waterfowl refuge.
- **Major Purpose** — The major purpose of the property is for recreation activities or as a wildlife and waterfowl refuge.

- **Open to the Public** — The property must be open to the public. (Refuges are the exception; they do not have to be open to the public.)
- **Significance** — The property serves a major recreational role. This is determined by the official with jurisdiction. The official with jurisdiction is the official of the agency owning or administering the land.

10.6. PUBLIC MULTI-USE PROPERTIES

If publicly owned lands are administered under statutes permitting management for multiple uses and are managed for multiple uses, Section 4(f) may apply to certain parts of that property. For properties being managed for multiple uses, Section 4(f) only applies to those portions that function as or are designated in the management plans of the administering agency as a significant park, recreation, or wildlife and waterfowl refuges. The public must be permitted visitation to these areas at any time the facility is open (except for refuges).

Examples of multi-use properties include:

- State forests
- Federal forests
- School grounds
- Military properties

To determine what portions of the multi-use property are considered under Section 4(f), contact the official with jurisdiction over the property and discuss recreational management. The official with jurisdiction will make the final determination as to which portions of the property are significant park, recreation, or wildlife and waterfowl refuge areas. For publicly owned multi-use property that does not have a management plan, Section 4(f) applies to those areas that function primarily for Section 4(f) purposes. FHWA will make the final determination of Section 4(f) applicability of multi-use property.

10.7. HISTORIC SITES

A historic site (commonly called a historic property or historic resource) that has been determined to be eligible for or listed in the NRHP is identified as a Section 4(f) resource. Historic properties are evaluated and determined eligible for listing in accordance with the requirements and criteria in Section 106 of the NHPA of 1966 (see Section 6). For historic properties, the official with jurisdiction is the WVSHPO. Section 4(f) also applies to historic properties if they are a contributing resource in an NRHP eligible or listed historic district. Unlike public parks, recreation areas, and refuges, it does not matter if a historic site is publicly owned or open to the public.

The WVSHPO maintains an online interactive map that identifies known historic resources across the state (see Section 6); however, there may be unidentified historic resources associated with a given project area. In this case, an evaluation of the historic property's NRHP eligibility must be conducted to determine whether it should be considered a Section 4(f) resource.

10.8. SECTION 4(F) USE OF A RESOURCE

The use of a Section 4(f) property occurs when:

- Land is permanently incorporated into a transportation project (for example, permanent acquisition of right of way or permanent easements).
- There is a temporary occupancy of land that is adverse in terms of preserving the integrity of the Section 4(f) property.

A constructive use of the Section 4(f) property occurs when:

- A project's proximity impacts, without the acquisition of land from that property, are so severe that the protected activities, features, or attributes of a property (that is, the characteristics that qualify the property as a Section 4(f) resource) are substantially impaired.

When there is permanent incorporation of part of an NRHP-eligible or NRHP-listed historic district as part of the project, it will be necessary to determine whether the affected property belongs to a contributing or noncontributing resource of the historic district. If the project requires use of land from a noncontributing resource, there is no Section 4(f) use.

If the project involves a Section 4(f) use of a Section 4(f) resource, the type of use must be determined. Compliance with Section 4(f) for a transportation project with FHWA or FTA involvement can be achieved in one of four ways:

1. Finding of no use
2. *De minimis* impact determination
3. Documentation with a programmatic evaluation
4. Individual Section 4(f) evaluation

10.9. NO USE AND TEMPORARY OCCUPANCY

FHWA or FTA can determine that the project will not use any Section 4(f) properties. In some cases, this finding is straightforward and requires little if any documentation. In others, a finding of "no use" requires detailed analysis to determine whether Section 4(f) applies to a property and/or whether the project will use that property. This analysis should

be included in the project file and summarized in the NEPA document. WVDOH's NEPA Compliance Section provides direction on necessary documentation.

Temporary occupancy of the Section 4(f) resource can be considered an actual use if, as described in Section 10.9, that temporary occupancy adversely affects the resource. If the temporary occupancy does not adversely impact the resource, then it is not considered a Section 4(f) use. Depending on how straightforward the temporary occupancy is, documentation may need to be included in the project file and summarized in the NEPA document. WVDOH's NEPA Compliance Section provides direction on necessary documentation.

10.10. DE MINIMIS IMPACTS

FHWA or FTA can determine that the project's impacts on one or more Section 4(f) properties will be *de minimis*. A *de minimis* impact determination is not an exemption from Section 4(f); it is an authorization for a minor use of a Section 4(f) property without having to make a finding that there are no feasible and prudent avoidance alternatives. A *de minimis* impact determination is made on a property-by-property basis, not for a project as a whole. Therefore, several separate *de minimis* impact determinations could be made for a single project.

For publicly owned public parks, recreation areas, and wildlife and waterfowl refuges, a *de minimis* impact is one that will not adversely affect the activities, features, or attributes of the Section 4(f) property. For historic sites, a *de minimis* impact means that FHWA has determined, in accordance with 36 CFR Part 800 regulations implementing Section 106 of the NHPA (Section 6; References and Links #19.7.3) that either no historic property is affected by the project or that the project will have "no adverse effect" on the historic property. A *de minimis* impact determination does not require analysis of feasible and prudent avoidance alternatives.

10.11. PROGRAMMATIC EVALUATIONS

Programmatic Section 4(f) evaluations can be used in place of individual evaluations for highway projects where uses are considered minor. In general, programmatic evaluations are intended to be used for projects with relatively minor impacts to Section 4(f) properties. FHWA can apply a programmatic evaluation to an individual project without some of the process steps required for an individual Section 4(f) evaluation. For example, a legal sufficiency review is not required, and there is no need for a 45-day review by the U.S. Department of the Interior (DOI). Therefore, the Section 4(f) approval usually can be granted more quickly with a programmatic evaluation than with an individual evaluation.

FHWA has issued five programmatic evaluations that have been approved for use nationwide:

1. The Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate Minor Involvement with Public Parks, Recreation Lands, and Wildlife and Waterfowl Refuges
    a. A *de minimis* impact evaluation for public parks, recreation lands, and wildlife and waterfowl refuges may sometimes be implemented instead of this form.
2. The Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate Minor Involvement of a Historic Site
    a. A *de minimis* impact evaluation for historic properties may sometimes be implemented instead of this form.
3. The Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges
    a. For the purpose of this programmatic Section 4(f) evaluation, a proposed action will "use" a bridge that is listed in or eligible for inclusion in the NRHP when the action will impair the historic integrity of the bridge either by rehabilitation or demolition.
    b. Rehabilitation that does not impair the historic integrity of the bridge as determined by procedures implementing the NHPA of 1966, as amended, is not subject to Section 4(f).
    c. It may be possible to pair a Historic Bridge Programmatic documenting an adverse effect to a bridge that contributes to an eligible or listed historic district with a *de minimis* evaluation for the WVDOH to avoid the need to prepare an individual Section 4(f) Evaluation.
4. Transportation Projects that have a Net Benefit to a Section 4(f) Property
    a. This programmatic evaluation has been prepared for certain federally assisted transportation improvement projects on existing or new alignments that will use property of a Section 4(f) resource, which in the view of the FHWA and official(s) with jurisdiction over the Section 4(f) property, will result in a net benefit to the Section 4(f) property.
    b. A "net benefit" is achieved when the transportation use, the measures to minimize harm, and the mitigation incorporated into the project result in an overall enhancement of the Section 4(f) property when compared to both the future do-nothing or avoidance alternatives and the present condition of the Section 4(f) property, considering the activities, features, and attributes that qualify the property for Section 4(f) protection. A project does not achieve a "net benefit" if it will result in a substantial diminishment of the function or value that made the property eligible for Section 4(f) protection.
5. Independent Walkway and Bikeways Construction Projects

a. Independent bikeway or walkway construction projects are those highway construction projects that provide bicycle or pedestrian facilities in contrast to a project whose primary purpose is to serve motorized vehicles. This document does not cover bicycle or pedestrian facilities that are incidental items of construction in conjunction with highway improvements having the primary purpose of serving motor vehicle traffic.

b. This programmatic evaluation is only applicable for independent bikeway or walkway construction projects that require the use of recreation and park areas established and maintained primarily for active recreation, open space, and similar purposes. Additionally, this document is applicable only when the official having specific jurisdiction over the Section 4(f) property has given his or her approval in writing that the project is acceptable and consistent with the designated use of the property and that all possible planning to minimize harm has been accomplished in the location and design of the bikeway or walkway facility. This document does not apply if the project would require the use of critical habitat of endangered species.

c. This document does not cover the use of land from a publicly owned wildlife or waterfowl refuge or land from a historic site of national, state, or local significance. It also does not cover those projects where there are unusual circumstances (major impacts, adverse effects, or controversy). A separate Section 4(f) statement and environmental document must be prepared in these categories.

10.12. INDIVIDUAL SECTION 4(F) EVALUATION

If it is not possible to evaluate all of the project's Section 4(f) impacts using a *de minimis* analysis or a programmatic evaluation, an individual Section 4(f) evaluation will be required. An individual Section 4(f) evaluation authorizes the use of one or more Section 4(f) properties. An individual Section 4(f) evaluation requires legal sufficiency review by the agency's legal counsel. It must include two findings: (1) that there is no feasible and prudent alternative that completely avoids the use of the Section 4(f) property and (2) that the project includes all possible planning to minimize harm to the Section 4(f) property resulting from the use.

An individual Section 4(f) evaluation is processed in two phases, draft and final, both of which must be submitted to the FHWA Division Office or Federal Lands Division Office for review and approval. The final Section 4(f) evaluation is subject to a legal sufficiency review by FHWA's Office of Chief Counsel. The review is intended to ensure that Section 4(f) requirements have been met in case of a legal challenge to Section 4(f) use.

For projects processed with an EIS or an EA, the evaluation should typically be submitted as a subsection of the NEPA document where pertinent summaries from various sections are included. When putting an evaluation together as part of the NEPA document, make sure the Section 4(f) information is consistent with other references and information throughout the rest of the NEPA documentation.

For projects eligible as a CE, the Section 4(f) evaluation should be a separate document. Other projects that require the Section 4(f) evaluation to be submitted separately include those with design changes that were made after the CE, FONSI, or record of decision was processed, and those in which design modifications substantially increase the use of the Section 4(f) property after the original Section 4(f) approval.

10.13. DEVELOPING AND EVALUATING AVOIDANCE ALTERNATIVES

Unless the use of a Section 4(f) property is determined to have a *de minimis* impact, FHWA must determine that no feasible and prudent avoidance alternative exists before approving the use of such land (see 23 CFR § 774.3). The Section 4(f) regulations refer to an alternative that would not require the use of any Section 4(f) property as an avoidance alternative. Feasible and prudent avoidance alternatives are those that avoid using any Section 4(f) property and do not cause other severe problems of a magnitude that substantially outweigh the importance of protecting the Section 4(f) property while still meeting the project purpose and need.

10.14. ANALYSIS REQUIRED WHEN A USE IS NOT DE MINIMIS

When a use is not *de minimis*:

- **Identify and Evaluate Total Section 4(f) Avoidance Alternative(s)**. If a Section 4(f) property is used by a proposed transportation alternative, FHWA must determine whether a feasible and prudent alternative to using the property exists. Look at possible alternatives that would not result in any actual uses of Section 4(f) property. The alternative also cannot result in proximity impacts to the magnitude of a constructive use. This total avoidance alternative must be selected if it is determined to be feasible and prudent.
- **Identify and Evaluate Other Alternatives Considered**. All alternatives that were considered in the NEPA process, but that were not determined to be total Section 4(f) avoidance alternatives, are examined and a determination is made whether or not they (1) can be constructed in accordance with sound engineering judgment, (2) address the project purpose and satisfy the project need, or (3) result in impacts of an extraordinary magnitude.
- **Make an Assessment of Least Overall Harm**. When no feasible and prudent total Section 4(f) avoidance alternative exists, compare all remaining alternatives

to determine which project alternative would result in the least overall harm. The least overall harm analysis includes shifts/design modifications to avoid the use of Section 4(f) properties, as well as all possible planning to minimize harm to those properties. These shifts/design modifications can sometimes be dismissed as not reasonable under the environmental review process.

10.15. SECTION 4(F) EXEMPTION CRITERIA

Section 4(f) exemption criteria apply to the following types of properties:

- Land owned by private institutions (including nonprofit organizations) or individuals that is used as a park, recreational area, or wildlife/waterfowl refuge is not considered Section 4(f) property, and no Section 4(f) evaluations are required.
- To qualify as a Section 4(f) property, the park, recreation area, or refuge property in question must serve a major recreational or refuge purpose. Incidental, secondary, occasional, or dispersed recreational activities do not constitute a major purpose. Just because a property is designated as a park does not guarantee that it serves a major recreation purpose. If there are no visitors or noticeable recreational activities, it may not qualify as a Section 4(f) property.
- To qualify as Section 4(f) property, the public must be permitted visitation at any time when the publicly owned park or recreation area is open. Section 4(f) does not apply when visitation is permitted to only a select group and not the public at large.

10.16. PROJECTS AND SITUATIONS WHERE SECTION 4(F) DOES NOT APPLY

Section 4(f) does not apply to the following types of projects or properties:

- The restoration, rehabilitation, or maintenance of transportation facilities that are listed in or eligible for listing in the National Register if the following conditions are true:
    - FHWA determines that the facility's historic qualities that caused it to be on or eligible for the National Register will not be adversely affected.
    - The official(s) with jurisdiction have been consulted and have not objected to the finding.
- The Interstate System is exempt from Section 4(f) consideration, except for those elements formally identified by FHWA as having national or exceptional historic significance. The Final List of National and Exceptionally Significant Features of the Federal Highway System is available on FHWA's website (References and Links #19.7.8). In West Virginia, the following historic resources require Section 4(f) consideration:

  - The I-70 Fort Henry Bridge over the Ohio River in Wheeling, West Virginia.
  - The I-64/I-77 Yeager Bridge (southbound) over the Kanawha River in Charleston, West Virginia.
  - The I-77 Charlton Bridge (southbound) over the Bluestone River in Princeton, West Virginia.
- Certain trails, paths, bikeways, and sidewalks where any of the following conditions apply:
  - The trail-related project is funded under the Recreational Trails Program (23 USC § 206(h)(2)).
  - The trail is a National Historic Trail designated under the National Trails System Act (with the exception of segments that are historic sites) (16 USC §§ 1241–1251).
  - The trail/path/bikeway/sidewalk occupies a transportation facility right of way and can be maintained somewhere within that right of way.
  - The trail/path/bikeway/sidewalk is part of the local transportation system and functions primarily for transportation.
- Transportation enhancement projects and mitigation activities where the following conditions apply:
  - The use of the 4(f) property is solely for the purpose of preserving or enhancing an activity, feature, or attribute that qualifies the property for section 4(f) protection.
  - The officials with jurisdiction over the 4(f) property agree in writing that the project is solely for such preservation/enhancement.

11. SECTION 6(F)

11.1. INTRODUCTION TO SECTION 6(F) OF THE LAND AND WATER CONSERVATION FUND (LWCF)

Section 6(f) refers to a section of the Land and Water Conservation Fund (LWCF) Act of 1965 (Public Law 88-578, 78 Stat 897) (References and Links #19.8.7). According to the NPS,

> The LWCF Program provides matching grants to States and local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies). The program is intended to create and maintain a nationwide legacy of high-quality recreation areas and facilities and to stimulate non-federal investments in the protection and maintenance of recreation resources across the United States.

Section 6(f) of the LWCF Act prohibits the conversion of property acquired or developed with grants from this fund to a non-recreational purpose without the approval of the NPS. Importantly, Section 6(f) applies to all transportation projects (and others) involving possible conversions of the property regardless of whether federal funding is being used for the project.

The program provides matching grants (up to 50 percent) to states and through states to local governments for the acquisition and development of public outdoor recreation sites and facilities. Any property that was planned, purchased, or improved with LWCF money is considered a Section 6(f) property.

Section 6(f) provides that property acquired or developed with LWCF assistance shall be retained and used for public outdoor recreation. Any property so acquired and/or developed shall not be wholly or partly converted to other than public outdoor recreation uses without the approval of NPS pursuant to the LWCF Act (54 U.S. Code § 200305(f)(3)) (References and Links #19.8.2) and conversion requirements outlined in regulations (36 CFR § 59.3) (References and Links #19.8.1).

The NPS, which is part of the DOI, is the federal agency responsible for administering the LWCF.

Each state has a State Liaison Officer (SLO) and an alternate SLO appointed by the governor to administer the LWCF program at the state level.

Section 6(f) of the LWCF Act contains mandatory provisions to protect federal investments. The NPS provides the following guidance:

- The law recognizes that changes in land use or development may make some recreation areas obsolete over time and discourages casual "discards" of park and recreation facilities by ensuring that changes or "conversions from recreation use" require replacement land, assuring taxpayers that investments will not be wasted.
- According to Section 6(f), “No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if found in accordance with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as deemed necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location.”

11.2. ADDITIONAL SECTION 6(F) GUIDANCE

Overall guidance for understanding and implementing Section 6(f) is provided by the DOI NPS LWCF Federal Financial Assistance Manual (References and Links #19.8.5 and #19.8.6).

11.3. IDENTIFYING LAND AND WATER CONSERVATION FUND PROPERTIES

The NPS has developed a list of Section 6(f) properties within each state/county that can be accessed through the “Map of LWCF” website (References and Links #19.8.3) maintained by the LWCF Coalition. It is important to note that this database does not show the boundaries of each property protected by Section 6(f) and not all LWCF properties are identified in the NPS database. It is also important to remember that the boundary of the property protected under Section 6(f) does not always match the current boundary of the park, refuge, etc.

In West Virginia, during the project initiation and scoping phase, the WVDOH Environmental Unit will review the LWCF website to determine whether the project is subject to Section 6(f). During this phase, WVDOH will also identify whether any Section 6(f) LWCF properties are located within the project area.

If one or more Section 6(f) properties are present, WVDOH will contact the appropriate County Commission Development Office to determine the property boundary protected under Section 6(f). Once a Section 6(f) property is identified, the Section 6(f) boundary must be verified. The County Commission Development Office will identify the official boundary. It is important to contact the County Commission Development Office to identify the Section 6(f) property boundaries for recreation areas receiving LWCF development grants because the area protected by Section 6(f) may not match the extent of the whole recreation area boundary. Boundaries are important as they must be known to determine whether there is to be a conversion or temporary non-conforming use of the

property by the project, and if so, the extent of that conversion. An additional resource that can be reviewed is the property deed to determine whether the deed includes language referring to the LWCF and whether the deed includes restrictions on the property.

11.4. SECTION 6(F) PROPERTY IMPACTS

If it is determined that a Section 6(f) property is present within a project area, the next step is to determine whether any impacts will occur to the Section 6(f) property. Any acquisition of property by WVDOH from land where LWCF funding has been applied has the potential to be a conversion.

11.5. WHAT IS A CONVERSION

Each individual project scope will determine whether a project will result in a conversion. According to the NPS manual dated October 1, 2023 (Chapter 8, Section F.), situations that generate a conversion include:

- Property interests are conveyed for private use or non-public outdoor recreation uses.
- Non-outdoor recreation uses (public or private) are made of the project area or a portion thereof, including those occurring on preexisting rights of way and easements, or by a lessor.
- Unallowable indoor facilities are developed within the project area without NPS concurrence, such as unauthorized public facilities and sheltering of an outdoor facility.
- Public outdoor recreation use of property acquired or developed with LWCF assistance is terminated.

11.6. TEMPORARY USES OF SECTION 6(F) PROPERTY

Temporary uses of a Section 6(f) property for purposes such as staging areas, construction easements, or equipment or material storage are rare, as there is usually another property that can be used for these purposes. If there is any alternative to temporary use of Section 6(f) property, it should be chosen rather than using the Section 6(f) property.

Nevertheless, in certain situations, temporary use of a Section 6(f) property may be necessary due to the spatial relationship between the project area and the Section 6(f) property. When this happens, there are two compliance paths for temporary uses of the Section 6(f) property. Selection of the appropriate path depends on whether the use will be greater or less than six months in duration.

11.6.1. TEMPORARY USES OF SIX MONTHS OR LESS

As explained in the NPS Manual (Chapter 8, Section K.), all requests for temporary uses for purposes that do not conform to the public outdoor recreation requirement of less than six months must be reviewed by the WVDOH and the NPS to determine whether the use qualifies as a "conversion" requiring a replacement property.

For temporary uses of six months or less, WVDOH and the County Commission Development Office should work with the owner of the Section 6(f) property to prepare a written request regarding the temporary use. The NPS Manual specifies the documentation that must be included in the written request (see Chapter 8, Section K.). There are three components, two of which are written statements by the SLO, which is the WVDOH in West Virginia. The written request prepared by WVDOH and the owner of the Section 6(f) property consists mainly of a Compliance and Stewardship Form (References and Links #19.8.4).

The owner of the Section 6(f) property should submit the written request to WVDOH. WVDOH, in turn, will submit a formal request to NPS describing the temporary non-conforming use proposal. The NPS Manual (Chapter 8, Section K.) specifies that the NPS will use the following four criteria when evaluating a request for a temporary use of six months or less:

1. The size of the LWCF-assisted area affected by any temporary non-recreation use shall not result in a significant impact on public outdoor recreation use. This means that the site of the temporary activity should be sufficiently small to restrict its impact on other areas of a LWCF-assisted area.
2. A temporary use shall not result in permanent damage to the LWCF-assisted area, and appropriate measures will be taken to ensure the outdoor recreation area is restored for public recreation use and there are no residual impacts on the site once the temporary use is concluded.
3. No practical alternatives to the proposed temporary use exist.
4. The proposal has been adequately reviewed at the state level and has been recommended by the SLO.

If the NPS agrees that the temporary use of six months or less is not a conversion, then no further actions are required.

11.6.2. TEMPORARY USES OF MORE THAN SIX MONTHS

As explained in the NPS Manual (Chapter 8, Section K.), continued use beyond six months will not be considered temporary but will result in a conversion of use and will require the project sponsor to provide a new replacement recreation area.

11.7. IDENTIFICATION OF A NEW REPLACEMENT RECREATION AREA

As soon as it is determined that a project may involve a conversion of a Section 6(f) property, WVDOH and the County Commission Development Office should work with the owner of the Section 6(f) property to identify a suitable replacement recreation area to be owned and operated by the owner of the Section 6(f) property impacted by the project.

The NPS Manual (Chapter 8, Section F.) sets forth several criteria for selecting a suitable replacement property (see "Prerequisites to the NPS consideration of conversions"). The most fundamental requirements are that the replacement property must be (1) of at least equal fair market value and (2) of reasonably equivalent usefulness and location as compared to the portion of the Section 6(f) property to be converted.

Regarding the first of these two fundamental requirements, equal fair market value, an appraisal must be conducted in accordance with the Uniform Appraisal Standards for Federal Land Acquisitions (UASFLA) (i.e., a "yellow book appraisal"), excluding the value of structures or facilities that will not directly enhance its outdoor recreation utility. UASFLA appraisals can be much more expensive than a regular real property appraisal. It may be possible for WVDOH and the owner of the Section 6(f) property to hold off on expending resources on a formal UASFLA appraisal until WVDOH and NPS have informally approved the acceptability of the proposed replacement property as explained below. This will only work if it is possible to do a ballpark estimate of the value of the properties or a non-UASFLA appraisal (for both the portion of Section 6(f) property that will be converted and the replacement property) to know whether the proposed replacement property is likely to be ultimately approved by NPS.

Regarding the second of these two fundamental requirements, "reasonably equivalent usefulness and location," depending on the situation, and at the discretion of the NPS, the replacement property need not provide identical recreation experiences or be located at the same site, provided it is in a reasonably equivalent location. According to the NPS Manual, generally, the replacement property should be administered by the same political jurisdiction as the converted property; however, NPS may be willing to approve a change in ownership (i.e., the impacted Section 6(f) property is a county park, but the replacement property will be a city park). Additionally, the replacement property need not necessarily be directly adjacent to or close by the converted site. See the NPS Manual (Chapter 8, Section F.) for more details about the suitability of a replacement property.

As soon as a proposed replacement property is identified, WVDOH and the owner of the Section 6(f) property should informally consult with the NPS. It is recommended that WVDOH work with the owner of the Section 6(f) property to compile a brief, informal report or memo with maps, drawings, and photos (as appropriate) explaining the proposed impact to the Section 6(f) property, including details such as the recreational needs that are being fulfilled by the property and the size and boundaries of the area that will be

impacted by the project, as well as the location, size, boundaries, and recreational needs that will be fulfilled by the proposed replacement property.

Once these informal materials are prepared, the owner of the Section 6(f) property should reach out to WVDOH and request a meeting with WVDOH and NPS to informally discuss whether the proposed replacement property is viable.

11.8. PREPARING THE CONVERSION PROPOSAL

As soon as NPS has given preliminary approval of the acceptability of the proposed replacement property, it is recommended that WVDOH work with the owner of the Section 6(f) property to start preparing a draft of the formal conversion proposal. In West Virginia, a consultant of WVDOH will complete the draft documents required for the conversion proposal. These documents will then be reviewed by the County Commission Development Office.

A main component of the formal conversion proposal is the LWCF Compliance and Stewardship Form (References and Links #19.8.4).

In addition to the Compliance and Stewardship Form, additional information required for submission includes project mapping (location map, Section 6(f) boundary map, and conversion area impact map), state liaison approval letter, and the environmental approval document.

Ideally, preparation of the formal conversion proposal will still be early in the environmental review process for the transportation project, prior to NEPA clearance. The proposal will not be formally submitted until after the transportation project is cleared under NEPA and all federal authorizations for the transportation project are obtained; however, it is recommended that the owner of the Section 6(f) property request that WVDOH and NPS informally review the draft as soon as possible to identify any deficiencies and avoid any unforeseen issues with the conversion.

Formal submittal of the conversion proposal and request for NPS approval cannot occur until after NEPA clearance of the transportation project (i.e., categorical exclusion, finding of no significant impact, or record of decision), and all environmental review requirements for the transportation project have been satisfied (see the NPS Manual Chapter 8, Section F). The NPS Manual has a detailed list of prerequisites that must be met prior to formal submittal of the conversion proposal.

12. NOISE

The WVDOH recognizes that highways and their associated maintenance and construction can be sources of noise impacts on surrounding areas. Therefore, WVDOH understands the need to decrease the effects of noise associated with highways wherever feasible. NEPA provides guidelines for addressing noise in highway projects, which involves coordination with the FHWA. Noise reports are typically required for large-scale projects and are included in NEPA documents such as EAs and EISs. These reports may also be part of the alternatives analysis phases for some CEs.

See WVDOH's Design Directive 253 (DD-253), "Noise Analysis and Abatement Guidelines" (References and Links #19.9.4), along with the FHWA "Highway Traffic Noise Analysis and Abatement Policy Guidelines" (References and Links #19.9.2), for more detailed information about assessing, permitting, and coordinating projects dealing with highway noise. A consultant is often hired to conduct noise assessments and compile a noise report for larger projects. Refer to Section 19 for definitions relating to 23 CFR Part 772 (References and Links #19.9.1).

12.1. COORDINATION WITH FHWA

Federal requirements for addressing noise impacts are contained in 23 CFR Part 772 (References and Links #19.9.1) and the Highway Traffic Noise Analysis and Abatement Guidance issued July 12, 2010, (revised January 2011) by the FHWA (References and Links #19.9.2). WVDOH considers the guidance set forth by the state in DD-253 to be consistent with the federal policies and procedures described in these federal documents.

12.2. PROJECT TYPES

Three types of projects are specified in 23 CFR Part 772:

Type I projects require a highway traffic noise impact study. Type I projects consist of one or more of the following actions:

1. Construction of a highway in a new location.
2. Physical alteration of an existing highway with either of the following:
    a. A substantial horizontal alteration (a project that halves the distance between the source of traffic noise and the closest receptor)
    b. A substantial vertical alteration (a project that removes shielding and exposes line-of-sight between noise source and receptor).
3. Addition of through-traffic lane(s).

4. Addition of an auxiliary lane (with the exception of turn lanes). According to FHWA FAQs issued in January 2015, the addition of an auxiliary lane is considered a Type I project if it exceeds 2,500 feet in length.
5. Significant alteration of an existing partial interchange, including adding or relocating interchange lanes or ramps.
6. Restriping existing pavement to add a through-traffic or auxiliary lane.
7. Addition of or substantial alteration to a weigh station, rest stop, ride-share lot, or toll plaza.

If a project is determined to be a Type I project under this definition, then the entire project area as defined in the environmental document is a Type I project.

Type II projects consist of all federal or Federal-aid Highway Program projects conducted to reduce noise on an existing highway. The WVDOT does not develop or implement Type II projects.

Type III projects consist of all federal or Federal-aid Highway Program projects that do not fall under the criteria of Type 1 or Type II projects. Type III projects do not require noise analysis.

12.3. HIGHWAY NOISE IMPACT STUDY

WVDOH must conduct a highway noise impact study for all Type I projects. Multiple alternatives are often considered in the development of Type I projects. A noise impact study must be completed for all alternatives under consideration, and should include the following steps:

1. **Initial Assessment** — Identify existing and planned noise-sensitive land uses. An inventory should be made of all existing activities, as well as developed land, undeveloped land, and land with planned development that may be affected by noise from the proposed highway. See Table 1 of 23 CFR Part 772 for a list of all noise-sensitive receptors that must be documented in the initial assessment.
2. **Noise Analysis** — Conduct a noise analysis by measuring existing noise levels, predicting future noise levels, and evaluating the effectiveness of potential noise abatement measures. Procedures for conducting the noise analysis are outlined in Measurement of Highway Related Noise FHWA-80-96-046.
3. **Noise Predictions** — Predict the project's design-year noise levels using the existing and planned noise-sensitive receptors for all project alternatives. Noise predictions should be made using a prediction method approved by the FWHA.
4. **Calculated Noise Impacts** — Compare the predicted design-year noise levels with the Noise Abatement Criteria (NAC) of 23 CFR Part 772 to estimate the

project's noise impacts. Impacts are considered to occur if any of the following are true:

a. Predicted noise levels approach the NAC level(s) (come within one A-weighted decibel [dBA] of NAC levels).
b. Predicted noise levels exceed the NAC levels.
c. Predicted design-year noise levels exceed existing noise levels by 15 dBA or greater.

5. **Assess Interior Noise Impacts** — After all outdoor analysis options have been exhausted, an indoor analysis may be conducted to determine the project's impact on certain noise-sensitive receptors. See Activity Category D, Table 1, 23 CFR Part 772 for a list of relevant receptors.
6. **Examine Noise Abatement Measures** — For projects with a determined noise impact, alternative noise abatement measures should be examined to reduce or eliminate impacts. Noise abatement measures include, but are not limited to, traffic management measures, alignment changes, acquisition of buffer properties, installation of insulation or air conditioning in impacted buildings, and construction of noise barriers.
7. **Prepare Noise Study Report** — A detailed noise study report should be prepared to demonstrate the impacts of the proposed project as well as the proposed mitigation or abatement measures. Alternatively, if no noise impacts are anticipated, the report should summarize the findings leading to that conclusion. See DD-253 for a list of components that should be included in each report. A copy of the report should be included in the CE, EA, FONSI, or EIS for the proposed project.

12.4. MITIGATION MEASURES

If the analysis identifies significant noise impacts, mitigation measures such as noise barriers, quieter pavement, or changes in project design are considered to reduce noise levels to acceptable standards. Information on avoiding, minimizing, and mitigating noise can be found on the FHWA website (References and Links #19.9.3).

12.5. DOCUMENTATION AND APPROVAL

The findings from the noise analysis and public involvement are documented in the CE, EA, FONSI, or EIS associated with the project. The FHWA and WVDOT are responsible for reviewing and approving the document.

13. AIR QUALITY

The purpose of the CAA legislation and NEPA is to protect health and welfare by attaining and maintaining the National Ambient Air Quality Standards (NAAQS). These air quality guidelines implement CAA and NEPA and provide information for the project manager on how to comply with the regulations throughout the environmental review process.

13.1. ANALYSES NEEDED BY THE PROJECT

Air quality, at a project level, must be addressed during the NEPA process. The level of analysis will vary considerably in content and level of detail from one project to another based on the project scope, size, geographic location, background conditions, and anticipated impacts. At a project level, any required air quality analysis in West Virginia primarily addresses localized emissions of carbon monoxide and Mobile Source Air Toxics (MSATs) and is performed to assure that violations of the NAAQS will not occur because of the proposed project.

13.2. REGULATIONS THAT GUIDE THE PROCESS

The CAA, passed by Congress in 1970 and updated in 1977 and 1990, is comprehensive national legislation relating to air quality. The CAA of 1970 established six criteria pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide) and required the USEPA to set NAAQS for these criteria pollutants at levels protective of vulnerable persons, with a margin of safety. These standards must be reviewed periodically to reflect new research findings.

The USEPA Conformity Rule, 40 CFR Part 93 (References and Links #19.10.1), requires each Metropolitan Planning Organization (MPO) in an air quality nonattainment or maintenance area to determine the conformity of its Metropolitan Transportation Plans (MTP) and Transportation Improvement Programs (TIP). In addition to the conformity requirements that apply to the MTP and TIP, the USDOT is required to make conformity determinations for individual federal projects.

Conformity is demonstrated if the plan, program, or project does not do any of the following:

- Cause new violations of the air quality standards
- Exacerbate existing violations of the standards
- Delay attainment of the standards or achievement of any required interim milestones

NEPA is a broad national framework for the protection of the environment. It establishes environmental policy, an interdisciplinary framework to prevent undue environmental

damage, and procedures to be followed so that environmental factors are considered by decision-makers. The NEPA process is used as the mechanism for reporting the results and findings of conformity analyses for projects, as well as other types of air quality analysis, including MSATs.

There are no established criteria for determining when MSAT emissions become a significant issue in the NEPA context because tools and techniques for assessing project-specific health outcomes are limited. The NEPA documentation may involve a quantitative analysis of emissions to compare or differentiate among proposed project alternatives, a qualitative analysis to explore the general nature of the project and a method to inform interested parties, or no analysis depending on the circumstances set forth in the Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents (Federal Highway Administration [FHWA] October 18, 2016) (References and Links #19.10.2).

13.3. CONSIDERATION OF MOBILE SOURCE AIR TOXICS IN NEPA DOCUMENTS

The FHWA developed a tiered approach with three categories for analyzing MSAT in NEPA documents, depending on specific project circumstances:

1. No analysis for projects with no potential for meaningful MSAT effects
2. Qualitative analysis for projects with low potential MSAT effects
3. Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects

For projects warranting MSAT analysis, all nine priority MSATs should be considered. The nine priority MSATs are 1,3-butadiene, acetaldehyde, acrolein, benzene, diesel particulate matter, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter

For Class 1,2 and 3 actions, ensure that all mitigation commitments are incorporated into the Plan, Specifications, and Estimate package during design.

13.3.1. CLASS 1 ACTIONS (ENVIRONMENTAL IMPACT STATEMENTS)

Scoping documents — Conduct early assessment of the magnitude and significance of potential air impacts. Consult with FHWA and the relevant MPO to see whether regional emissions analysis and conformity determination will be needed.

Draft Environmental Impact Statement (DEIS) — When localized intersection modeling is required, the DEIS should include background monitoring results at receptor sites along project alignment(s). The MPO may provide background numbers to preclude the need to monitor under certain conditions. Modeling results of air pollutants for the alternatives should also be reported. Modeled pollutant concentrations should be compared to state

and federal air quality standards. MSAT should be addressed per Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents (FHWA January 2023) (References and Links #19.10.2).

Final Environmental Impact Statement (FEIS) — Model air quality impacts of the preferred alternative. The preferred alternative must be in conformance with the State Implementation Plan. Where conformity is required, include information needed for a positive conformity determination. MSAT should be addressed per Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents (FHWA January 2023) (References and Links #19.10.2).

Record of Decision (ROD) — The draft ROD is prepared through a consultation process among FHWA, USEPA, and the WVDOH. Include a summary statement on air quality. If the project is not already included in the conforming MTP and TIP, it must be added to those documents. A final conformity determination is made in the ROD.

13.3.2. CLASS 2 ACTIONS (CATEGORICAL EXCLUSIONS)

Categorical Exclusion — Determine whether the project is exempt from conformity determination and/or regional emissions analysis. If the project is exempt, document this in the project report. If not, follow the guidance for scoping for a DEIS and FEIS above in Section 13.3.1.

13.3.3. CLASS 3 ACTIONS (ENVIRONMENTAL ASSESSMENTS)

Environmental Assessment — Follow guidance for scoping for a DEIS and FEIS above in Section 13.3.1.

Finding of No Significant Impact — Include a summary statement on air quality. For Class 1, 2, and 3 Actions, ensure that all mitigation commitments are incorporated into the Plan, Specifications, and Estimate package during design.

14. HAZARDOUS MATERIALS INVESTIGATION

These guidelines explain the procedure for identifying and addressing hazardous material encountered during the development of highway projects. Federal law places the responsibility and cost of cleaning up hazardous material on the current property owner for any hazardous material found.

It is the practice of the WVDOH to avoid known hazardous material locations. When avoidance is not possible, or alternatives create greater adverse environmental impacts or excessive costs, early evaluation of hazardous material locations allows time for site management and environmental protection. The chances of discovering unknown hazardous material sites are remote; however, the potential added cost and adverse environmental impact warrants careful research early in the planning process.

14.1. GOVERNING REGULATIONS

The WVDOH's procedures for hazardous materials investigation have been established through the following guidance documents:

- WVDOH Design Directive 302 (DD-302)
- WVDOH Guidelines for Identifying and Dealing with Hazardous Waste on Highway Projects
- WVDOH Design Directive 313 (DD-313)
- FHWA documents

The procedures also follow USEPA and WVDEP guidelines.

14.2. WHEN A HAZARDOUS MATERIAL INVESTIGATION IS WARRANTED

A hazardous materials investigation is warranted for the following types of infrastructure or conditions:

- Solid waste (landfills)
- Leaking underground storage tanks
- Leaking aboveground storage tanks
- Hazardous material generators
- Registered storage tanks
- If the site is listed on any of the following websites:
    - Resource Conservation and Recovery Act (RCRA) (References and Links #19.11.6)

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (References and Links #19.11.7)
- Toxic Substance Control Act (TSCA) (References and Links #19.11.3)
- Superfund Amendments and Reauthorization Act (SARA) (References and Links #19.11.8)
- Cleanups In My Community (References and Links #19.11.4)

14.3. TYPES OF HAZARDOUS MATERIAL PROJECTS

The following types of projects would normally require a hazardous material review:

- A new controlled access freeway
- A highway project of four or more lanes on a new location
- Any highway or bridge improvement project on a new location
- Any highway or bridge improvement project requiring additional ROW or easements.

The following types of projects would normally not require a hazardous material review:

- Paving, resurfacing
- Bridge replacement
- Highway safety or traffic improvement
- Landscaping projects
- Utility installations
- Construction of bicycle/pedestrian facilities
- Planning activities
- Highway training/research
- Emergency relief projects
- Disposal and joint or limited use of excess ROW

14.4. WVDOH GUIDANCE DOCUMENTS

Several WVDOH guidance documents address hazardous material. The following WVDOH guidance documents should be referenced when encountering hazardous material or possible hazardous material on a project.

14.4.1. DESIGN DIRECTIVE 302 (DD-302) – HAZARDOUS WASTE

DD-302 provides guidelines for implementing specific procedures for identifying and dealing with hazardous material on highway projects. It references the “Guidelines for

Identifying and Dealing with Hazardous Waste on Highway Projects" document. A copy of the guidelines is available in Section 20 of this document.

14.4.2. DESIGN DIRECTIVE 313 (DD-313) – ASBESTOS INSPECTION REPORTS

DD-313 provides guidance on when an asbestos inspection report is warranted; procedures for obtaining a competent and licensed person to perform the inspection; and guidelines for preparing an inspection report.

The WVDEP Division of Air Quality is the agency that enforces the federal asbestos National Emission Standards for Hazardous Air Pollutants rule (40 CFR Part 61, Subpart M) (References and Links #19.11.1). In addition, the Bureau of Public Health, Environmental Health Services has related rules that require persons conducting these building inspections and/or removing or handling asbestos-containing materials be properly trained and licensed.

14.4.2.1. When Asbestos Inspections Are Warranted

Asbestos inspections are required on any structure when that structure is to be renovated or demolished. A structure, by definition, is a building or other human-made structure or part of a building or a group of buildings on the same premises or any other type of human-made construction such as a pipeline, barn, shed, trailer, or appurtenances to a building or human-made structure. Some examples include residential, commercial, industrial, or storage buildings; houses; sheds; barns; garages; trailers; mobile homes; bridges; pipelines; lighted sign structures; or light structures.

The WVDOH Engineering Division currently has two resources for obtaining an asbestos inspection report: from WVDOH inspectors (already employed in each of the Districts) or from a list of prequalified asbestos inspection firms. The WVDOH inspectors only inspect bridge structures.

14.4.2.2. Obtaining an Inspection

The following information for each structure that is to be purchased and inspected should be listed.

- Project manager (name and contact information)
- State Project Number
- Federal R/W Number (if applicable)
- Building Demolition Number (assigned per DD-709); if the structure does not have a building demolition number, the project manager must assign a number to the structure before the inspection can be requested

- Street address of the structure
- Short description of the project purpose (demolition, renovation)
- Half-scale plan sheet indicating the affected structure(s)
- Labeled photos of the front of each structure

The Consultant Services Group asbestos coordinator will select and assign one firm for the entire project. This firm will be responsible for the inspection of all applicable structures purchased within the ROW. The district ROW agent working with the project will be given the contact information of the inspection firm and will notify the firm as the structure(s) becomes available for inspection. The ROW agent shall maximize the number of structures in the notifications so that the inspection firm can minimize the number of trips to the field to obtain samples. The inspection firm will coordinate with the district ROW agent to obtain access to the structures.

An asbestos inspector and the inspection must comply with 64 CSR Part 63 (References and Links #19.11.9). The project manager is responsible for reviewing the inspection reports after they are submitted. This section gives a format and suggestions to aid in the review. Asbestos inspection reports shall be submitted as two separate documents: a contract bidding report and a complete inspection report.

14.4.2.3. Contract Bidding Report

The contract bidding report shall be included in the contract proposal when the project is advertised for bid. This contract bidding report shall consist of the following:

- **Title page** — This shall be on the inspection firm's company letterhead bearing the project name, state project number, federal ROW number, building demolition numbers, and date.
- **Narrative** — The narrative shall contain the description, sampling protocol, and any other pertinent information. The report shall be signed by the report's author and the firm's internal reviewer. The narrative shall state that "This report is for the solicitation of bids; a complete inspection report will be provided at the pre-construction meeting."
- **Summary Table** — Only structures that contain positive samples are included in this report. The table shall contain the project name, state project number, building demolition numbers, address, structure description, material description, sample number, location, approximate quantity in linear feet or square feet or cubic feet, and percent asbestos. This table does not show samples taken that did not contain asbestos.
- **Floor Plan** — One floor plan for each level of the structure that had samples containing asbestos showing the sample locations and numbers with the building

demolition numbers and the room name or number. Asbestos-containing material shall be shown as a colored circle. The floor plans shall be arranged in the order in which the structures are shown in the summary table.

- **Plan Sheet** — This shall be an 8.5 × 11 photocopy (not reduced) of the plan sheet showing the structure(s). The plan sheet shall show only the structure(s) with positive samples as crosshatched and labeled with the building demolition number.
- **Color photos** — Color photos of the positive sample locations and the front of the structure shall be included.
- **Licenses** — A photocopy of the inspector's license and current certification and a photocopy of the testing laboratory's license and current certification shall be included.

14.4.2.4. Complete Inspection Report

The complete asbestos inspection report shall comply with the following requirements, in addition to any state and/or federal regulations.

- Section I — This section shall contain the following items:
  - The title page shall be on company letterhead bearing the project name, state project number, federal ROW number, building demolition numbers, and date. A narrative containing a project description, sampling protocol, and any pertinent information and signatures of the report's author and the firm's internal reviewer.
  - A table of contents.
  - A master summary table shall be complete with all structures inspected and shall contain the project name, state project number, building demolition numbers, address, structure description, material description, sample numbers, location, approximate quantity represented in linear feet or square feet or cubic feet of all materials assumed to contain asbestos that were sampled, and percent asbestos.
- Section II — Each structure shall have its own section arranged in the order of the structures in the master summary table, including the following items:
  - Vicinity map.
  - The plan sheet shall be an 8.5 x 11 photocopy (not reduced) of the plan sheet showing the structure(s) that were sampled as cross hatched and labeled with the building demolition number.
  - Homogeneous area tables shall detail the location and approximate quantity represented in linear feet, square feet, or cubic feet of all materials assumed to contain asbestos that were sampled.

- A sample table shall show all samples taken with a unique identifying sample number and homogeneous area.
- Floor plan(s) for each level of structure, with sample locations labeled and shown as positive (colored circle) or negative (empty circle).
- Color photos of the front of the structure and each of the sample locations and numbers.

- Section III — All lab testing and chain of custody numbers shall match the sample numbers (indexed). Include the following items:
  - Laboratory sample results and chain of custody record.
  - Photocopy of inspector's license and current certification.
  - Photocopy of laboratory's license and current certification.
  - Copy of inspectors' field sample sheets.

14.4.2.5. Inspection Standards Compliance

As part of the WVDOH Engineering Division's quality control program, random asbestos reports will be audited. The audit will include but not be limited to: a clerical review, a structure review, and a sampling and testing results review. The clerical review will verify that the report has been prepared using the standard format and is clear and concise. The building demolition number, sample numbers, and room numbers must be consistent and should cross-reference the structure section with photo, sample table, floor plan, chain-of-custody, and laboratory testing results. The structure review will be performed shortly after the report is submitted and before the bidding advertisement. This review will verify that each sample from the report is clearly marked on the structure and that each sample location was photographed and is consistent with the floor plan. Samples will be taken near the marked samples for a laboratory audit. The location map and structure address will be checked for accuracy. The WVDOH Engineering Division's auditor will inspect the structure for possible presumed asbestos-containing material that has not been sampled and obtain samples to be lab tested if needed. The sampling and testing results review will be a check of the certified sampling laboratory with comparative sample testing.

14.4.3. LEAD PAINT INSPECTIONS

When an inspection for lead paint is required, lead inspection and sampling services should be handled in accordance with the methodology described in the USEPA's Paint Chip Sample Collection Guide (References and Links #19.11.5) and as described by the requirements in 40 CFR Part 745 (References and Links #19.11.2). Lead-based paint hazards are regulated by Title IV under the Toxic Substance Control Act, the CWA, the SDWA, the CAA, and other laws and regulations. The inspection must be led by a lead

inspector certified by the West Virginia Office of Environmental Health Services. Samples collected for analysis must be submitted to a laboratory accredited for the lead analysis recognized by the National Lead Laboratory Accreditation Program.

The lead inspection report will follow the inspection to document the results. Any materials determined to be lead based will be conveyed in the report. The report must also document an approximate amount of lead-based material based off of the approximate square footage estimates determined for the applicable sample (References and Links #19.11).

Please refer to the hazardous materials investigation Flowchart 21.8 for additional details.

15. COMMUNITY IMPACTS, HUMAN POPULATIONS, AND TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

WVDOH recognizes that proposed actions receiving federal funds must be assessed to ensure they are not discriminating based on race, color, or national origin, as required by Title VI of the Civil Rights Act of 1964.

Title VI of the Civil Rights Act of 1964 prohibits discrimination by recipients of federal financial assistance on the basis of race, color, and national origin, including matters related to language access for persons with Limited English Proficiency (LEP). Supplemental legislation provides these same protections from discrimination based on sex, age, disability or religion.

WVDOH shall consider and address human populations and potential impacts to them in all NEPA decision-making processes regardless of the project's scoped NEPA class of action and will appropriately document findings in the appropriate environmental document. WVDOH will ensure any benefits derived from proposed actions will be administered without regard to race, color, or national origin.

Titlve VI of the Civil Rights Act of 1964:
• Title VI of the Civil Rights Act of 1964 is the federal law that protects individuals and groups from discrimination on the basis of their race, color and national origin in programs and activities that receive federal financial assistance. • This program also assesses and addresses the needs of otherwise eligible limited English proficient persons seeking access to the programs and activities of recipients of federal financial assistance.

Special considerations apply if disproportionate impacts are expected to occur to a population protected by Title VI of the Civil Rights Act of 1964. In this case, consultation with WVDOH's Title VI program specialists should be conducted.

As a direct recipient of federal financial assistance, WVDOH's practices assure that no person shall, on the grounds of race, color, or national origin, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its programs and activities. This includes discrimination based on English proficiency, and FHWA and the U.S. Department of Justice have specific guidance to assist with these evaluations

(References and Links #19.12.5, #19.12.9, and #19.12.10). Under Title VI, recipients are required to provide LEP individuals with meaningful access to their programs and services. Providing "meaningful access" will generally involve some combination of services for oral interpretation and written translation of vital documents. In addition to Title VI, the following other nondiscrimination statutes afford legal protection: Section 162 (a) of the Federal-Aid Highway Program Act of 1973 (23 U.S. Code 324) (sex), Age Discrimination Act of 1975 (age), and Section 504 of the Rehabilitation Act of 1973/Americans with Disabilities Act of 1990 (disability). Together, these requirements define an overarching Title VI Program.

As part of this policy, WVDOH is committed to doing the following:

- Engaging all populations early and often in the planning and decision-making process.
- Offering language assistance and access to all who may require it.
- Preventing, minimizing, and mitigating for adverse disproportional impacts associated with a WVDOH-sponsored action.

WVDOH's Title VI Implementation Plan and program web page (WVDOH 2024) (References and Links #19.12.12) includes information, a download link for the implementation plan (2024), and the Title VI Complaint Form (2022).

15.1 GUIDANCE FROM THE FHWA AND USEPA

Guidance, memos, and regulatory framework offered by the USDOT and FHWA to assist with community impacts and human population evaluations are listed below. WVDOH's recommended procedures documented in this guidance document are based on these directives.

- USDOT Civil Rights Awareness and Enforcement (References and Links #19.12.11)
- USDOT Title VI Order (1000.12C) (References and Links #19.12.4)
- USDOT FHWA U.S. Census — Limited English Proficiency (LEP) Data Collection Walkthrough (References and Links #19.12.5)
- USDOT's Limited English Proficiency (LEP) Guidance (References and Links #19.12.10)
- U.S. Department of Justice Final LEP Guidance (References and Links #19.12.9)

Historical data sources and screening reference materials are available for additional context. These include USEPA's community and regulatory evaluation frameworks. Historical USEPA assessments provide background context regarding analytic considerations, demographics, and screening methods to evaluate localized project

effects. USEPA's EJScreen tool (References and Links #19.12.1), EnviroAtlas (References and Links #19.12.2), and NEPAssist (References and Links #19.12.3) are available tools that provide baseline community context, ecosystem data, and human population information in project scoping and screening activities.

Data sources that are generally available for evaluating the potential presence of Title VI populations in the vicinity of a given project are listed in Table 15.1.

Table 15.1. Sources of Data to Guide Community Demographic and Title VI Population Screenings

Data Source	Section 19 Link Reference	Description
U.S. Census Bureau	References and Links #19.12.7	Primary source of population data
American Community Survey	References and Links #19.12.6	U.S. Census Bureau population data summary statistics.
U.S. Department of Housing and Urban Development Data Sets	References and Links #19.12.8	Mapping tool to identify affordable housing resources.

While information from the U.S. Census Bureau and similar national databases provide core foundational data for evaluating demographic data, these data sets should be supplemented as necessary through community engagement, public outreach, and other data directly applicable to the affected community. This information could be acquired from other federal, state, or local sources.

15.2 COMMUNITY IMPACTS, HUMAN POPULATION, AND TITLE VI POPULATION EVALUATION PROCEDURES

The potential presence of Title VI populations should be evaluated early in the project development process to ensure these communities are actively informed and involved, and to identify and correct any potential for any discriminatory consequences related to the proposed action. Refer to Section 21 for Flowchart 21.9 breaking down Title VI procedures. The process is described in more detail below.

Step 1. Develop a study area that will be used to evaluate the potential presence of Title VI populations.

This would include any U.S. Census Tract Block Groups that overlap with the project area. The study area should encompass a broad area where the project holds potential to affect Title VI populations.

The project area used for Title VI population evaluations should encompass block groups that do not overlap with the immediate project footprint if the impacts could extend to

those areas. For example, all areas and populations that may be affected by access impacts associated with a bridge replacement project should be considered and included in the study area.

Step 2. Evaluate the presence of Title VI populations

The potential presence of these populations may be determined from demographic data.

Identify the potential for Title VI population presence based on the demographic data collected from the US Census Bureau website (References and Links #19.12.7) at a minimum.

Once statistics are gathered for the block groups that would be affected by the proposed action (typically those that overlap with a project area or those where access would be impacted by the project), a Title VI population is considered to be likely to be present in the vicinity if the block group percentage exceeds that of the respective statistic for the overall county.

Use data from observations based on field view and/or aerial and other online resource review. Through desktop research and (when possible) field observation, review the area for field indicators that might suggest the presence of Title VI populations. These may include (but are not limited to) the items listed in Table 15.2, below. Additional resources and procedures applicable to LEP population evaluations should be reviewed, as advised in FHWA's Limited English Proficiency Data Collection Walkthrough guidance (References and Links #19.12.5).

Table 15.2. Potential Example Indicators of Title VI Populations Based on Observational Data

Potential Observational Title VI Population Indicators
Churches or businesses targeted to serve minority populations
Newspapers distributed in other languages
Ethnic grocery stores or services
Retirement communities
Resources specifically serving youth, disabled populations, elderly, or minority populations

Consult with local officials (e.g., city or county officials, planners, administrators, human services representatives, local school personnel, etc.) on the demographic makeup of the community. All coordination efforts involving the local community should include conversations centered on the presence of and potential impacts to Title VI populations. Local officials should be consulted to identify any specific organized groups representing, serving as social centers to, or offering services to any Title VI populations in the vicinity of the project.

Use the results from public outreach activities. General public involvement activities should seek comments and feedback from local residents, property owners, business owners, and local officials in the vicinity of the project. When appropriate, incorporate public engagement efforts targeted toward Title VI populations (refer to Section 9). When Title VI populations are suspected to be present, all public involvement activities and advertisements should include appropriate measures to reach them.

If any of the bolded items under Step 2 identifies the potential presence of Title VI populations, engage these populations early in the project development and public involvement process to paint a clear picture of potential community needs and impacts. Communication and engagement with these communities should occur as early as possible and should be ongoing through the life of the project.

EXAMPLE MEASURES TO BE TAKEN TO ENSURE FULL AND FAIR PARTICIPATION IN THE PUBLIC INVOLVEMENT PROCESS:
• Public meeting materials should be translated as appropriate. • Translation services should be made available at public meetings. • Public meetings should always be held in ADA-accessible locations. • Advertisements should be made in ways that would reach those without access to the internet. • Invitations for requests for any special accommodations should be made in public meeting advertisements. • Door-to-door distribution of public meeting advertisements and project information should occur when appropriate. • Public meeting advertisements and project information should be posted in community centers or gathering places.

Early identification of the potential presence of Title VI populations, and the early engagement of these communities, additionally helps to inform the alternatives development process. The project should be designed in a way that avoids and minimizes Title VI population impacts, and any unavoidable adverse impacts to these populations should be mitigated for appropriately.

Step 3. Evaluate project impacts in the context of any Title VI populations that might be present.

Analyze all potential project impacts (to non-Title VI or Title VI populations) associated with the following items:

- Access
- Air quality
- Bicycle/pedestrian facilities
- Contamination
- Economic conditions
- Historic/archaeological resources
- Land use
- Noise
- Parking
- Parks/recreational facilities
- Relocation
- ROW acquisition
- Social conditions
- Surface or groundwater quality
- Traffic
- Transit
- Tribal lands
- Vibration and visual quality

For the purposes of the Title VI population evaluation, only actions to the resources listed above that might be adverse need to be considered. When no impact is expected, or if general project impacts to any of these resources would only be a beneficial one, then that particular resource does not need to be evaluated in the context of Title VI populations.

In this context, “adverse action” refers to significant individual human health or environmental effects caused by an action taken with the intent to discriminate on the basis of race, color, or national origin. These may include, but are not limited to, bodily impairment, infirmity, illness or death; air, noise, and water pollution; destruction or disruption of community cohesion; displacement of persons or businesses; and the denial or significant delay in the receipt of benefits from FHWA programs, policies, or activities.

Review all general adverse project impacts in the context of how they may affect specific populations and compare these expected impacts to the type and magnitude of impact they will have on non-Title VI populations to determine whether they may be disproportionate.

A DISPROPORTIONATELY HIGH AND ADVERSE EFFECT ON A SPECIFIC POPULATION IS AN ADVERSE EFFECT IF IT HAS EITHER OF THESE CHARACTERISTICS

- It is predominately borne by one specific population.
- It will be suffered by one specific population and is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the general population.

When evaluating the potential for disparate impacts, the relative distribution of adverse impacts between Title VI and non-Title VI populations must be considered. Consideration must be given for the adverse effects and whether those effects are appreciably more severe or greater than those borne by non-Title VI populations.

EXAMPLES / CONSIDERATIONS WHEN EVALUATING COMMUNITY AND TITLE VI POPULATION IMPACTS AND PROJECT DEVELOPMENT:

- Does the project impact a resource that is especially important to the community or a Title VI population?
- Is any person or population being excluded from participating in, denied the benefits of, or subjected to discrimination by the project or action because of race, color, or national origin?
- Does a potentially impacted property serve an especially important social, religious, or cultural function for the community?
- Is a park that is used regularly for cultural events being impacted by the project?
- Would the project require substantial displacements within the community?
- Are any impacted businesses known to be owned by a Title VI population?

Impacts may be permanent (such as relocation/displacement) or temporary (such as long detour routes or a loss of access to residences, businesses, or community resources during construction).

Step 4. Review mitigation commitments.

Review mitigation commitments that have been proposed for general adverse project impacts. Consider how these measures, or other off-setting project benefits, may also mitigate for specific impacts to Title VI populations. Consider whether impacts would still remain after any mitigation measures are implemented. If the proposed mitigation options would address impacts to the point where no substantial adverse impacts to any Title VI or non-Title VI population would be expected, no additional evaluation regarding Title VI population impacts are necessary. Proposed mitigation options and input on their effectiveness for remediating any expected Title VI population impacts should be presented through public engagement activities, and feedback on these options should be solicited from any affected populations.

If mitigation options are determined to also sufficiently address all adverse impacts to Title VI populations, this finding should be summarized in the environmental decision document with substantial evidence listed to support this finding.

Step 5. Incorporate project changes, refinements, or additional mitigation to address remaining disparate impacts to Title VI populations.

If disproportionate impacts to Title VI populations are still expected to occur after considering the implementation of mitigation commitments, consider adjustments to the project design to avoid these impacts and/or other mitigation items that could be implemented.

Community engagement should be ongoing through the planning process to understand potential risks and mitigation options and to inform design decisions. Any targeted mitigation should be developed in cooperation with the affected populations and be relevant to the anticipated impacts.

Step 6. Document the demographics and Title VI population analysis findings in the environmental decision document and, if appropriate, a stand-alone white paper document.

The NEPA document should include a summary of the Title VI population analysis findings. The summary should include the applicability of screening, the overall analysis and conclusions, and the rationale. The following details should be incorporated:

- The screening results describing the presence of Title VI populations. This should include details related to population statistics for the block groups within the study area compared to those of the applicable reference geographies. Other indicators of Title VI populations based on other sources should additionally be described.
- Discussions of general project impacts and how any of them may affect each identified Title VI population or resource. A description of the no-build or other

alternative impacts should also be summarized. This discussion should highlight the impacts that may result in disparate impacts to Title VI populations or resources.

- A summary of any public engagement activities and any additional outreach that may have occurred to target these populations.
- Descriptions of any design modifications, other accommodations, or mitigation that may have been incorporated.

If the project is expected to result in displacements, the screening findings and evaluation summary should be documented in a short, stand-alone white paper with all of the above information included. Overall, professional judgment should be used to determine the level of detail included in the summary and/or white paper.

16. PERMITTING

16.1 INTRODUCTION

The WVDOH, Engineering Division, Permitting Unit oversees permit preparation and submission for all permits required for WVDOH projects. This section of the manual provides high-level guidance for WVDOH staff and their consultant practitioners to adequately prepare the necessary permit documents for the WVDOH to obtain clearances for its projects.

Understanding the WVDOH's Design Directives, specification manuals, the rules of the CWA, and guidance from the regulatory agencies is very important to ensure that permitting does not become a problem for a project. Understanding each project and the relevant regulatory rules and guidance will give WVDOH the information needed to know when a project requires a permitting task and whether a pre-construction notification (PCN) is required.

16.2 PRE-APPLICATION MEETING / JURISDICTIONAL DETERMINATIONS

Permitting often drives the project schedule and can have negative impacts if not completed within the allotted timeframe. Therefore, it is important to prepare and submit an accurate permit application upon initial submission. To ensure that a permit application is accurately prepared at the time of initial submission, a pre-application meeting should be conducted. This meeting provides an opportunity to present the project and project area resources to the agencies and ensure that there is not a special item, document, or mitigation item that should be included with the permit application. Invitees to this meeting should include USACE and other appropriate agencies that may have an opportunity to comment on the project or may be issuing approvals/authorizations for other resources within the project area.

16.3 SECTION 404 PERMIT

Section 404 of the CWA establishes a program to regulate the discharge of dredge and fill material into waters of the United States, including wetlands. Activities regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g., certain farming and forestry activities).

The Section 404 program falls under the jurisdiction of USACE, the USEPA, and the USFWS. USACE administers the day-to-day program, which includes individual and general permit decisions; conducts jurisdictional determinations; and develops policy and guidance. The USEPA develops and interprets policy, guidance, and environmental criteria for evaluating permit applications; determines the scope of geographic jurisdiction; approves and oversees state and tribal assumption; reviews and comments on individual permit submissions; can request that certain permit or policy decisions receive a higher level of review; and can prohibit, deny, or restrict the use of any defined area as a disposal site. The USFWS evaluates impacts of a project on fish and wildlife for all new federal projects and federally permitted projects, pursuant to the Fish and Wildlife Coordination Act. Both USACE and USEPA have authority to enforce Section 404 provisions.

Wetlands are included under the regulations of Section 404. Wetlands are defined as land that is saturated or inundated for a certain period of time and supports the growth of wetland vegetation and the development of hydric soils. When evaluating whether a project will need a Section 404 permit, WVDOH or its consultant should have a thorough understanding of the jurisdictional aquatic resources within a project area along with the proposed design (see Section 7 of this manual for more information pertaining to aquatic resources). With this information, a permitting practitioner should be able to determine which type of permit would be appropriate for the project. Section 404 permits in West Virginia include standard permits and general permits.

16.3.1 STANDARD PERMITS

Under Section 404, there are two types of standard permits: an individual permit and a letter of permission permit.

Individual Permit: An individual permit requires the solicitation of public and agency input through publication and distribution of a public notice that includes information on the project and its anticipated effects on aquatic resources. A public interest review and preparation of an EA or EIS may be necessary pursuant to NEPA.

Letters of Permission Permit: A letter of permission permit is a streamlined permitting process used by the USACE for activities that have minimal impacts on the aquatic environment. This type of permit is typically used for projects that do not qualify for a nationwide permit but still have relatively minor impacts. The letter of permission process involves a simplified review and approval procedure, which includes coordination with relevant agencies and public notice.

16.3.2 GENERAL PERMITS

Under Section 404, there are two types of general permits: nationwide and regional general permits.

Nationwide General Permit: A nationwide permit is a type of general permit that is reissued every five years by USACE. These permits are tailored to specific activities that have minimal impacts to the environment. Several types of nationwide general permits could be implemented for typical WVDOH projects. Additional Nationwide General Permit information can be found in Section 19 (References and Links #19.13.1).

Regional General Permit: A regional general permit (RGP) is a type of general permit available for transportation projects. Generally speaking, many WVDOH projects may fit within one of the three RGPs. The three RGP authorizations available in West Virginia are listed below:

- **RGP A** — Linear Transportation Projects
- **RGP B** — Maintenance
- **RGP C** — Bank Stabilization

See Flowchart 21.10 for the Section 404 Permitting Process. To obtain a Section 404 permit, the first step is to have completed a thorough aquatic resources investigation within the environmental clearance zone for the project. Information from the investigation needs to be compared with the project design to determine the impacts to federally regulated aquatic resources. Permanent and temporary impacts need to be calculated and reported in any Section 404 application or package prepared for the project, and these impacts should be assessed before the pre-application meeting in order to determine the appropriate application package.

Permanent impacts are impacts that cannot be avoided or minimized by shifts in project design. This includes any streams or wetlands that will be permanently filled.

Temporary impacts occur to resources within temporary construction easements where fill is only temporarily installed to complete the project. Resources that are temporarily impacted must be restored to approximate pre-construction conditions upon completion of construction activities. The amount and type of resource impact will dictate the type of permit necessary for the project and determine whether a PCN will be necessary.

Upon thorough review of the project design and tabulation of the proposed impacts, a pre-application meeting should be conducted. Additional information regarding the pre-application meeting is discussed in the previous section. The following list describes the typical process for preparing a Section 404 permit application package.

To obtain a Section 404 Individual Standard Permit, follow these steps:

Step 1. Calculate the project's impacts on aquatic resources and schedule a pre-application meeting with agency representatives.

Step 2. In the pre-application meeting, determine the type of Section 404 permit needed for the project as well as whether the project will require a PCN.

Step 3. Complete the application form (ENG Form 4345) (References and Links #19.13.2) and provide the appropriate project plans, a detailed project description, and any required environmental assessment documents.

Step 4. If a PCN is required for the project, submit the application to USACE representatives as determined in the pre-application meeting. If a PCN is not required for the project, the applicant is not required to submit the application and must hold the application throughout the life of the project.

Additionally, the CWA requires that any project requiring a Section 404 permit will have to obtain a Section 401 permit from the state or authorized Tribe where the project will occur. See Section 16.5 for more information on Section 401 permits. For additional information on aquatic resources, including wetland identification and delineation, see Section 7 on Aquatic Resources.

16.4 USCG PERMIT

The USCG has jurisdiction over the review and approval of the construction or modification of bridges or causeways in or over navigable waters of the United States. Therefore, any individual, agency, or authority proposing to construct a new bridge or causeway or modify an existing bridge or causeway over a navigable waterway of the United States is required to obtain a USCG Section 9 Bridge Permit. Temporary bridges or causeways used for construction access or traffic detours over navigable waters of the United States also require a permit from USACE. The purpose of this authorization is to ensure that any bridge or causeway construction does not obstruct navigation or negatively impact the environment. Legislative authority is granted to the USCG to issue permits under Section 9 of the Rivers and Harbors Act of 1899, as amended; the General Bridge Act of 1946, as amended; and the Act of March 23, 1906, as amended.

To obtain a USCG Section 9 Bridge Permit:

Step 1. Determine whether the project is over a navigable waterway of the United States. This can be done using field reconnaissance and online databases. USACE maintains an online database of known navigable waterways. The known navigable waterways of West Virginia can be found on the West Virginia Wetlands and Permits page, under the "Navigable Waterways" tab (References and Links #19.13.3).

Step 2. Contact the appropriate USCG District Bridge Office, or District 8 for the State of West Virginia, to schedule a pre-application consultation early in the

planning phase. In the pre-application meeting, work with USCG representatives to determine whether a permit will be required. Contact information for USCG District 8 can be found on the USCG Office of Bridge Programs' web site (References and Links #19.13.4).

Step 3. Prepare the permit application package, if applicable. The USCG has a Bridge Permit Application Guide to assist in the development of the permit application. The USCG's guide can be accessed via the link found in Section 19 (References and Links #19.13.5).

Step 4. Submit the completed permit application package to the USCG District Bridge Office. The USCG will review the permit application package and may issue a public notice for the project. This may include coordination with other federal, state, and local agencies. If the permit application package meets all requirements and there are no significant objections, the USCG will issue the permit.

Step 5. Finally, if a permit will be issued, the applicant is required to ensure that construction will comply with all the permit conditions and regulations.

16.5 401 WATER QUALITY CERTIFICATION

In collaboration with federal agencies, Section 401 of the CWA allows states and authorized Tribes to protect the quality of federally regulated waters within their boundaries. Under Section 401 of the CWA, a federal agency may not issue a permit or license to conduct any activity that results in discharge into the waters of the United States until a Section 401 permit or license has been certified for the project. Section 401 water quality certifications typically come from the state or authorized Tribe at the origin of the discharge. Major federal licenses and permits subject to Section 401 include:

- The Clean Water Act Section 402 and 404 permits
- Federal Energy Regulatory Commission licenses for hydropower facilities and natural gas pipelines
- Rivers and Harbors Act Section 9 and 10 permits

In West Virginia, Section 401 permit applications are reviewed by the WVDEP's Division of Waste and Water Management. The division may grant, grant with conditions, waive, or deny a Section 401 permit based on the project's compliance with the state's water quality standards. See Flowchart 21.11 for the Section 401 Permitting Process.

The following steps guide applicants through the process to obtain a Section 401 permit.

Step 1. Contact the WVDEP Division of Water and Waste Management to arrange a pre-filing meeting. The pre-filing meeting is required and has to be completed 30

days prior to submitting the full certification application. In the pre-filing meeting, work with WVDEP representatives to determine which permit(s) will be required based on project plans and affected aquatic resources.

Step 2. If applicable, prepare the permit application package and submit the completed application package to WVDEP (References and Links #19.13.6).

Step 3. A legal advertisement is required to be posted for any project requiring a Section 401 permit. See permit application instructions to determine the type of legal advertisement appropriate for the project. Legal advertisements must be published in the county where the project will occur and must be followed by a 30-day public comment period.

Step 4. Upon completion of the permit application package, the applicant must inform WVDEP of the date that the public notice will be advertised publicly. Certification requests must be certified and notarized by the publishing newspaper. The certified and notarized advertisement and official publication dates must be added to the approved application package no later than four weeks after the publication date.

Additionally, WVDEP may require a project to obtain a West Virginia State Waters Permit for isolated waters. Isolated waters are waterways that are considered federally non-jurisdictional, such as ephemeral channels or isolated wetlands. See Section 16.7 for more information about WVDEP Isolated Waters Permits (References and Links #19.13.6).

16.6 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT (NPDES)

The CWA of 1972 created the NPDES, which permits discharges to navigable waters. USEPA delegates the administration of the NPDES Permit for Construction to WVDEP. NPDES permit registration is for projects that propose to disturb 1 acre or more. These projects should be registered with WVDEP. See Flowchart 21.12 for the WV NPDES construction stormwater general permit process.

There are two types of registration: “Minor Construction Application” (MCA) and “Large Construction Application” (LCA). An MCA is for projects that propose to disturb more than 1 acre and less than 3 acres. An LCA is for projects that propose to disturb 3 acres or more. Temporary erosion and sediment control measures and NPDES permitting measures are required to be incorporated into contract plans on all projects.

16.6.1 GENERAL REQUIREMENTS

Designers shall prepare (or include provisions in the contract plans for the contractor to prepare) erosion and sediment pollution control plans following the latest edition of the WVDEP Erosion and Sediment Control Best Management Practice Manual (BMP Manual). The designer should be familiar with design and applicability information in the BMP Manual.

16.6.2 PRE-CONSTRUCTION MEETING

The designer can schedule a pre-construction meeting with WVDEP if it wants clarification on its proposed design.

16.6.3 DESIGN

The checklists for Sediment Control Plans in Section 3 of the BMP Manual are recommended for developing a technically complete E&S plan.

The permit calls for enhanced BMPs for discharges subject to sediment-related total maximum daily loads and discharges to sensitive waters (Tier 2 and Tier 3 Streams, trout streams, or water bodies with an established sediment-related total maximum daily load). Refer to the WVDOH Design Manual for information about designing sediment basins and enhanced BMPs.

Designers may use the clearing and grubbing (C&G) area to determine the disturbed area. Examples are:

- Any project with less than 1 acre of C&G activity and an undefined waste site, borrow site, or undefined construction access area will require a Letter of Non-registration. The project manager completes the Letter of Non-registration memo template, signs it, and sends it to the Permitting Unit Leader. That person signs it and sends it to the Director of Engineering for signature. The signed Letter of Non-registration is included with the bid proposal.
- Any project with at least 1 acre but less than 3 acres of C&G activities requires a completed MCA form.
- Projects with 3 acres or more of earth disturbance require a completed LCA form.
- The contractor is responsible for waste and borrow areas that are outside the state right of way. These areas will not be included in any NPDES Construction Stormwater Permit when the WVDOH is a permittee or co-permittee.
- The designer will complete the appropriate NPDES registration and submit it to the Review Section of the Engineering Division during the final phases of design.

16.6.4 PERMIT ISSUSANCE AND FEES

The Engineering Division reviews the registration for completeness and provides comments to the designer, if needed. Once the registration is complete, the Engineering Division will submit the permit registration documents to the WVDEP in the name of the WVDOH and will pay fees for the conditional NPDES permit. This establishes the contractor as the co-permittee, and the contractor is responsible for all fees after this step.

WVDEP invoices WVDOH for the conditional registration and the modification fee, paid electronically by an internal electronic transfer. The contractor is responsible for arranging payment to WVDEP.

WVDOH will obtain conditional approval for all design-bid-build projects that will disturb 1 acre or greater. WVDOH will perform the permitting process for all projects built by West Virginia entities.

The contractor is responsible for NPDES registration, fees and modifications for alternative delivery/design projects. WVDOH shall not be an NPDES co-applicant/co-permittee for alternative delivery/design projects.

16.6.5 PERMIT APPLICATION CHECKLIST

The following items are needed for a complete permit application, and the applicant should use permit application checklists:

Large Construction Projects (Table 16.1)

- Application form, including sign template
- Stormwater Pollution Protection Plan
- Groundwater Protection Plan (this is a separate plan)
- Pre-construction drainage map
- During construction drainage map (shows proposed location of all drainage structures and associated access maps)
- Post-construction drainage maps
- Annual progress maps (if permitted for longer than one year)
- Detailed site plan (maps) showing limits of disturbance and receiving waters
- Design details for the following:
    - Sediment basins, roads, cut and fill cross sections, and other engineered structural design calculations
    - Other controls, including post-development stormwater management plans required by local governments

Table 16.1. When to Apply for Large Construction Projects

Timeframe	Category
100 days prior to construction	Tier 3 waters*
	100 acres of disturbance*
	Construction greater than one year*
60 Days prior to construction	Tier 1 and Tier 2 Waters

*Requires public comment

Minor Construction Projects (Table 16.2)

- Application form, including sign template
- Stormwater Pollution Prevention Plan
- Pre-construction drainage map
- During construction drainage map (shows proposed location of all drainage structures and associated access routes)
- Post-construction drainage map
- Annual progress map if permitted for more than one year
- Detailed site plan showing limits of disturbance and receiving waters
- Typical design details
- Posting sign or notice—Post the following information near the front entrance or near the active part of the project within 72 hours of filing an application:
    - Applicant's name and emergency telephone number
    - Project reference ID
    - For information on this stormwater permit contact 800-654-5227 or DEP.Comments@wv.gov
    - Permit Number — Add to the sign within seven business days of permit number assignment.

Table 16.2. When to Apply for Minor Construction Projects

Timeframe	Category
60 days prior to construction	Tier 3 waters (include a Stormwater Pollution Prevention Plan)*
15 days prior to construction	Tier 1 and Tier 2 waters

*Requires public comment

16.6.6 PUBLIC NOTICE

Make payment for Class 1 legal advertisement concerning the application to the local newspaper with the largest readership in the vicinity of the proposed project. Obtain an affidavit for the publication of the Class I legal advertisement from the newspaper. Include a notarized statement of billing in the application. The permit issued by the applicant must not disturb land prior to obtaining authorization.

The applicant must keep the Director informed with up-to-date and accurate information.

The applicant shall maintain a copy of the approval from the Director on site and make it available to the WVDEP's Division of Water and Waste Management upon request.

16.6.7 INSTALLATION OF EROSION AND SEDIMENT CONTROLS

Install E&S controls before beginning construction activities according to the approved registration. BMPs should be in place and functional before land disturbance.

For phased projects, BMPs for each phase must be installed and functional prior to land disturbance.

A qualified person shall inspect and verify that new E&S controls are installed according to plan. Defective controls must be repaired and/or installed correctly within 24 hours and verified by the Qualified Person. "Qualified Person" means a person who is knowledgeable in the principles and practices of E&S controls and pollution prevention and possesses the education and ability to assess the conditions at the proposed site that could impact stormwater quality and to assess the effectiveness of proposed stormwater controls to meet the requirements of the permit.

Construction activities shall begin after the Qualified Person determines that all E&S controls are installed properly for the areas they serve.

16.6.8 NOTICE OF TERMINATION (NOT)

A Qualified Person will inspect all areas of the project and any off-site areas that were impacted by the project to verify that all disturbed areas are compliant and stabilized and that stormwater conveyances and structures are constructed.

The Qualified Person will provide a report to the permittee documenting any deficiencies that should be corrected. These will be corrected within 24 hours, and the permittee will request a reinspection. When an inspection determines that there are no deficiencies, the site is ready for submitting a Notice of Termination (NOT). Follow the steps below to submit an NOT.

- Prepare records, which will be retained for three years.

- Within 30 days of the determination that the site is permanently stabilized, prepare the site for submittal of the NOT.
- Verify that fees are paid in full.
- Prepare and submit the NOT to the Director by electronic means. The NOT acknowledgment will be delivered electronically.
- The Director will inspect the site to determine whether the permit can be terminated.
- For projects that are at least 1 acre but not more than 3 acres, the final inspection should be conducted within 30 days of receipt of the NOT.
- For projects of 3 acres or more, the final inspection should be conducted within 60 days of receipt of the NOT.
- Permit and permit conditions remain in effect until the Director acknowledges that the permit is terminated.

The permittee can submit a certification by a registered professional engineer or professional surveyor that states that the site meets stabilization requirements. If the Director cannot complete the inspection in the established time frame for each permit type, the Stabilization Certificate will be accepted in lieu of the final inspection. The Stabilization Certificate cannot be submitted in lieu of the NOT.

Projects with less than 1 acre of disturbance and an undefined waste/borrow site or undefined construction access require a Letter of Non-registration.

16.6.9 SITE REGISTRATION FORM

If a project requires coverage, the Site Registration Application must be submitted at least 60 days before starting or, in cases that require public notice, must be submitted at least 100 days before starting. This applies to projects disturbing 3 or more acres discharging to Tier 3 waters, projects disturbing 100 or more acres, projects with a grading phase lasting one year or more, and new registrations or modifications under general permits that, along with open registrations, will disturb 100 or more acres in a drainage area that must go out for public notice. This includes the following situations:

- Earth disturbance in response to a public emergency.
- Permit coverage is authorized for immediate earth disturbance provided that a complete and accurate MCA or LCA is submitted within 30 calendar days after commencing earth-disturbing activities.
- Waste Areas and construction-related earth disturbance (laydown areas, etc.).

- When a proposed waste area is inside WVDOH ROW / temporary construction easement or on WVDOH property, WVDOH will apply for the NPDES permit based on the amount of disturbed acreage.
- When a proposed waste area is outside the ROW, it is the contractor's responsibility to apply for the appropriate permit. This should be communicated to the contractor before they proceed to use the waste area.

16.6.10 ROAD MAINTENANCE AREAS

Road maintenance activity that does not disturb earth does not require registration. This includes, but may not be limited to, resurfacing, shoulder paving, and superstructure replacement.

16.6.11 RESOURCES

See the following resources for more information:

- WVDOH Design Manual (References and Links #19.13.13)
- Construction Stormwater (References and Links #19.13.8)
- West Virginia Erosion and Sediment Control BMP Manual (References and Links #19.13.10)
- Posting sign guidelines (References and Links #19.13.8)
- Fees; always check fee schedule online in case it changes (References and Links #19.13.9)

16.7 WVDEP ISOLATED WATERS PERMIT

This permit applies to discharges to federally non-jurisdictional waters of West Virginia and is overseen by the WVDEP. This permit is required under the West Virginia Water Pollution Control Act, which puts responsibility for protection of waters of the state in the WVDEP's jurisdiction. The act requires a permit for activities that may result in a change to the physical or biological integrity of waters of the state. This includes the discharge of fill or alteration to any federally non-jurisdictional streams in the State of West Virginia. To determine whether a WVDEP Isolated Waters Permit would be necessary, please contact the WVDEP — Division of Water and Waste Management 401 Certification Program at (304) 926-0499. A fillable WVDEP Isolated Waters Permit can be accessed via the link in Section 19 (References and Links #19.13.7).

16.8 STREAM DISTURBANCE PERMIT

A project involving an activity within a river or stream requires a right of entry permit from the WVDNR, Office of Land and Streams. This is necessary for any planned activity that

involves working or placing equipment within a stream. The purpose of this approval is to protect water quality and aquatic life in the stream being impacted. Please note, this approval is not necessary for the removal of floating woody debris or trash from a stream if the removal is completed by hand or with hand tools. If equipment other than hand tools is necessary, even if the equipment remains on the stream bank, then a Stream Activity Application is necessary. Ultimately, "'a permit is needed if a planned activity involves going over, under, or through a stream." After an accurately completed application is received by the WVDNR the approval "process generally takes 5–7 business days unless the activity is in a high-quality stream which could take up to 2 weeks" (References and Links #19.13.11). For questions regarding Stream Activity Applications, please contact the WVDNR at (304) 558-6048. A fillable WVDNR Office of Land and Streams Stream Activity Application can be accessed via the link in Section 19 (References and Links #19.13.12).

16.9 AIR PERMITTING

Project construction techniques shall exercise every reasonable precaution throughout the life of a project to keep air pollution to a minimum. All projects shall comply with the applicable regulations per the WVDEP Division of Air Quality. During times of limited dispersion, construction operations may be suspended. All plants in West Virginia producing bituminous concrete for WVDOH shall obtain a permit or certification from WVDEP.

WVDEP's permit program includes review of applications, determination of permit applicability, and issuance of permits for both minor and major sources. Minor sources are primarily permitted under the minor source rule found in 45 CSR Chapter 13. Major sources are primarily permitted under the new source review rules found at 45 CSR Chapter 14 and 45 CSR Chapter 19. Major sources are issued operating permits under the authority of 45 CSR Chapter 30 (Requirements for Operating Permits), which is the implementing rule of Title V of the 1990 Federal Clean Air Act Amendments.

16.9.1 MINOR SOURCE PERMITS

Minor source permits are for smaller projects with lower emissions. The following requirements apply to such projects:

- Any source that proposes to have the potential to emit before controls at or above 2 pounds/hour or 5 tons/year of hazardous air pollutants (HAPs) considered on an aggregated basis, either through a modification or new construction, is required to obtain a pre-construction permit under 45 CSR Chapter 13.

- Sources are required to identify and quantify all HAP emissions associated with a proposed project and include them with supporting calculations as part of the 45 CSR Chapter 13 permit application review process.
- Sources that will be subject to any substantive requirement of an emission control rule promulgated by the Director (including a New Source Performance Standard, National Emission Standards for Hazardous Air Pollutants, or Maximum Achievable Control Technology standard) are also required to obtain a pre-construction permit under 45 CSR Chapter 13.
- A new or reconstructed source that proposes potential emissions increases of 10 tons/year of any single HAP or 25 tons/year of combined HAPs and that is not already regulated by a maximum achievable control technology standard may be subject to case-by-case maximum achievable control technology.
- Table 45-13A lists 19 specific air toxics and associated maximum potential annual plantwide emissions limits. If a facility exceeds those limits, it is required to obtain a 45 CSR § 13 permit. All 19 compounds listed in Table 45-13A are also included in the USEPA's list of HAPs.
- In all, fourteen of the compounds listed in Table 45-13A are Toxic Air Pollutants as defined by 45 CSR Chapter 27. The remaining five compounds listed in Table 45-13A are metals also addressed in 45 CSR Chapter 7 — arsenic compounds (inorganic), asbestos, beryllium, lead or lead compounds, and mercury. Some sources with maximum potential annual plantwide emissions over the listed amounts are required to obtain a 45 CSR Chapter 13 permit.
- Any source already over the quantities listed in Table 45-13A that proposes a change that will result in an emissions increase of a pollutant listed in Table 45-13A of 10 percent or more of the amount set forth in the table is required to obtain a permit under 45 CSR Chapter 13. Note: Even if there will be an emissions increase of less than 10 percent of the amount set forth in Table 45-13, such a source is still required to comply with 45 CSR Chapter 27, which may include obtaining a permit under 45 CSR Chapter 13.
- The WVDEP Division of Air Quality may determine that a source (not otherwise subject to this rule) should be made subject to the permitting requirements of 45 CSR Chapter 13 to prevent statutory air pollution (45 CSR § 13-14).

16.9.2 MAJOR SOURCE PERMITS

Major source permits are for larger projects with significant emissions. The following requirements apply to such projects:

- A source with maximum potential plantwide emissions at or exceeding 10 tons/year of a single HAP or 25 tons/year of combined HAPs is required to obtain an operating permit under 45 CSR Chapter 30.
- Any source subject to a new source performance standard or National Emission Standards for Hazardous Air Pollutants standard is required to obtain an operating permit under 45 CSR Chapter 30, unless eligible for a deferral either as stated in the rule itself or in 45 CSR Chapter 30A.

16.9.3 GENERAL PERMITS

WVDEP offers general permits for both concrete batch plants and hot mix asphalt plants. These permits streamline the permitting process by incorporating all applicable air quality regulations into a single permit. Major Source Facilities are not applicable for general permits.

- **Concrete Batch Plants**
  - **General Permit G50-C** — This permit addresses the prevention and control of air pollution from concrete batch plants. It includes requirements for construction, modification, relocation, and operation.
- **Hot Mix Asphalt Plants**
  - **General Permit G20-C** — This permit covers the prevention and control of regulated air pollutants from hot mix asphalt plants. It includes all applicable air quality regulations.

Refer to the WVDEP Division of Air Quality web page for additional information on General Permit Applications under “Permitting” and “General Permit Registration.”

16.9.4 TITLE V PERMITS

Refer to Major Source Permits, above, and the WVDEP Division of Air Quality web page under “Permitting,” “Title V Guidance and Forms,” for more information.

Application Process

- **Electronic Submission** — Applications must be submitted through the Electronic Submission System.
- **Detailed Information** — Applicants must provide comprehensive details about the project, including location, operations, and potential emissions.

Public Involvement:

- **Public Notice and Input** — The permitting process includes opportunities for public notice and input to ensure community awareness and involvement.

Compliance and Monitoring:

- **Ongoing Compliance** — Projects must adhere to permit conditions and regularly monitor emissions to ensure compliance with air quality standards.

These requirements help ensure that transportation projects in West Virginia are conducted in a manner that protects air quality and public health.

16.10 UNDERGROUND INJECTION CONTROL PERMIT

The WVDEP Division of Water and Waste Management's Underground Injection Control (UIC) Program coordinates the groundwater protection efforts of the Bureau for Public Health, the Department of Agriculture, and various WVDEP programs under the authority of the 1991 Groundwater Protection Act and the USEPA. The UIC Program is designed to ensure that fluids injected underground will not endanger drinking water sources. UIC regulations are addressed in the following state codes: 47 CSR Chapter 9 — Underground Injection Control Fee Schedule, 47 CSR Chapter 13 — Underground Injection Control, and 47 CSR Chapter 55 — Ground Water Protection Act Fee Schedule.

16.10.1 UNDERGROUND INJECTION WELLS

An injection well is a well into which fluids are injected. As defined in the UIC regulations, a well includes:

- A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension
- A dug hole whose depth is greater than the largest surface dimension
- An improved sinkhole
- A subsurface fluid distribution system

Injection wells are classified into six categories, designated as Classes I through VI. This guidance document specifically addresses Class V wells in relation to the permitting requirements that may be necessary for transportation projects undertaken by WVDOH.

Class V wells are used to inject non-hazardous fluids underground, either above or within underground sources of drinking water (aquifers). These wells include agriculture drainage wells, improved sinkholes, industrial disposal wells, stormwater infiltration systems, and septic systems that have the capacity to serve 20 or more people. Class V wells can range from simple shallow wells to complex experimental injection wells and most often depend on gravity to drain fluids below the surface and provide little or no pretreatment before injecting fluids in or above groundwater.

16.10.2 STORMWATER DRAINAGE WELLS AND INFILTRATION SYSTEMS

Class V stormwater drainage wells are typically shallow disposal wells designed to place rainwater or melted snow below the land surface. By definition, a Class V injection well is any bored, drilled, or driven shaft or dug hole that is deeper than its widest surface dimension or an improved sinkhole or a subsurface fluid distribution system. Common facilities include the development of dry wells, bored wells, or infiltration galleries or the use of preexisting subsurface dissolution cavities (improved sinkholes) and underground mines.

Improved sinkholes use natural karst depressions or intentionally modified open fractures to effectively capture and drain stormwater runoff. Likewise, the injection of stormwater runoff into underground mines leverages the void spaces formed during the extraction of coal, stone, and minerals beneath the surface.

Two types of infiltration systems are not considered storm water drainage wells: infiltration trenches and surface impoundments/ditches. Infiltration trenches are excavated trenches filled with stone (no piping or drain tile) to create an underground reservoir that is usually wider than it is deep. Surface impoundments and ditches are excavated ponds, lagoons, and ditches (lined or unlined, without piping or drain tile) with an opened surface used to hold storm water.

16.10.3 UNDERGROUND INJECTION CONTROL PROGRAM REQUIREMENTS

In general, the UIC Program requirements consist of the following:

- Submit inventory information to the WVDEP Division of Water and Waste Management about Class V injection well(s) and verify authorization to inject fluids.
- Construct, operate, and close Class V injection wells in a manner that protects underground sources of drinking water.
- Properly close Class V wells in a way that prevents movement of any contaminated fluids into any underground source of drinking water when the well is no longer being used.

16.10.4 UNDERGROUND INJECTION CONTROL STORMWATER APPLICATION REQUIREMENTS

Permitting requirements for Class V underground injection control stormwater wells involves the preparation and submission of a permit application to the WVDEP Division of Water and Waste Management. The permit application (WVDEP UIC Stormwater Permit Application) is available on WVDEP's website. Application requirements for a technically complete application include the following:

1. Facility Information — Provide basic details about the facility including its name, telephone number, type of business, and applicant status (i.e., federal, state, private, or public).
2. Facility Address — Provide the complete address of the facility, including navigation directions to facilitate site inspections.
3. Ownership Information — Document the facility owner's details to ensure that the party can be contacted if needed.
4. Operator Information — Provide the name and phone number of the person(s) responsible for the facility's operation.
5. Applicant Request — Indicate the purpose of the application (i.e., reissuance, modification, or new permit).
6. Prior Permits — Provide the assigned permit number for any issued permits associated with the facility.
7. Type of Permit Requested — Specify the type of permit (area or site) and number of injection wells required. An area permit refers to the authorization to operate multiple wells within a specific geographic area. Conversely, a site permit is suitable for a single specific location well; this type of permit is generally used in construction projects.
8. Well Location(s) — Provide the locational coordinates for each proposed injection well, including the method of survey.
9. Well Type — Provide the well type code(s), number of wells per type, and the method of fluid disposal. Well type codes are provided in the application.
10. Comments — Provide additional pertinent information relevant to the proposed facility.
11. Certification — Provide the name, title, and signature of the responsible party official.
12. Financial Responsibility — Document the name and title of the person(s) who will assume financial responsibility for properly closing the injection system.
13. Area of Review, Operating Data, Construction Details, and Monitoring Plan — Prepare a topographic map, comprehensive narrative (project description), schematic drawings, construction details, and a detailed monitoring program that ensures the facility's operations are well documented and that measures are in place to protect the groundwater resource. Prepare a plugging and abandonment plan detailing how the well(s) will be abandoned after the completion of the project.
14. A Groundwater Protection Plan (GPP) is required for all UIC permits in West Virginia and shall contain the following information from Title 47, Series 58 — Groundwater Protection Regulations: potential contamination sources, protective

procedures, and employee training to prevent groundwater contamination. The GPP should also include an inventory of operations that may contaminate groundwater, procedures for new equipment, a summary of relevant regulatory activities, and provisions for quarterly inspections. Consultation with WVDEP is available to determine applicability and GPP requirements (304-926-0499).

15. Permit and Application Fees — Calculate the appropriate fees required for the application using the permit application fee worksheet and return it with the permit application package.

16.11 MUNICIPAL SEPARATE STORM SEWER SYSTEMS

Stormwater is the surface runoff that results from rain and snowmelt. Urban development alters natural infiltration capabilities of the land and generates a host of pollutants associated with urban activities that increase runoff volumes and pollutant loadings discharged into receiving waterbodies. Urban development increases impervious surfaces in a watershed when farmland, forests, and meadowlands with natural infiltration qualities are converted to parking lots, buildings, streets, and driveways that have little or no absorption characteristics.

Small municipal separate storm sewer systems (MS4s) found in West Virginia discharge polluted stormwater to local rivers and streams. According to 40 CFR § 122.26(b)(8), a municipal separate storm sewer is a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, constructed channels, or storm drains) that is:

> 1.Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States;
>
> 2. Designed or used for collecting or conveying stormwater;
>
> 3. Which is not a combined sewer; and
>
> 4. Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR § 122.2.

This general permit is intended to minimize the volume and pollutant loadings of these discharges. Federal regulations require West Virginia to permit stormwater discharges

from small MS4s and to require permittees to implement BMPs through an iterative process focused on six minimum control measures.

WVDOH is in the process of updating its procedures for MS4s. Upon finalization of these new procedures, this section should be revised accordingly.

16.12 NATIONAL PARK SERVICE COORDINATION

If proposed work accesses land managed by the NPS, advance coordination with NPS will be necessary. The two types of permits that may be required for work on NPS land in West Virginia, Right of Way and SUPs, are described in Section 16.12.1 and 16.12.2.

16.12.1 RIGHT OF WAY PERMIT

A ROW permit is required by NPS for any utility to pass over, under, or through NPS property. A ROW permit is required for any utility built or installed on NPS land and is generally considered if there is no appropriate alternative. The ROW permit includes transmission lines, telephone lines, canals, sewer lines, and sites for telecommunications, microwave, and fiber optics. Regulations regarding ROW permits can be found in 54 USC § 100902. In addition to a ROW permit, a SUP may be required for some activities.

NPS requires a minimum of six months to process a ROW permit request. If additional environmental and cultural analysis is required for the project, additional time could be needed. Therefore, ROW applications should be completed early in the project planning process. To obtain a ROW permit from the NPS:

1. **Obtain a permit application and contact the NPS superintendent responsible for the land where the project will take place (ROW permit applications are found in Standard Form SF-299).**
2. **Arrange a pre-application meeting with the park superintendent and appropriate staff to review the proposed project and application requirements.**
3. **Submit the completed application and a nonrefundable application fee to the park superintendent. NPS will work with applicants to issue a response within six months.**

Depending on project specifics, work requiring a ROW permit may require additional permits such as a SUP.

16.12.2 SPECIAL USE PERMIT

A SUP for temporary construction is required to perform road or infrastructure construction on NPS property. Typically, an additional 30 days are needed to obtain an

SUP; however, the SUP application should be initiated as far in advance as possible. To obtain a SUP:

Step 1. Acquire a permit application from the NPS superintendent responsible for the land where the project will take place.

Step 2. Arrange a pre-application meeting with the park superintendent and appropriate staff to review the proposed project and application requirements.

Step 3. The applicant should gather the following information and resources prior to the pre-application meeting:

a. **A description of the proposed work (scope), including location, staging areas, and impacts to natural resources, structural resources, and access to facilities**
b. **Photographs of the area (and resources) that will be affected by the proposed work**
c. **Contact information for the representative(s) who will sign the permit for that agency permittee**
d. **Contact information for the representative(s) who will serve as the day-to-day on-site contact throughout the project duration**
e. **Proposed start and end dates and hours of work**
f. **Traffic control plan (if applicable)**

Step 4. Submit the completed application and nonrefundable application fee to the park superintendent for NPS review.

NPS permits may be denied if there is no legal authority for the proposed project, the proposal is inconsistent with the purposes for which the park was established, the work occurs in a designated wilderness area, a practicable alternative is available, or the work would cause unacceptable impacts to park resources or impacts that cannot properly be mitigated.

Upon obtaining an NPS permit, the permittee must agree to indemnify and hold harmless the United States for claims and damages occurring during the term of the permit within permitted areas. Additionally, the NPS requires contractors working within NPS property to obtain liability insurance that names the United States as also insured. Other requirements may be identified in pre-application meetings with park personnel.

16.13 FLOODPLAIN COORDINATION

In West Virginia, each county and flood-prone municipality is involved in the National Floodplain Insurance Program (NFIP) and enforces a Floodplain Ordinance to manage development within the floodplain. This ordinance meets the requirements of Section 60.3(d) of the NFIP, the National Floodplain Insurance Act of 1968, and West Virginia Code §§ 8-12-14, 7-1-3v, 7-1-3n, and 7-1-3kk. The Floodplain Ordinance includes a flood map identifying floodplain areas and establishes a permitting system for new development regulations in these areas. Some jurisdictions regulate activities in and around streams regardless of their floodplain status.

The NFIP sets minimum standards for regulating development in the floodplain. In all floodplain ordinances, development includes dredging, filling, grading, excavation, and building or altering of new or replacement bridges, culverts, or other stream crossings.

16.13.1 IDENTIFICATION OF FLOOD HAZARDS WITHIN THE PROJECT AREA

During the project planning phase, a desktop analysis should be performed using online tools maintained by federal and state agencies to determine whether the project area occurs within a flood hazard area.

The Federal Emergency Management Agency (FEMA) maintains two online resources for flood hazard information in support of the NFIP, the FEMA Flood Map Service Center, and the National Flood Hazard Layer Interactive Viewer. The National Flood Hazard Layer Interactive Viewer can be used to navigate to the project area to view current local flood hazard data and download the location's full Flood Insurance Rate Map (FIRM) or FIRMette (smaller, printable version of a FIRM). This information can also be obtained using the Map Service Center by entering the project address or coordinates into the search bar.

The State of West Virginia also maintains the West Virginia Flood Tool website designed to provide floodplain managers and project developers with an effective means to make informed decisions about the degree of flood risk for a specific area.

Projects located within a Non-Special Flood Hazard Area (Zone B, C, or X) are at a reduced risk of flooding.

Projects situated within a Special Flood Hazard Area (Zone A, AE, or V) are at a higher risk of flooding.

16.13.2 FLOODPLAIN ADMINISTRATOR COORDINATION

After the mapped flood hazard for the project area has been determined and a detailed hydrologic and hydraulic (H&H) analysis has been performed, consultation with the local

floodplain administrator or permit officer should be conducted to determine whether a permit is required. The informational package should consist of the following components:

- A cover letter identifying the proposed project, project location, and a brief description of the work to be completed.
- Informational drawings for the proposed project including a location map, FEMA FIRM or FIRMette, and design plan sheet(s) depicting proposed developments to occur within the floodplain.
- A summary of the H&H analysis showing that the project will not increase the base flood elevation (BFE) in the project area. The summary should include the methods used and numerical results.
- No-Rise Certification containing the seal and signature of a qualified registered professional engineer licensed to practice in the State of West Virginia. This should certify that the technical data supports the fact that the proposed project development will not increase the 100-year BFEs or floodway elevations or impact the floodway widths on published or unpublished cross sections (as applicable) in the vicinity of the proposed development.

For projects situated within a Zone A flood hazard area, the flood carrying capacity of the stream must be maintained, and the post-construction water surface elevation cannot rise by 1-foot or greater.

For projects situated within a Zone AE flood hazard area (with BFEs but without a designated floodway) the H&H analysis must demonstrate that the post-construction development does not create more than a 1-foot cumulative rise in flood elevations.

For projects situated within a Zone AE flood hazard area (with BFEs and floodways) the H&H analysis must demonstrate that the post-construction development will result in no increase to the BFE (zero rise). Before issuing a permit, the floodplain administrator/permit officer will often require copies of all other permits required by federal or state law.

16.14 FISH SPAWNING WAIVER

A Fish Spawning Waiver from the WVDNR is required for instream work that occurs during fish spawning seasons in streams and adjacent tributaries designated as trout streams or warm water habitat. Fish spawning seasons for designated waters are listed below:

- April through June for designated warm water habitat
- September 15 through March 31 for designated trout streams

To determine whether a Fish Spawning Waiver will be necessary for the project, the agency or contractor must first determine whether waters within the project area are designated trout streams or warm water habitat. This usually follows an aquatic resource investigation and delineation, as described in Section 7 of this manual. Once waterways within the project area have been delineated, use the WVDNR's online interactive fishing map to find the waters within the project area and determine whether they are designated fish spawning habitat. For questions about stream designations, contact the WVDEP's Water Quality Standards Section.

If designated trout streams or warm water habitat are present within the project area, a Fish Spawning Waiver is required to complete instream work during the designated spawning seasons listed above. Contact the WVDNR's Elkins Operations Center to obtain a Fish Spawning Waiver application and instructions. Fish Spawning Waiver applications are completed in an Excel spreadsheet document, which includes details from the aquatic resource investigation as well as the project purpose, construction plans, and erosion and sediment control plans. Upon completion of the application, it should be returned to the WVDNR for review by division fisheries biologists who will issue a decision about the Fish Spawning Waiver.

16.15 SECTION 408 PROGRAM

A Section 408 request is required for projects that have the potential to alter a Civil Works project under the jurisdiction of USACE, such as a dam, levee, or navigation channel. The Section 408 program provides permission for people, towns, or businesses to alter or impact a USACE project and ensures that these changes will not negatively impact the public interest, safety, and usefulness of the Civil Works project.

To determine whether the project is in the vicinity of a USACE Civil Works project, check land ownership on the local USACE district website, the National Levee Database, and the National Inventory of Dams. Each USACE district has an assigned Section 408 Coordinator who can help guide applicants through the process.

If Section 408 permission is required:

1) **Determine who the non-federal sponsor is for the affected Civil Works project. The non-federal sponsor is the local or state agency responsible for the operations and maintenance of the Civil Works project.**
2) **Contact the non-federal sponsor and explain the proposed alteration to the Civil Works project. The non-federal sponsor will need to issue a Statement of No Objection, which documents their awareness of the Section 408 request and their lack of objection to USACE's review of the request.**

a. Note: A Statement of No Objection is not required for a non-federal sponsor proposing alterations to the Civil Works project that they represent.

3) Once a Statement of No Objection has been obtained, USACE recommends scheduling a pre-application meeting between the USACE Coordinator, the non-federal sponsor, and the applicant. This step is not required but can help determine what USACE will need for each specific application.

4) Prepare the Section 408 request. Section 408 requests often involve work in navigable waters or result in discharge of dredged or fill material into waterways. These activities will require a Section 404 permit through USACE Regulatory in addition to the Section 408 request through the USACE Coordinator. If applications for both Section 404 and Section 408 permissions are needed, both must be submitted or the review process will be delayed. The contents of the Section 408 request will vary with project complexity and should be discussed and verified with a USACE Section 408 Coordinator. The Section 408 request generally includes:

   a. Cover letter with the applicant's signature;

   b. Construction schedule;

   c. Statement of No Objection from the affected non-federal sponsor(s);

   d. Project description with drawings, sketches, maps, and plans;

   e. Technical analysis and design showing the Civil Works project being altered, including impacts from the proposed work and design drawings. Design drawings must include:

      i. Proposed project name, drawing number, date, scales, north arrows, and legends following USACE standards;

   f. Environmental and cultural resources compliance documents, referencing compliance with the Endangered Species Act (ESA) and the National Historic Preservation Act;

   g. Adjoining property information, indicating all properties affected by the proposed alteration;

   h. Potential changes to the Civil Works project's operation, maintenance, repair, replacement, and rehabilitation practices;

   i. Regulatory project number and regulatory point of contact.

5) **Submit the Section 408 request to the Section 408 Coordinator. The Coordinator may request additional information throughout their review. Timely responses to Coordinator requests will facilitate a more efficient process. For USACE reviewers to ensure that the Section 408 request will not harm a Civil Works project or relevant public interest, they may hold a public comment period. Upon submitting an initial and formal Section 408 request, the USACE has a 30-day completeness review period. Assuming the Section 408 request package is complete, the USACE generally has 90 days to complete the technical review of the proposed project.**

6) **The Section 408 Coordinator will contact the applicant once the Section 408 review is complete. Upon completion of the agency technical review, draft decision and Section 408 documents are forwarded to the District Commander for final review and signature.**

7) **The Section 408 Coordinator will also need to be notified before construction begins, and before it is complete. USACE may monitor the site throughout the project's duration.**

8) **Upon completion, provide the USACE district with "as built" project drawings, as requested. USACE may require inspection of the site after construction is complete.**

17. ENVIRONMENTAL COMMITMENTS

17.1 GUIDANCE FROM WVDOH SPECIAL PROVISION 107.27.3

Special Provision (SP) 107.27.3—Environmental Commitment and Mitigation—states that the contractor must be advised when a project is located within an area for which the WVDOH has made previous environmental commitments (References and Links #19.14.1). These commitments were outcomes of the environmental process and are contained in the project's NEPA document, in which WVDOH has pledged and/or has an agreement to perform an activity at a future time in an effort to avoid, minimize, or mitigate impacts. The fulfillment of these commitments and the associated mitigation are essential requirements that must be incorporated into the development of the proposed project. WVDOH must translate the mitigation items so that they are clearly understandable to contractors and inspectors.

17.2 COMMITMENTS

If commitments have been made for the project, they will be recorded in the approved NEPA document, with SP 107.27.3 included in the documentation. These commitments may cover various environmental scenarios and agreements, as illustrated in the three examples below:

- **Example 1** — The project is located within the range of the Indiana bat (*Myotis sodalis*), the northern long-eared bat (*Myotis septentrionalis*), and tricolored bat (*Perimyotis subflavus*). Therefore, tree cutting will need to be completed between November 15 and March 31.
- **Example 2** — The Memorandum of Agreement with the State Historic Preservation Office, the ACHP, and the FHWA includes mitigation to document the current status of the bridge, including a brief historic context and photographs. This documentation will be published in a brochure for distribution to the public by the Morgan County Historical Society and the Morgan County Public Library, as well as online on the West Virginia historic bridge website: Highways Through History (References and Links #19.14.2).
- **Example 3** — Based on the results of the mussel survey, relocation of mussels shall occur prior to any work below the ordinary high-water mark. The mussel survey expires on July 15.

17.3 EPIC SHEET

WVDOH Design Directive 701 (DD-701) – Contract Plan Presentation – outlines the composition and presentation standards for a complete set of contract plans aimed at

standardizing the production of plans throughout the WVDOH. A key component of the sheets within the contract plans includes the Environmental Permit Impact Commitments (EPIC) Sheet. The EPIC Sheet serves an essential role in integrating environmental compliance into construction planning. The inclusion of the EPIC Sheet in construction plans enables the project developers to facilitate the tracking and implementation of environmental commitments determined through the NEPA and permitting processes are properly tracked and incorporated into the project lifecycle.

In accordance with SP 107.27.3, any required commitments or mitigation measures must be included on the “contract plan” section of the EPIC Sheet. This approach ensures that environmental obligations established during the NEPA and permitting processes are clearly and effectively communicated to the contractor and provides assurances to the regulatory agencies that the environmental commitments will be fulfilled.

18. GLOSSARY

18.1 NATIONAL ENVIRONMENTAL POLICY ACT

Adverse effect — The impact to a property that is on or eligible for the National Register of Historic Places. Adverse effect refers to the diminishment of a property's integrity with respect to its location, design, setting, materials, workmanship, feeling, or association. The term is used by federal agency officials, in consultation with the State (or Tribal) Historic Preservation Officer, as part of the Section 106 process.

Adverse environmental effect — Any significant and widespread adverse effect that may reasonably be anticipated to impact wildlife, aquatic life, or other natural resources, including adverse impacts on populations of endangered or threatened species or significant degradation of environmental quality over broad areas.

Alternative — A reasonable way to fix the identified problem or satisfy the stated need.

Applicant — A non-federal entity, including a project sponsor, that seeks an action by a federal agency such as granting a permit, license, or financial assistance.

Authorization — Any license, permit, approval, finding, determination, or other administrative decision issued by an agency that is required or authorized under federal law in order to implement a proposed action.

Categorical exclusion — A category of actions that, based on past experience or statutory direction, has been determined to normally not have a significant effect on the human environment and therefore does not require preparation of an Environmental Assessment or Environmental Impact Statement. Agencies continue to develop and apply their own categorical exclusions under NEPA’s statutory authority and any applicable congressional direction.

Conversion — The change of land from an existing or future use to permanent transportation use.

Direct impact/effect — Result of an action that occurs at the same time and place as the action.

Effects or impacts — Changes to the human environment caused by the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives. Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health impacts. This includes community-level impacts and effects on tribal resources. A "but-for" causal relationship is insufficient to make an effect "reasonably foreseeable." Effects that are

remote in time, geographically distant, or the product of a lengthy causal chain are generally excluded from analysis. Effects may be beneficial or adverse. An agency must analyze all reasonably foreseeable significant effects even if, on balance, the agency believes the overall effect of the action will be beneficial.

Environmental assessment — A concise public document, for which a federal agency is responsible, for an action that is not likely to have a significant effect or for which the significance of the effects is unknown, that is used to support an agency's determination of whether to prepare an environmental impact statement or a finding of no significant impact.

Environmental document — Means an environmental assessment, environmental impact statement, documented categorical exclusion determination, finding of no significant impact, record of decision, or notice of intent.

Environmental impact statement — A process and document prepared pursuant to NEPA for projects in which it is known that the action will have a significant effect on the environment. It is a detailed statement required by NEPA for major federal actions significantly affecting the human environment.

Federal agency — All agencies of the federal government. It does not mean the Congress, the Judiciary, or the President, including the performance of staff functions for the President in his Executive Office. For the purposes of the regulations in this subchapter, federal agency also includes states, units of general local government, and tribal governments assuming NEPA responsibilities from a federal agency pursuant to statute.

Finding of no significant impact — A document by a federal agency briefly presenting the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and for which an environmental impact statement therefore will not be prepared. Typically completed at the conclusion of an environmental assessment where no significant impacts were identified. Defined in 23 CFR § 771.121

Human environment — Includes the natural and physical environment and the relationship of people with the environment.

Independent utility — A project that should serve a purpose and be a reasonable expenditure of taxpayer’s dollars even if no other projects are completed in the area.

Land and Water Conservation Fund — A fund established by Congress in 1964 to fulfill a bipartisan commitment to safeguard natural areas, water resources, and cultural heritage and to provide recreation opportunities to all Americans. The fund helps strengthen communities, preserve history, and protect the national endowment of lands and waters.

Local short-term uses / long-term productivity relationship — The balance or trade-off between short-term uses and long-term productivity needs to be defined in relation to the proposed activity in question. Each resource, of necessity, must be provided with its own definitions of short term and long term.

Logical termini — Rational endpoints for a linear transportation improvement and rational endpoints for a review of environmental impacts.

Major federal actions — An action that the agency carrying out such action determines is subject to substantial federal control and responsibility. (e.g., granting authorizations, adoption of official policy, adoption of formal plans, adoption of programs, approval for carrying out specific projects, or providing more than a minimal amount of financial assistance).

Mitigation — Measures that avoid, minimize, or compensate for adverse effects caused by a proposed action or alternatives as described in an environmental document or record of decision and that have a connection to those adverse effects. Mitigation includes, in general order of priority, the following: (1) Avoiding the adverse effect altogether by not taking a certain action or parts of an action. (2) Minimizing the adverse effect by limiting the degree or magnitude of the action and its implementation. (3) Rectifying the adverse effect by repairing, rehabilitating, or restoring the affected environment. (4) Reducing or eliminating the adverse effect over time by preservation and maintenance operations during the life of the action. (5) Compensating for the adverse effect by replacing or providing substitute resources or environments.

National Environmental Policy Act (NEPA) —Established in 1969, NEPA is considered to be the basic “National Charter” for protection of the environment. NEPA requires that, to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

NEPA process — All measures necessary for compliance with the requirements of section 2 and Title I of NEPA.

Planning and Environmental Linkages – a collaborative and integrated approach to transportation decision-making that considers environmental, community, and economic goals early in the transportation planning process and uses planning-level information, analyses, and products to inform the environmental review process, including reviews conducted under the National Environmental Policy Act.

This approach is intended to improve coordination between transportation planning and project development by allowing information developed during planning—such as purpose and need, alternatives, environmental considerations, and stakeholder input—to be carried forward into environmental review, thereby reducing duplication, improving efficiency, and supporting better project outcomes.

Practicable — Able to be done or put into practice successfully.

Programmatic environmental document — An environmental impact statement or environmental assessment analyzing all or some of the environmental effects of a policy, program, plan, or group of related actions.

Proposals — A proposed action at a stage when an agency has a goal, is actively preparing to make a decision on one or more alternative means of accomplishing that goal, and can meaningfully evaluate its effects. A proposal may exist in fact as well as by agency declaration.

Reasonable alternatives — A reasonable range of alternatives that are technically and economically feasible and meet the purpose and need for the proposed action.

Reasonably foreseeable effects — Effects that are sufficiently likely and causually connected to the proposed action that a competent agency decisionmaker can meaningfully evaluate them during NEPA review.

Segmentation — Splitting a project up into smaller pieces to avoid significant impacts; prohibited under NEPA.

Significant environmental consequences / significant effect — Before the rescission of 40 CFR § 1508.27, use in NEPA required consideration of both context and intensity. Context is the significance of an action that must be analyzed in its current and proposed short- and long-term effects on the whole of a given resource (e.g., affected region), while intensity refers to the severity of the effect. Following the current guidance, analysis should be limited to “reasonably foreseeable effects.”

Umbrella legislation — Encouraging agencies to incorporate other environmental and historic preservation requirements into one analysis for a streamlined decision-making process.

18.2 SECTION 7 OF THE ENDANGERED SPECIES ACT

Biological assessment — An evaluation of the biological condition of a project area using biological surveys and other direct measurements.

Biological Opinion — The document that states the opinion of the U.S. Fish and Wildlife Service as to whether the federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Conservation — The use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the Endangered Species Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resource management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Direct impact/effect — Result of an action that occurs at the same time and place.

Endangered species — Any species that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA) — A program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The lead federal agencies for implementing the ESA are the U.S. Fish and Wildlife Service and the U.S. National Oceanic and Atmospheric Administration Fisheries.

Federal agency — Any department, agency, or instrumentality of the United States.

Foreign commerce — Any transaction (A) between persons within one foreign country; (B) between persons in two or more foreign countries; (C) between a person within the United States and a person in a foreign country; or (D) between persons within the United States, where the fish and wildlife in question are moving in any country or countries outside the United States.

Import — To land on, bring into, or introduce into, or attempt to land on, bring into, or introduce into, any place subject to the jurisdiction of the United States, whether or not such landing, bringing, or introduction constitutes an importation within the meaning of the customs laws of the United States.

Plant — Any member of the plant kingdom, including seeds, roots and other parts thereof.

Reasonable and prudent alternatives — Alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that the Director believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

Species — A principle taxonomic unit consisting of a group of living organisms with similar individuals capable of exchanging genes or interbreeding.

Take — To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Threatened species — Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

18.3 SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

Advisory Council on Historic Preservation — The federal entity charged with overseeing the efforts of federal agencies to ensure their compliance with Section 106. On a broader level, it is a cabinet-level body of presidentially appointed citizens, experts in the field, and federal, state, and local government representatives charged with ensuring that private citizens, local communities, and other concerned parties would have a forum for influencing federal policy, programs, and decisions as they impact historic properties and their attendant values.

Area of potential effects — The geographic area(s) within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. An area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.

Avoidance — An alternative and/or measure that results in the avoidance of an adverse effect on a historic property.

Categorical exclusion — A category of actions that, based on past experience or statutory direction, has been determined to normally not have a significant effect on the human environment and therefore does not require preparation of an Environmental Assessment or Environmental Impact Statement. Agencies continue to develop and apply their own categorical exclusions under NEPA's statutory authority and any applicable congressional direction.

Consultation — Consultation is seeking, discussing, and considering the views of all participants in the Section 106 process and, where feasible, seeking agreement with them.

Consulting parties — A person, entity, or organization that has consultative standing in the Section 106 process in addition to the Federal Highway Administration and the Advisory Council on Historic Preservation (ACHP). Consulting parties include the following: State Historic Preservation Officers; Tribal Historic Preservation Officers; Indian

Tribes; Native Hawaiian Organizations; local governments; applicants for federal assistance, permits, licenses, and other approvals; and other individuals and organizations with a demonstrated interest in the undertaking or affected historic properties.

Direct effects — Direct effects to a historic property would include the physical destruction of, or damage to, all or part of a historic property; alteration of a historic property in a way that is not consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties and applicable guidelines; or the removal of the property from its historic location.

Environmental impact statement — A process and document prepared pursuant to the NEPA for projects in which it is known that the action will have a significant effect on the environment. It is a detailed statement required by NEPA for major federal actions significantly affecting the human environment.

Historic property — Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian Organization that meet the National Register of Historic Places criteria.

Indirect effects — Effects that may change the character of the property's use or of physical features within the property's setting that contribute to its historic significance, or introduce visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features.

Integrity — The ability of a property to convey its significance. To be eligible for inclusion in the National Register of Historic Places, in addition to being significant, a property must retain sufficient integrity to convey its significance. The National Register of Historic Places identifies seven aspects of historic integrity: location, design, setting, materials, workmanship, feeling, and association.

Lead federal agency — Entity with designated responsibility for Section 106 review when multiple federal agencies are involved. The lead agency determines how the Section 106 process will be coordinated with NEPA and other environmental reviews to avoid duplication of effort and protracted consultation.

Memorandum of Agreement — The document that records the terms and conditions agreed upon to resolve the adverse effects of an undertaking upon historic properties.

National Environmental Policy Act (NEPA) — Established in 1969, NEPA is considered to be the basic "National Charter" for protection of the environment. NEPA requires that,

to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

National Historic Landmarks — Nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States. Today, just over 2,500 historic places bear this national distinction. The category includes historic buildings, sites, structures, objects, and districts, each representing an outstanding aspect of American history and culture.

National Historic Preservation Act — The National Historic Preservation Act of 1966, as amended, is the primary federal law governing the preservation of historic properties in the United States. The law establishes a national preservation program and a system of procedural protections that encourage the identification and protection of historic properties of national, state, tribal, and local significance.

National Register of Historic Places —To be eligible for listing in the National Register of Historic Places, in addition to retaining sufficient historic integrity, a historic property must possess significance under at least one of the following criteria:

> Criterion A — Association with events that have made a significant contribution to the broad patterns of our history.
>
> Criterion B — Associated with the lives of significant persons in our past.
>
> Criterion C — Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
>
> Criterion D — Have yielded, or may be likely to yield, information important in history or prehistory.

No adverse effect — A finding where an undertaking may have an effect on a historic property but will not alter any of the characteristics of the historic property that qualify it for inclusion in the National Register of Historic Places in a manner that would diminish its integrity.

Precontact — The period before contact of an indigenous people with an outside culture.

Programmatic agreement — A way to tailor the Section 106 process for a specific program or series of undertakings. This type of agreement allows federal agencies to govern the implementation of a particular agency program or the resolution of adverse effects from complex projects or multiple undertakings similar in nature through negotiation of an agreement among the agency, appropriate State/Tribal Historic Preservation Office, and the ACHP. Programmatic agreements generally fall into two types: project programmatic agreements and program programmatic agreements.

Section 106 — Section 106 of the National Historic Preservation Act of 1966 requires federal agencies to take into account the effects of their undertakings on historic properties and afford the ACHP a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is set out in regulations issued by the ACHP, "Protection of Historic Properties" (36 CFR § 800). In 2014, the National Historic Preservation Act was recodified, and Section 106 is now found at 54 U.S. Code [USC] § 306108.

Significance — The importance of a historic property as defined by the National Register of Historic Places criteria in one or more areas of significance.

State Historic Preservation Office — The official designated by the governor of each state to carry out the responsibilities of the National Historic Preservation Act of 1966 and administer the state's historic preservation program and the duties, as described in 36 CFR Part 61. While the State Historic Preservation Officer is an individual, it is also an office that performs a variety of functions under the National Historic Preservation Act and associated state laws.

Tribal land — Tribal land is defined in the National Historic Preservation Act as: (a) all lands within the exterior boundaries of any Indian reservation; and (b) all dependent Indian communities.

Undertaking — Projects, activities, or programs funded in whole or in part under the direct or indirect jurisdiction of a federal agency. Includes those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval.

18.4 AQUATIC RESOURCES

Approved Jurisdictional Determination — An official determination that there are, or are not, jurisdictional aquatic resources present. Additionally, Approved Jurisdictional Determinations define the limits of each jurisdictional resource and typically remain valid for five years.

Buffer zone — An upland, wetland, and/or riparian area that protects and/or enhances aquatic resource functions associated with wetlands, rivers, streams, lakes, marine, and estuarine systems from disturbances associated with adjacent land uses.

Compensatory mitigation — Implemented by the permittee as a requirement of a U.S. Army Corps of Engineers permit (i.e., permittee-responsible mitigation), or by a mitigation bank or an in-lieu fee program.

Cowardin classification — System used by the federal government to identify and classify different types of wetlands. The Cowardin system uses a biological definition of wetlands, which focuses on habitat-related characteristics of a wetland, such as the vegetation community and the length of time water is present. The classification includes five general systems: marine, estuarine, riverine, lacustrine, and palustrine wetlands.

Direct impact/effect — Result of an action that occurs at the same time and place as the action.

Ephemeral streams — Also known as "wet weather streams," these are streams that flow only in direct response to precipitation or whose channels are always above the water table.

Intermittent streams — Streams that have no flow during sustained periods without precipitation and that do not support aquatic life whose life history requires residence in flowing waters for a continuous period of at least six months.

Jurisdictional Determination — An official determination of aquatic resource boundaries and whether a resource is considered jurisdictional under the U.S. Army Corps of Engineers.

National Wetland Inventory — A publicly available resource maintained by the U.S. Fish and Wildlife Service that provides detailed information on the abundance, characteristics, and distribution of U.S. wetlands.

Navigable waters — Those waters that are subject to the ebb and flow of the tide and those inland waters that are currently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce while the waterway is in its ordinary condition at the time of statehood.

Perennial streams — Streams or a portion of a stream that flows year-round, is considered a permanent stream, and for which base flow is maintained by groundwater discharge to the streambed due to the groundwater elevation adjacent to the stream being higher than the elevation of the streambed.

Preliminary Jurisdictional Determination — These are not legally binding determinations regarding the jurisdictional nature of aquatic resources present.

Preliminary Jurisdictional Determinations often include delineation limits of all aquatic resources present without determining the jurisdictional status of each resource. Requestors of a Preliminary Jurisdictional Determination can later obtain an Approved Jurisdictional Determination if appropriate.

Tributary — A water that contributes flow, either directly or through another water (including an impoundment), to a traditional navigable water, interstate water (including wetlands), or tidal water that is characterized by the presence of a bed and banks and an ordinary high-water mark. A tributary can be natural, human-altered, or human-made and includes waters such as rivers, streams, canals, and ditches (with the exception of waters defined as non-jurisdictional in 33 CFR § 238.3(b)). A tributary will not lose its status as a tributary if, for any length, there are one or more constructed breaks (i.e., bridges, culverts, pipes, or dams) or one or more natural breaks (i.e., wetlands along the run of a stream, debris piles, boulder fields, or a stream that flows underground) so long as a bed and banks and an ordinary high-water mark can be identified upstream of the break. A tributary will not lose its status if it contributes flow through a water of the United States that does not meet the definition of a tributary or through a non-jurisdictional water to a traditional navigable water, interstate water (including wetlands), or tidal water. (33 CFR § 238.3(c)(3))

Waters of the United States — Federally protected waters, including all surface waters with a direct connection to navigable waters, including associated tributaries and wetlands.

Wetland — Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.

18.5 FARMLAND

Conversion — The change of land from an existing or future use to permanent transportation use.

Farmland — Prime or unique farmlands as defined in Section 1540(c)(1) of the Act or farmland that is determined by the appropriate state or unit of local government agency or agencies with concurrence of the Secretary to be farmland of statewide of local importance.

Farmland Conversion Impact Rating — Metric used to determine the extent of each alternative's impact to farmland. Generally, the AD–1006 or CPA–106 form is used to determine this rating, and the Natural Resources Conservation Service is asked for concurrence.

Farmland Protection Policy Act — Intended to minimize the impact federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Soil Survey Geographic Database — Information about soil as collected by the National Cooperative Soil Survey over the course of a century. The information can be displayed in tables or as maps and is available for most areas in the United States and the Territories, Commonwealths, and Island Nations served by the U.S Department of Agriculture, Natural Resources Conservation Service.

Web Soil Survey — A dataset maintained by the U.S Department of Agriculture, Natural Resources Conservation Service that provides agricultural producers, agencies, technical service providers, and others with electronic access to relevant soil and related information needed to make land-use and management decisions.

18.6 PUBLIC INVOLVEMENT

Alternative — A reasonable way to fix the identified problem or satisfy the stated need.

Categorical exclusion — A category of actions that, based on past experience or statutory direction, has been determined to normally not have a significant effect on the human environment and therefore does not require preparation of an Environmental Assessment or Environmental Impact Statement. Agencies continue to develop and apply their own categorical exclusions under NEPA's statutory authority and any applicable congressional direction.

Environmental assessment — A concise public document, for which a federal agency is responsible, for an action that is not likely to have a significant effect or for which the significance of the effects is unknown. It is used to support an agency's determination of whether to prepare an environmental impact statement or a finding of no significant impact.

Environmental impact statement — A process and document prepared pursuant to NEPA for projects in which it is known that the action will have a significant effect on the environment. It is a detailed statement required by NEPA for major federal actions significantly affecting the human environment.

Floodplain — The 100-year floodway and that maximum area of land that is likely to be flooded by a 100-year flood as shown on the floodplain maps approved or promulgated by the Federal Emergency Management Agency.

Limited English Proficiency — Individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand the English language. Limited English Proficiency statutes and authorities prohibit exclusion from

participation in, denial of benefits of, and discrimination under federally assisted and/or federally conducted programs on the grounds of race, color, or national origin.

National Environmental Policy Act (NEPA) —Established in 1969, NEPA is considered to be the basic "National Charter" for protection of the environment. NEPA requires that, to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

Significant environmental consequences / significant effect — Refers to the degree to which an action may affect the quality of the human environment, historically used under CEQ's guidance on context and significance. Following the 2025 rescission of those regulations, agencies now determine what constitutes a 'significant' effect under their own NEPA procedures rather than CEQ's prior definitions.

Title VI population — Title VI declares it to be the policy of the United States that discrimination on the grounds of race, color, or national origin shall not occur in connection with programs and activities receiving federal financial assistance and authorizes and directs the involved federal departments and agencies to take action to carry out this policy. Title VI prohibits discrimination, whether intentional or unintentional, or where the unintended effect is unduly burdensome.

Wetland — Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.

18.7 SECTION 4(F)

Adverse effect — The impact on a property that is on or eligible for the National Register of Historic Places. Adverse effect refers to the diminishment of a property's integrity with respect to its location, design, setting, materials, workmanship, feeling, or association. The term is applied by federal agency officials, in consultation with the State (or Tribal) Historic Preservation Officer, as part of the Section 106 process.

All possible planning — All possible planning means that all reasonable measures identified in the Section 4(f) evaluation to minimize harm or mitigate adverse impacts and effects must be included in the project.

Alternative — A reasonable way to fix the identified problem or satisfy the stated need.

Constructive use — A Section 4(f) term denoting that a project's proximity impacts are so severe that the protected activities, features, or attributes of a property are substantially impaired (see Section 10 — Section 4(f)).

***De minimis* impact** — An impact involving the use of a Section 4(f) property that is generally minor in nature. A *de minimis* impact is one that, after accounting for avoidance, minimization, mitigation, and enhancement measures, results in no adverse effect to the activities, features, or attributes qualifying a park, recreation area, or refuge for protection under Section 4(f). For historic properties, a *de minimis* impact is one that results in a Section 106 determination of "no adverse effect" or "no historic properties affected." A *de minimis* impact determination requires agency coordination with the officials having jurisdiction over the Section 4(f) property and opportunities for public involvement. A *de minimis* impact determination may not be made when there is a constructive use.

Extraordinary magnitude — A reference to exceedingly high costs or other objectionable factors associated with a project alternative. Extraordinary magnitude characterizes the impacts to Section 4(f) or non–Section 4(f) resources as beyond the boundaries of feasible and prudent.

Feasible and prudent — These are Section 4(f) terms referring to the development of avoidance alternatives. A feasible and prudent avoidance alternative avoids using Section 4(f) property and does not cause other severe problems of a magnitude that substantially outweighs the importance of protecting the Section 4(f) property. An alternative is not feasible if it cannot be built as a matter of sound engineering judgment. An alternative is not prudent if it results in consequences listed in 23 CFR § 774.17 (See Section 10 — Section 4(f).)

> **Feasible** — The term "feasible" refers to the constructability of a project — whether it can be built as a matter of sound engineering judgment, using current construction methods technologies and practices.
>
> **Prudent** — The term "prudent" refers to how reasonable the alternative is — in essence whether it makes sense. An alternative may be considered not prudent for any of the following reasons:
>
> - It compromises the project to a degree that it is unreasonable to proceed in light of the project's stated purpose and need (i.e., the alternative does not address the purpose and need of the project).
> - It results in additional construction costs of extraordinary magnitude.
> - It involves extraordinary operational or safety problems.
> - It causes severe social, economic, or environmental impacts.
> - It causes severe disruption to established communities.

- It causes severe or disproportionate impacts to Title VI populations.
- It causes severe impacts to environmental resources protected under other federal statutes.
- It has unique problems or truly unusual factors.
- There is an accumulation of factors that collectively, rather than individually, have adverse impacts that present unique problems or reach extraordinary magnitude.

Historic site / historic property / historic resource — In the context of Section 106 and Section 4(f), historic property means any precontact district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places. Section 106 requires the Federal Highway Administration and all federal agencies to take into account the effects of their actions on historic properties.

Least overall harm — If the analysis of avoidance alternatives concludes that there is no feasible and prudent avoidance alternative, then the Federal Highway Administration may only approve the alternative that causes the least overall harm to the Section 4(f) property. 23 CFR § 774.3(c) includes a list of factors to consider in making this determination of least overall harm. These factors include the ability to mitigate adverse impacts to Section 4(f) property; the relative severity of remaining harm, after mitigation, to Section 4(f) property; and the relative significance of each Section 4(f) property. For instance, will the project alternatives result in edge takes of a park, or will they cut through the middle? How will activities, features, or attributes of the 4(f) property be affected by various alternatives and to what degree? If alternatives are determined to cause "substantially equal" harm to Section 4(f) property, then the Federal Highway Administration may choose any alternative.

Minor use — When applied to parks, recreation lands, and wildlife or waterfowl refuges, minor use signifies that the amount of land acquired by a transportation agency is relatively small. With respect to historic sites, an acquisition is considered to be a minor use when there is a determination of "no adverse effect" (or "no effect").

National Register of Historic Places — The official list of the nation's historic places worthy of preservation. Authorized by the National Historic Preservation Act of 1966, the National Park Service's National Register of Historic Places is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archaeological resources.

Net benefit — In Section 4(f) of the U.S. Department of Transportation Act, "net benefit" refers to a situation where a transportation project, including mitigation measures, results in an overall improvement or enhancement of a protected property like a park, recreation area, or historic site, even though the project may require some use of that property, when

compared to the current condition or alternative options that would avoid using the protected land altogether.

Official with jurisdiction — Typically for a park, this would be the federal, state or local park authorities or agencies that own and/or manage the park; for a refuge, the federal, state, or local wildlife or waterfowl refuge owners and managers; and for historic sites, the State Historic Preservation Officer or Tribal Historic Preservation Officer, whichever has jurisdiction under Section 106 of the National Historic Preservation Act (16 USC § 470f).

Programmatic evaluation — Programmatic Section 4(f) evaluations can be used in place of individual evaluations for highway projects where uses are considered minor. The primary advantage of a programmatic evaluation is that it saves time. Unlike an individual evaluation, a programmatic evaluation does not require a draft, a comment period, or circulation, because its framework and basic approach has already been circulated and agreed upon by the U.S. Department of the Interior. Project-specific details are then applied to the programmatic evaluation to determine whether it can be used. Programmatic evaluations are usually approved much faster than individual evaluations.

Publicly owned — Property that is owned or operated by a public entity. If a governmental body has a proprietary interest in the land (such as fee ownership, drainage easements or wetland easements), it can still be considered publicly owned. Land subject to a public easement in perpetuity can also be considered to be publicly owned land for the purpose for which the easement exists.

Section 106 — Under Section 106 of the National Historic Preservation Act of 1966, as amended, federal agencies must identify and evaluate cultural resources and consider the impact of undertakings they fund, license, permit, or assist on historic properties eligible for inclusion in the National Register of Historic Places. The federal agencies must afford the State Historic Preservation Officer and the ACHP the opportunity to comment on these undertakings.

Section 4(f) — A regulation in the U.S. Department of Transportation Act, which provides for consideration of public park and recreation lands, wildlife and waterfowl refuges, and historic sites during transportation project development (see Section 10 — Section 4(f)).

Section 4(f) properties — Publicly owned public parks, recreation areas, and wildlife or waterfowl refuges, or any publicly or privately owned historic site listed or eligible for listing on the National Register of Historic Places.

Significance — Significance means that in comparing the availability and function of the resource with the recreational, park, and refuge objectives of that community, the resource in question plays an important role in meeting those objectives. If a determination from the official with jurisdiction cannot be obtained, Section 4(f) land will

be presumed to be significant. All determinations (whether stated or presumed) are subject to review by the Federal Highway Administration for reasonableness.

State Historic Preservation Office — All 50 U.S. states, 5 territories, 3 freely associated states, and the District of Columbia have a designated State Historic Preservation Office. Preservation efforts are led by a governor-appointed State Historic Preservation Officer and/or one or more delegated Deputy State Historic Preservation Officers.

Substantially impaired — Substantial impairment occurs only when the protected activities, features, or attributes of the resource are substantially diminished.

Temporary occupancy — A temporary occupancy of land is so minimal that it does not constitute a use within the meaning of Section 4(f) when the duration is temporary, the scope of work is minor, there are no anticipated permanent adverse physical impacts, and the land will be fully restored. There must be documented agreement of the appropriate federal, state, or local officials having jurisdiction over the resource regarding the above conditions.

Transportation enhancement projects — Projects that improve communities' cultural, aesthetic, and environmental qualities. Eligible activities include bicycle and pedestrian pathways, historic preservation, acquisition of conservation or scenic easements, rails-to-trails projects, and the mitigation of water pollution due to highway runoff.

Use — Use of a Section 4(f) property occurs in the following situations: (1) when land is permanently incorporated into a transportation facility, (2) when there is a temporary occupancy of land that is adverse in terms of the statute's preservation purpose, or (3) when there is a constructive use (a project's proximity impacts are so severe that the protected activities, features, or attributes of a property are substantially impaired). The regulation lists various exceptions and limitations applicable to this general definition.

18.8 SECTION 6(F)

Alternatives — A reasonable way to fix the identified problem or satisfy the stated need.

Conversion — Situations that generate a conversion include the following: property interests are conveyed for private use or non-public outdoor recreation uses; non-outdoor recreation uses (public or private) are made of the project area or a portion thereof, including those occurring on preexisting rights of way and easements, or by a lessor; unallowable indoor facilities are developed within the project area without National Park Service concurrence, such as unauthorized public facilities and sheltering of an outdoor facility; and public outdoor recreation use of property acquired or developed with Land and Water Conservation Fund assistance is terminated.

National Environmental Policy Act (NEPA) — Federal legislation requiring federal entities to document the environmental impacts of transportation projects.

"Public" outdoor recreation areas and facilities — These are facilities owned or operated by a public entity. If a governmental body has a proprietary interest in the land (such as fee ownership, drainage easements, or wetland easements), it can still be considered publicly owned. Land subject to a public easement in perpetuity can also be considered to be publicly owned land for the purpose for which the easement exists.

Section 6(f) — Passed by Congress in 1965, the act established the Land and Water Conservation Fund, a matching assistance program that provides grants that pay half the acquisition and development cost of outdoor recreation sites and facilities. Section 6(f) of the act prohibits the conversion of property acquired or developed with these grants to a non-recreational purpose without the approval of the Department of the Interior's National Park Service. The Department of the Interior must ensure that replacement lands of equal value, location, and usefulness are provided as a condition of such conversions. Consequently, where conversions of Section 6(f) lands are proposed for highway projects, project sponsors must provide replacement lands.

Significant — When comparing the availability and function of the resource with the recreational, park, and refuge objectives of that community, the resource in question plays an important role in meeting those objectives.

Temporary use — When a project temporarily occupies land within a property during construction activities. Examples of temporary use include right of entry, a temporary easement, or other short-term arrangement.

18.9 NOISE

Abatement — Any positive action taken to reduce the impact of highway traffic noise.

Auxiliary lane — The American Association of State Highway Transportation Officials defines an auxiliary lane as the portion of the roadway adjoining the traveled way for speed change, turning, weaving, truck climbing, maneuvering of entering and leaving traffic, and other purposes supplementary to through-traffic movement.

Barrier — A solid wall or earth berm located between the roadway and receptor location that provides noise reduction.

Categorical exclusion — A category of actions that, based on past experience or statutory direction, has been determined to normally not have a significant effect on the human environment and therefore does not require preparation of an Environmental Assessment or Environmental Impact Statement. Agencies continue to develop and apply

their own categorical exclusions under NEPA's statutory authority and any applicable congressional direction.

Decibel — Units for measuring sound. Decibels are logarithmic units.

Environmental assessment — A concise public document, for which a federal agency is responsible, for an action that is not likely to have a significant effect or for which the significance of the effects is unknown. It is used to support an agency's determination of whether to prepare an environmental impact statement or a finding of no significant impact.

Environmental impact statement — A process and document prepared pursuant to NEPA for projects in which it is known that the action will have a significant effect on the environment. An environmental impact statement is a detailed statement required by NEPA for major federal actions significantly affecting the human environment.

Line-of-sight — The line of vision between a receptor and a noise source.

National Environmental Policy Act (NEPA) —Established in 1969, NEPA is considered to be the basic "National Charter" for protection of the environment. NEPA requires that, to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

Noise Abatement Criteria — Noise impact thresholds for considering noise abatement for various land uses. Defined in 23 CFR § 772.

Receptor — Any locations of frequent human use where noise would have the potential to interfere with typical activities.

Traffic noise impact — Design-year build condition noise levels that approach or exceed the Noise Abatement Criteria for the future build condition or design-year build condition noise levels that create a substantial noise increase over existing noise levels.

Undeveloped land — Those tracts of land or portions thereof that do not contain improvements or activities devoted to frequent human habitation or use (including low-density recreational use) and for which no such improvements or activities are permitted.

18.10 AIR QUALITY

Air quality analysis — The Clean Air Act requires the U.S. Environmental Protection Agency (USEPA) to set national air quality standards for six pollutants considered harmful to public health and the environment (the other pollutants are ozone, nitrogen oxides, carbon monoxide, sulfur dioxide, lead and particulate matter). The air quality analysis is to ensure that all federally funded projects comply with the standards set by USEPA.

Clean Air Act Amendments — Legislation that address the key issues of air pollution, mobile sources, air toxics, acid deposition, and stratospheric ozone protection.

CO — Carbon monoxide.

Conformity — Transportation conformity, as required by the CAA, ensures that federally funded or approved transportation plans, programs, and projects conform to the air quality objectives established in the State Implementation Plan. Transportation conformity regulations are developed by USEPA, with the U.S. Department of Transportation's (USDOT's) input and concurrence. The USDOT (through the FHWA and FTA) and Metropolitan Planning Organizations are responsible for implementing the conformity regulation in nonattainment and maintenance areas.

Conformity determination — Project level conformity determinations require that the FHWA/FTA project must come from a conforming transportation plan/TIP or associated regional emissions analysis. In addition, in carbon monoxide and particulate matter nonattainment and maintenance areas, an analysis of localized emissions may be required for federally funded or approved projects. This analysis is called a "hot-spot" analysis.

Maintenance area — Any geographic region the USEPA previously designated as nonattainment pursuant to the CAA, and which USEPA subsequently re-designated to attainment status subject to the requirement to develop a maintenance plan.

Mobile Source Air Toxics — The Clean Air Act identified 188 air toxics, also known as hazardous air pollutants. The USEPA has identified a group of 21 (from the 188) as mobile source air toxics, which are set forth in an USEPA final rule, Control of Emissions of Hazardous Air Pollutants from Mobile Sources (66 Federal Record 17235). The FHWA extracted a subset list (from the 21) and labeled them as the nine priority MSAT: 1,3-butadiene,acetaldehyde, acrolein, benzene, diesel particulate matter, ethylbenzene, formaldehyde, naphthalene, and polycyclic organic matter.

The USEPA considers the MSAT as priority transportation toxics, and stresses that the lists are subject to change and/or be adjusted in future rules.

Metropolitan Planning Organization — The forum for cooperative decision-making and the organization designated, together with the state, as being responsible for conducting the continuing, cooperative, and comprehensive planning process under 23 USC § 134 and 49 USC § 5303.

National Ambient Air Quality Standards — Federal standards that set allowable concentrations and exposure limits for various pollutants.

National Environmental Policy Act (NEPA) —Established in 1969, NEPA is considered to be the basic "National Charter" for protection of the environment. NEPA requires that, to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

Nonattainment area — A geographic region of the United States that the USEPA has designated as not meeting the National Ambient Air Quality Standards.

State Implementation Plan — A plan mandated by the Clean Air Act Amendments that contains procedures to monitor, control, maintain, and enforce compliance with the National Ambient Air Quality Standards.

Transportation Improvement Program — A program that consists of transportation projects drawn from or consistent with the Transportation Policy Plan and developed pursuant to Title 23 USC and the Federal Transit Act.

18.11 HAZARDOUS MATERIALS INVESTIGATION

Aboveground storage tank — A stationary tank with a capacity of more than 250 gallons that has more than 90 percent of its volume (including the volume in the pipes) above the surface of the ground, can be visually inspected from the exterior, and is used to contain regulated substances. The definition also contains 19 exemptions.

Alternative — A reasonable way to fix the identified problem or satisfy the stated need.

Cleanups In My Community — This resource maps or lists Resource Conservation and Recovery Act Corrective Action sites that are currently undergoing corrective action, sites for which a remedy has been selected, sites for which construction has been completed, and sites where the corrective action cleanup is complete.

Comprehensive Environmental Response, Compensation, and Liability Act — The federal law that created Superfund and directed the USEPA to control, clean up, and designate liability for abandoned, uncontrolled, or inactive hazardous waste sites. Under this act, potential responsible parties who are found responsible for a site contaminated with hazardous substances or wastes are liable for the costs of removal and cleanup. Hazardous substances are defined in this act.

Dangerous waste — Discarded or abandoned non-radioactive substances, including pesticide containers and other chemical containers, posing substantial present or potential hazard to human health, wildlife, or the environment. Such wastes are normally toxic, corrosive, explosive, or flammable and are most often a hazardous waste.

Environmental document — This means an environmental assessment, environmental impact statement, documented categorical exclusion determination, finding of no significant impact, record of decision, or notice of intent.

Generator — The person or entity who produces or first causes dangerous waste to become subject to regulation.

Hazardous waste — Solid waste, or combination of solid wastes, which because of its quality; concentration; or physical, chemical, or infectious characteristics may:

a. Cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness;
b. Pose substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed;
c. Cause the release of a hazardous substance; or
d. Be highly toxic to humans or wildlife.

Manifest — This refers to a Hazardous Waste Manifest. It is required to transport hazardous waste.

Polychlorinated biphenyls — A group of human-made organic chemicals consisting of carbon, hydrogen, and chlorine atoms. PCBs belong to a broad family of human-made organic chemicals known as chlorinated hydrocarbons. Polychlorinated biphenyls were domestically manufactured from 1929 until manufacturing was banned in 1979. They have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, they were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; plasticizers in paints, plastics, and rubber products; pigments, dyes, and carbonless copy paper; and other industrial applications.

Release — Spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, uncovering, or disposing of hazardous waste into the environment.

Resource Conservation and Recovery Act — USEPA's authority to control hazardous waste from cradle to grave. This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. This act also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to the act enabled the USEPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.

Site assessment for potential hazardous wastes — A systematic process for evaluating health threats caused by abandoned hazardous waste sites and determining whether there is a need for remediation and, if so, making recommendations for cleanup plans.

Solid waste — Garbage, refuse, sludge, and other discarded material including solid, liquid, semi-solid, or contained-gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities.

Superfund — USEPA's program responsible for cleaning up some of the nation's most contaminated land and responding to environmental emergencies, oil spills, and natural disasters. To protect public health and the environment, the Superfund program focuses on making a visible and lasting difference in communities, ensuring that people can live and work in healthy, vibrant places.

Superfund Amendments and Reauthorization Act — The 1987 Act amending and reauthorizing the Comprehensive Environmental Response, Compensation, and Liability Act for responding to hazardous waste sites and increasing the size of the fund.

Toxic Substance Control Act — USEPA's authority to require that chemicals be tested for their potential health and environmental effects prior to or after their introduction into commerce; to collect, analyze, and review data concerning chemicals and new uses of chemicals prior to and after their introduction into commerce; and to restrict the manufacturing (including importation), processing, distribution, disposal, or use of these substances if they present or will present an unreasonable risk to human health or the environment.

Underground storage tank — A tank with a capacity of more than 110 gallons that has 10 percent or more of its volume (including the volume in the underground pipes) beneath the surface of the ground and is used to contain regulated substances. The definition also contains 17 exemptions.

18.12 COMMUNITY IMPACTS, HUMAN POPULATIONS AND TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

Adverse action — Significant individual human health or environmental effects caused by an action taken with the intent to discriminate on the basis of race, color, or national origin. These may include, but are not limited to, bodily impairment, infirmity, illness or death; air, noise, and water pollution; destruction or disruption of community cohesion; displacement of persons or businesses; and the denial or significant delay in the receipt of benefits from Federal Highway Administration programs, policies, or activities.

Alternative — A reasonable way to fix the identified problem or satisfy the stated need.

Block Group — Statistical divisions of census tracts that are generally defined to contain between 600 and 3,000 people and are used to present data and control block numbering.

Census tract — A geographic region defined for the purpose of taking a census. These areas are small, relatively permanent geographic entities within counties (or the statistical equivalents of counties) delineated by a committee of local data users. Generally, census tracts have between 2,500 and 8,000 residents and boundaries that follow visible features. When first established, census tracts are to be as homogeneous as possible with respect to population characteristics, economic status, and living conditions.

Direct impact/effect — Result of an action that occurs at the same time and place as the action.

Environmental document — This is an environmental assessment, environmental impact statement, documented categorical exclusion determination, finding of no significant impact, record of decision, or notice of intent.

Limited English Proficiency — Individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand the English language. Limited English Proficiency statutes and authorities prohibit exclusion from participation in, denial of benefits of, and discrimination under federally assisted and/or conducted programs on the ground of race, color, or national origin.

Low-income — A median household income that is at or below the Department of Health and Human Services poverty guidelines. The guidelines are updated annually and available online.

Low-income population — Any readily identifiable group of low-income persons who live in geographic proximity, and, if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed program, policy, or activity.

Meaningful engagement — Providing timely opportunities for members of the public to share information or concerns and participate in decision-making processes; fully considering public input provided as part of decision-making processes; seeking out and encouraging the involvement of persons and communities potentially affected by federal activities; and providing technical assistance, tools, and resources to assist in facilitating meaningful and informed public participation, whenever practicable and appropriate.

Minority / People of Color — This refers to people who are Black or African American, Hispanic, Asian American, American Indian/Alaskan Native, or Native Hawaiian or Pacific Islander.

Minority / People of Color population — Any readily identifiable groups of minority / people of color persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed program, policy, or activity.

Mitigation — Measures that avoid, minimize, or compensate for adverse effects caused by a proposed action or alternatives as described in an environmental document or record of decision and that have a connection to those adverse effects. Mitigation includes, in general order of priority, the following: (1) Avoiding the adverse effect altogether by not taking a certain action or parts of an action. (2) Minimizing the adverse effect by limiting the degree or magnitude of the action and its implementation. (3) Rectifying the adverse effect by repairing, rehabilitating, or restoring the affected environment. (4) Reducing or eliminating the adverse effect over time by preservation and maintenance operations during the life of the action. (5) Compensating for the adverse effect by replacing or providing substitute resources or environments.

National Environmental Policy Act (NEPA) — Federal legislation requiring federal entities to document the environmental impacts of transportation projects.

Significant environmental consequences / significant effect — Refers to the degree to which an action may affect the quality of the human environment, historically used under CEQ's guidance on context and significance. Following the 2025 rescission of those regulations, agencies now determine what constitutes a 'significant' effect under their own NEPA procedures rather than CEQ's prior definitions.

Title VI population — Title VI declares it to be the policy of the United States that discrimination on the ground of race, color, or national origin shall not occur in connection with programs and activities receiving federal financial assistance and authorizes and directs the involved federal departments and agencies to take action to carry out this policy. Title VI prohibits discrimination, whether intentional or unintentional, where the unintended effect is unduly burdensome.

U.S. Census Bureau — The principal agency of the U.S. Federal Statistical System. It is responsible for producing data about the American people and economy. The Census Bureau's primary mission is conducting the U.S. census every 10 years.

18.13 PERMITTING

Best management practice — Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices (including structural controls) to prevent or reduce pollution.

Discharge — Stormwater runoff or dry weather flow. When used without qualification, the term includes a discharge of a pollutant.

Maintenance activity — Cleaning and repairing roadways, appurtenances, and related facilities. Also includes activities that may require clearing, grading, or excavation to maintain the original line and grade, hydraulic capacity, or original purpose of the facility.

Sediment — Organic or inorganic material that is carried by or is suspended in water and that settles out to form deposits in the storm drain system or receiving waters.

Site — The land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.

Stormwater — Water runoff resulting from precipitation, including snowmelt, into natural drainages and constructed drainage conveyances.

Total maximum daily load — A written quantitative plan and analysis for attaining and maintaining water quality standards in all seasons for a specific water body and pollutant. The plan generally establishes an allocation of pollutant loading applicable to the discharge sources of the pollutant being targeted.

Water quality standards — Standards that define water quality goals of a water body by designating uses (“beneficial uses”) of the water and by setting objectives necessary to protect these beneficial uses. The objectives may be narrative or numeric. The beneficial uses include such things as cold freshwater habitat, domestic (drinking water) supply, and water contact recreation. The standards also include antidegradation requirements. Antidegradation is addressed through the establishment of requirements to “maintain existing or higher quality water.” Water quality standards are adopted by the state and approved by the USEPA.

Waters of the United States — Federally protected waters, including all surface waters with a direct connection to navigable waters, including associated tributaries and wetlands.

Wetland — Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions.

18.14 ENVIRONMENTAL COMMITMENTS

Mitigation — Measures that avoid, minimize, or compensate for adverse effects caused by a proposed action or alternatives as described in an environmental document or record of decision and that have a connection to those adverse effects. Mitigation includes, in general order of priority, the following (1) Avoiding the adverse effect altogether by not taking a certain action or parts of an action. (2) Minimizing the adverse effect by limiting the degree or magnitude of the action and its implementation. (3) Rectifying the adverse effect by repairing, rehabilitating, or restoring the affected environment. (4) Reducing or eliminating the adverse effect over time by preservation and maintenance operations during the life of the action. (5) Compensating for the adverse effect by replacing or providing substitute resources or environments.

National Environmental Policy Act (NEPA) —Established in 1969, NEPA is considered to be the basic “National Charter” for protection of the environment. NEPA requires that, to the extent possible, the policies, regulations, and laws of the federal government be interpreted and administered in accordance with the protection goals of the law. It also requires federal agencies to use an interdisciplinary approach in planning and decision-making for actions that impact the environment. Finally, NEPA requires the preparation of an environmental impact statement on all major federal actions significantly affecting the human environment.

19. REFERENCES AND LINKS

19.1 NATIONAL ENVIRONMENTAL POLICY ACT

19.1.1. 23 CFR § 771.105 <https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-771/section-771.105>.

19.1.2. 23 CFR § 771.111(f) <https://www.govinfo.gov/content/pkg/CFR-2011-title23-vol1/pdf/CFR-2011-title23-vol1-sec771-111.pdf>.

19.1.3. 23 USC § 134 <https://www.fhwa.dot.gov/map21/docs/title23usc.pdf>.

19.1.4. 23 USC § 139(b)(3) <https://www.govinfo.gov/content/pkg/USCODE-2011-title23/html/USCODE-2011-title23-chap1-sec139.htm>.

19.1.5. 40 CFR § 1502.14 <https://www.govinfo.gov/content/pkg/CFR-2012-title40-vol34/pdf/CFR-2012-title40-vol34-sec1502-14.pdf>.

19.1.6. Federal Highway Administration (undated). Environmental Review Toolkit: Planning and Environment Linkages Fact Sheet. <Updated_PEL_Fact_Sheet_2021-09-29.pdf>.

19.1.7. Federal Highway Administration (undated). A Guide to Federal-Aid Programs and Projects. < https://www.fhwa.dot.gov/federalaid/projects.cfm >.

19.1.8. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages <https://www.environment.fhwa.dot.gov/env_initiatives/pel.aspx>.

19.1.9. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages - PEL Hypothetical Case Study: Alternatives <https://go.usa.gov/xMXg4>.

19.1.10. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages - PEL Hypothetical Case Study: Planning Analyses <https://go.usa.gov/xMXg4>.

19.1.11. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages - PEL Hypothetical Case Study: Planning Studies <https://go.usa.gov/xMXgW>.

19.1.12. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages - PEL Hypothetical Case Study: Planning Studies <https://go.usa.gov/xMXgB>.

19.1.13. Federal Highway Administration (undated). Environmental Review Toolkit: Initiatives to Accelerate Project Delivery - Planning and Environment Linkages – Want More Information? <https://www.environment.fhwa.dot.gov/env_initiatives/pel/request_pel_info.aspx>.

19.1.14. Federal Highway Administration (undated). National Highway Institute <https://highways.dot.gov/nhi/home>.

19.2 SECTION 7 OF THE ENDANGERED SPECIES ACT

19.2.1. 16 USC § 1531–1544 (1973) — <https://www.govinfo.gov/content/pkg/USCODE-2017-title16/pdf/USCODE-2017-title16-chap35-sec1531.pdf>.

19.2.2. U.S. Fish and Wildlife Service (2023). Aquatic Habitats Supporting Federally listed Endangered, Threatened, and Proposed Species in West Virginia. https://www.fws.gov/sites/default/files/documents/Aquatic%20Habitats%20Supporting%20Federally%20Listed%20Species_July2023.pdf.

19.2.3. U.S. Fish and Wildlife Service (2024). Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines. <https://www.fws.gov/media/range-wide-indiana-bat-and-northern-long-eared-bat-survey-guidelines>.

19.2.4. U.S. Fish and Wildlife Service (undated). Information for Planning and Consultation (IPaC). https://ipac.ecosphere.fws.gov/.

19.2.5. U.S. Fish and Wildlife Service (undated). West Virginia plant survey guidelines. https://www.fws.gov/media/west-virginia-plant-survey-guidelines.

19.2.6. West Virginia DNR (undated). Freshwater Mussels. https://wvdnr.gov/plants-animals/freshwater-mussels/.

19.3 SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

19.3.1. Advisory Council for Historic Preservation (ACHP). (Undated). Electronic Section 106 Documentation Submittal System (e106). https://www.achp.gov/e106-email-form.

19.3.2. Advisory Council for Historic Preservation (ACHP). (2004). 36 CFR § 800 – Protection of Historic Properties.

19.3.3. Advisory Council for Historic Preservation (ACHP). (2024). Protecting Historic Properties. Protecting Historic Properties | Advisory Council on Historic Preservation. Accessed October 2024.

19.3.4. American Association of State Highway and Transportation Officials (AASHTO). (2016). Practitioners Handbook: Consulting Under Section 106 of the National Historic Preservation Act. Center for Environmental Excellence by AASHTO.

19.3.5. Bureau of Indian Affairs (BIA). (2024). Tribal Consultation. What is Tribal Consultation? | Indian Affairs. Accessed October 2024.

19.3.6. National Park Service (NPS). (Undated). Series: Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. https://www.nps.gov/articles/series.htm?id=62144687-B082-538A-A0174FFF26496394.

19.3.7. 19.3.8. National Park Service (NPS). (1990). National Register Bulletin: How to Apply the National Register Criteria for Evaluation. https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdf.

19.3.8. West Virginia. (2024). West Virginia Code of State Rules. Agency 82: Culture and History, Title 82: Legislative Rule Division of Culture and History.

19.3.9. West Virginia Department of Arts, Culture & History. (Undated). Historic Preservation Forms & Applications. https://wvculture.org/agencies/state-historic-preservation-office-shpo/certified-local-governments-historic-landmark-commissions/historic-preservation-forms-applications/.

19.3.10. West Virginia Department of Highways (WVDOH). (Undated). Highways Through History. <https://www.highwaysthroughhistory.com/>.

19.3.11. West Virginia Department of Highways (WVDOH). (2016a). Programmatic Agreement Among the Federal Highway Administration, the West Virginia

Division of Culture and History, the Advisory Council on Historic Preservation, and the West Virginia Division of Highways Regarding the Federal and Highway Program in West Virginia. https://www.environment.fhwa.dot.gov/env_topics/historic_pres/documents/sec106PAs/WV.aspx.

19.3.12. West Virginia Department of Highways (WVDOH). (2016b). Tribal Consultation Guidance for the Federal Highway Administration, WV Division and the West Virginia Department of Transportation, Division of Highways. https://www.highwaysthroughhistory.com/Content/documents/WVDOH-FHWA_Tribal_Consultation_Guidance.pdf.

19.3.13. West Virginia State Historic Preservation Office (WVSHPO). (2004). Guidelines for Phase I, II, and III Archaeological Investigations and Technical Report Preparation. On file at the West Virginia Division of Culture and History, State Historic Preservation Office, Charleston.

19.3.14. West Virginia State Historic Preservation Office (WVSHPO). (2016). West Virginia National Register and Architecture / History Survey Manual. https://wvculture.org/wp-content/uploads/2021/03/manual_2016_revisions.pdf

19.4 AQUATIC RESOURCES

19.4.1. Barbour and others. (1999). U.S.EPA. Rapid Bioassessment Protocols: Habitat Assessment and Physicochemical Parameters. Pages 5-9 through 5-34. https://www.nab.usace.army.mil/Portals/63/Appendix%20B_EPA%20RBP%20Habitat%20Forms%20and%20parameters_1.pdf.

19.4.2. Cowardin, L.M., Carter, V., Golet, F.C. and LaRoe, E.T. (1979). Classification of Wetlands and Deep-Water Habitats of the United States. U.S. Fish and Wildlife Service, FWS/OBS-79/31, Washington DC. https://www.nrc.gov/docs/ML1801/ML18019A904.pdf.

19.4.3. Environmental Laboratory. (1987). Corps of Engineers Wetlands Delineation Manual. <https://usace.contentdm.oclc.org/digital/collection/p266001coll1/id/4530>.

19.4.4. Environmental Laboratory. (2012). Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0).

<https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7607>.

19.4.5. Environmental Laboratory. (2024). USACE Wetland Determination Data Sheet – Eastern Mountains and Piedmont Region. <https://www.publications.usace.army.mil/Portals/76/Users/028/00/3100/Eng_Form_6116-4_2024Feb.pdf>.

19.4.6. Summers et al. (2017). USACE Operational Draft Regional Guidebook for the Functional Assessment of High-Gradient Headwater Streams and Low-Gradient Perennial Streams in Appalachia (ERDC/EL TR-17-1). <https://usace.contentdm.oclc.org/digital/collection/p266001coll1/id/4215/#:~:text=Technical%20Reports.%20Operational%20draft>.

19.4.7. U.S. Army Corps of Engineers (2016). Regulatory Guidance Letter No. 16-01. Subject: Jurisdictional Determinations. <https://www.spn.usace.army.mil/Portals/68/docs/regulatory/resources/RGL/RGL16-01.pdf>.

19.4.8. West Virginia Department of Environmental Protection (2024). User Manual for the West Virginia Wetland Rapid Assessment Method (Version 1.24). <https://dep.wv.gov/WWE/watershed/wetland/Documents/WVWRAM_User_Manual.pdf>.

19.5 FARMLAND

19.5.1. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). Farmland Conversion Impact Rating for Corridor Type Projects NRCS-CPA-106 Form. https://forms.sc.egov.usda.gov/efcommon/eFileServices/eForms/NRCS-CPA-106NRCS-CPA-106.PDF.

19.5.2. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). Farmland Conversion Impact Rating Form AD-1006. <https://www.nrcs.usda.gov/sites/default/files/2022-06/AD1006.pdf>.

19.5.3. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). Farmland Protection Policy Act. https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/cropland/farmland-protection-policy-act.

19.5.4. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). Land Evaluation and Site Assessment.

<https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/land/evaluation-and-assessment>.

19.5.5. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). State Soil Scientists. <https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns/soils/state-soil-scientists>.

19.5.6. Natural Resources Conservation Service, U.S. Department of Agriculture (undated). West Virginia's Field Office Technical Guide. <https://efotg.sc.egov.usda.gov/#/state/WV/documents>.

19.5.7. Natural Resources Conservation Service, U.S. Department of Agriculture (2019). Web Soil Survey. <https://websoilsurvey.sc.egov.usda.gov/App/>.

19.5.8. Natural Resources Conservation Service, U.S. Department of Agriculture, Soil Survey Staff (undated). Soil Survey Geographic (SSURGO) Database. <https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-database-ssurgo>.

19.6 PUBLIC INVOLVEMENT

19.6.1. WVDOT (undated). Civil Rights Compliance website. https://transportation.wv.gov/crc/Pages/default.aspx.

19.7 SECTION 4(F)

19.7.1. 23 CFR § 774 — https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-774.

19.7.2. 23 USC § 138 — <https://www.govinfo.gov/content/pkg/USCODE-2011-title23/html/USCODE-2011-title23-chap1-sec138.htm>.

19.7.3. 36 CFR § 800 — https://www.ecfr.gov/current/title-36/chapter-VIII/part-800.

19.7.4. 49 USC § 303(c) — https://www.govinfo.gov/content/pkg/USCODE-2023-title49/pdf/USCODE-2023-title49-subtitleI-chap3-subchapI-sec303.pdf.

19.7.5. AASHTO (2009). AASHTO Practitioner's Handbook, Complying with Section 4(f) of the U.S. DOT Act. https://environment.transportation.org/resources/practitioners-handbooks/complying-with-section-4f-of-the-u-s-dot-act/.

19.7.6. Federal Highway Administration (2012). Environmental Review Toolkit – Legislation, Regulations, and Guidance: Section 4(f) Policy Paper. <https://www.environment.fhwa.dot.gov/legislation/section4f/4fpolicy.aspx>.

19.7.7. Federal Highway Administration (undated). Environmental Review Toolkit – Section 4(f) Tutorial. https://www.environment.fhwa.dot.gov/env_topics/4f_tutorial/default.aspx.

19.7.8. Federal Highway Administration (undated). Environmental Review Toolkit. Final List of Nationally and Exceptionally Significant Features of the Federal Interstate Highway System. https://www.environment.fhwa.dot.gov/env_topics/historic_pres/highways_list.aspx.

19.8 SECTION 6(F)

19.8.1. 36 CFR § 59.3 — https://www.law.cornell.edu/cfr/text/36/59.3.

19.8.2. 54 USC § 200305(f)(3) — <https://www.law.cornell.edu/uscode/text/54/200305>.

19.8.3. Land and Water Conservation Fund Coalition (undated). Map of LWCF. https://lwcfcoalition.org/map.

19.8.4. National Park Service (2019). Compliance and Stewardship (C&S) Form. https://www.nps.gov/subjects/lwcf/upload/Compliance-and-Stewardship-Form.pdf.

19.8.5. National Park Service (2023). LWCF Manual & Logos. https://www.nps.gov/subjects/lwcf/lwcf-manual.htm.

19.8.6. National Park Service (2023). Land and Water Conservation Fund State Assistance Program. https://www.nps.gov/subjects/lwcf/upload/LWCF-FA-Manual-Vol72_2023-10-01_508.pdf.

19.8.7. Public Law 88-578, 78 Stat 897 — https://www.govinfo.gov/content/pkg/STATUTE-78/pdf/STATUTE-78-Pg897.pdf.

19.9 NOISE

19.9.1. 23 CFR § 772 https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772?toc=1.

19.9.2. FHWA (2017). Highway Traffic Noise Analysis and Abatement Policy and Guidance. https://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/polguide/polguide04.cfm.

19.9.3. FHWA (2022). Avoiding, Minimizing, and Mitigating Noise from Highways. https://www.fhwa.dot.gov/ENVIRonment/noise/avoid_minimize_noise.cfm.

19.9.4. WVDOH's Design Directive DD-253, Noise Analysis and Abatement Guidelines. https://transportation.wv.gov/highways/TechnicalSupport/Pages/Design-Directives.aspx

19.10 AIR QUALITY

19.10.1. 40 CFR § 93 <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-93?toc=1>.

19.10.2. FHWA (2023). Updated Interim Guidance on Mobile Source Air Toxic (MSAT) Analysis in National Environmental Policy Act (NEPA) Documents. <https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/msat/>.

19.11 HAZARDOUS MATERIALS INVESTIGATION

19.11.1. 40 CFR Part 61, Subpart M https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-61/subpart-M.

19.11.2. 40 CFR § 745 https://www.ecfr.gov/current/title-40/chapter-I/subchapter-R/part-745?toc=1.

19.11.3. Environmental Protection Agency (2024). Chemicals under the Toxic Substances Control Act (TSCA). <https://www.epa.gov/chemicals-under-tsca>.

19.11.4. Environmental Protection Agency (2024). Cleanups in my Community. https://www.epa.gov/cleanups/cleanups-my-community.

19.11.5. Environmental Protection Agency (2011). Paint Chip Sample Collection Guide: Lead Renovation, Repair and Painting Program – October 2011. https://www.epa.gov/lead/paint-chip-sample-collection-guide-lead-renovation-repair-and-painting-program-october-2011.

19.11.6. Environmental Protection Agency (2024). Resource Conservation and Recovery Act (RCRA) Laws and Regulations. <http://www.epa.gov/rcra>.

19.11.7. Environmental Protection Agency (2024). Superfund: CERCLA Overview. https://www.epa.gov/superfund/superfund-cercla-overview.

19.11.8. Environmental Protection Agency (2024). The Superfund Amendments and Reauthorization Act (SARA). <https://www.epa.gov/superfund/superfund-amendments-and-reauthorization-act-sara>.

19.11.9. Title 64 of the West Virginia Code of State Rules Series 63.40 https://apps.sos.wv.gov/adlaw/csr/readfile.aspx?DocId=8792&Format=PDF.

19.12 COMMUNITY IMPACTS, HUMAN POPULATIONS AND TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

19.12.1. Environmental Protection Agency (2025). Environmental Justice Screening and Mapping Tool (Version 3.2022.1). <https://pedp-ejscreen.azurewebsites.net/>.

19.12.2. Environmental Protection Agency (2026a). EnviroAtlas < https://www.epa.gov/enviroatlas>.

19.12.3. Environmental Protection Agency (2026b). NEPAssist. <https://nepassisttool.epa.gov/nepassist/nepamap.aspx>.

19.12.4. Federal Highway Administration (2021). DOT 1000.12C: The U.S. Department of Transportation Title VI Program. <https://highways.dot.gov/civil-rights/title-vi-civil-rights-act-1964-and-additional-nondiscrimination-requirements>.

19.12.5. Federal Highway Administration (2022). U.S. Census – Limited English Proficiency Data Collection Walkthrough. https://highways.dot.gov/civil-rights/programs/title-vi/title-vi-toolkit-us-census-limited-english-proficiency-data.

19.12.6. U.S. Census Bureau (2024). American Community Survey. https://www.census.gov/programs-surveys/acs.

19.12.7. U.S. Census Bureau (undated). Explore Census Data. https://data.census.gov/.

19.12.8. U.S. Department of Housing and Urban Development (undated). HUD Resource Locator. https://resources.hud.gov/.

19.12.9. U.S. Department of Justice (2002). DOJ Final LEP Guidance Signed 6-12-02. https://www.justice.gov/crt/doj-final-lep-guidance-signed-6-12-02.

19.12.10. U.S. Department of Transportation (2016). DOT's LEP Guidance. https://www.transportation.gov/civil-rights/civil-rights-awareness-enforcement/dots-lep-guidance.

19.12.11. U.S. Department of Transportation (2024). Civil Rights Awareness & Enforcement information. <https://www.transportation.gov/civil-rights/civil-rights-awareness-enforcement>.

19.12.12. West Virginia Department of Transportation (2024). Title VI Program Webpage. https://transportation.wv.gov/crc/TitleVI/Pages/default.aspx.

19.13 PERMITTING

19.13.1. U.S. Army Corps of Engineers (undated). 2021 Nationwide Permits Webpage. <https://www.spk.usace.army.mil/Missions/Regulatory/Permitting/Nationwide-Permits/2021NWPs/>.

19.13.2. U.S. Army Corps of Engineers (undated). Permit Application Form 4345. https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Obtain-a-Permit/Permit-Application-Form-4345/.

19.13.3. U.S. Army Corps of Engineers (2024). Regulatory Program – West Virginia https://www.lrd.usace.army.mil/Wetlands-Permits/West-Virginia/.

19.13.4. U.S. Coast Guard (undated). Office of Bridge Programs: District Contacts. https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/Marine-Transportation-Systems-CG-5PW/Office-of-Bridge-Programs/District-Bridge-Contacts/.

19.13.5. U.S. Coast Guard (2016). Bridge Permit Application Guide. <https://www.dco.uscg.mil/Portals/9/BPAG_COMDTPUB_P16591-3D_July2016.pdf>.

19.13.6. West Virginia Department of Environmental Protection (undated). 401 Certification Overview. https://dep.wv.gov/wwe/programs/pages/401certification.aspx.

19.13.7. West Virginia Department of Environmental Protection (undated). Application for West Virginia State Waters Permit for Federally Non-Jurisdictional Waters. https://dep.wv.gov/WWE/Programs/wqs/Documents/401%20Program/Isolated%20Waters%20Application%20090315.pdf.

19.13.8. West Virginia Department of Environmental Protection (undated). Construction Stormwater General Permit Webpage. https://dep.wv.gov/WWE/Programs/stormwater/csw/Pages/home.aspx.

19.13.9. West Virginia Department of Environmental Protection (undated). Permit Fees by Precipitation Zone. https://dep.wv.gov/WWE/Programs/stormwater/csw/SiteAssets/Pages/home/Fee%20Schedule%20and%20Precipitation%20Zone%20Map.pdf.

19.13.10. West Virginia Department of Environmental Protection (2006). Erosion & Sediment Control BMP Manual. https://dep.wv.gov/wwe/programs/stormwater/csw/pages/esc_bmp.aspx.

19.13.11. West Virginia Department of Environmental Protection (2017). West Virginia Stream Disturbance Permitting Requirements. https://dep.wv.gov/WWE/Programs/nonptsource/streamdisturbance/Documents/WVStreamDisturbancePermitGuide.pdf.

19.13.12. West Virginia Department of Natural Resources (undated). Office of Land and Streams Stream Activity Application. https://wvdnr.gov/wp-content/uploads/2021/04/OLS-SAA-2020.pdf.

19.13.13. West Virginia Department of Transportation Division of Highways (2014). Design Directives. https://transportation.wv.gov/highways/TechnicalSupport/Pages/Design-Directives.aspx

19.14 ENVIRONMENTAL COMMITMENTS

19.14.1. West WVDOT (2023). West Virginia Department of Transportation Division of Highways 2023 Standard Specifications Order Form. https://transportation.wv.gov/highways/TechnicalSupport/Pages/default.aspx

19.14.2. WVDOH (undated). West Virginia Historic Bridge Website. http://www.highwaysthroughhistory.com.

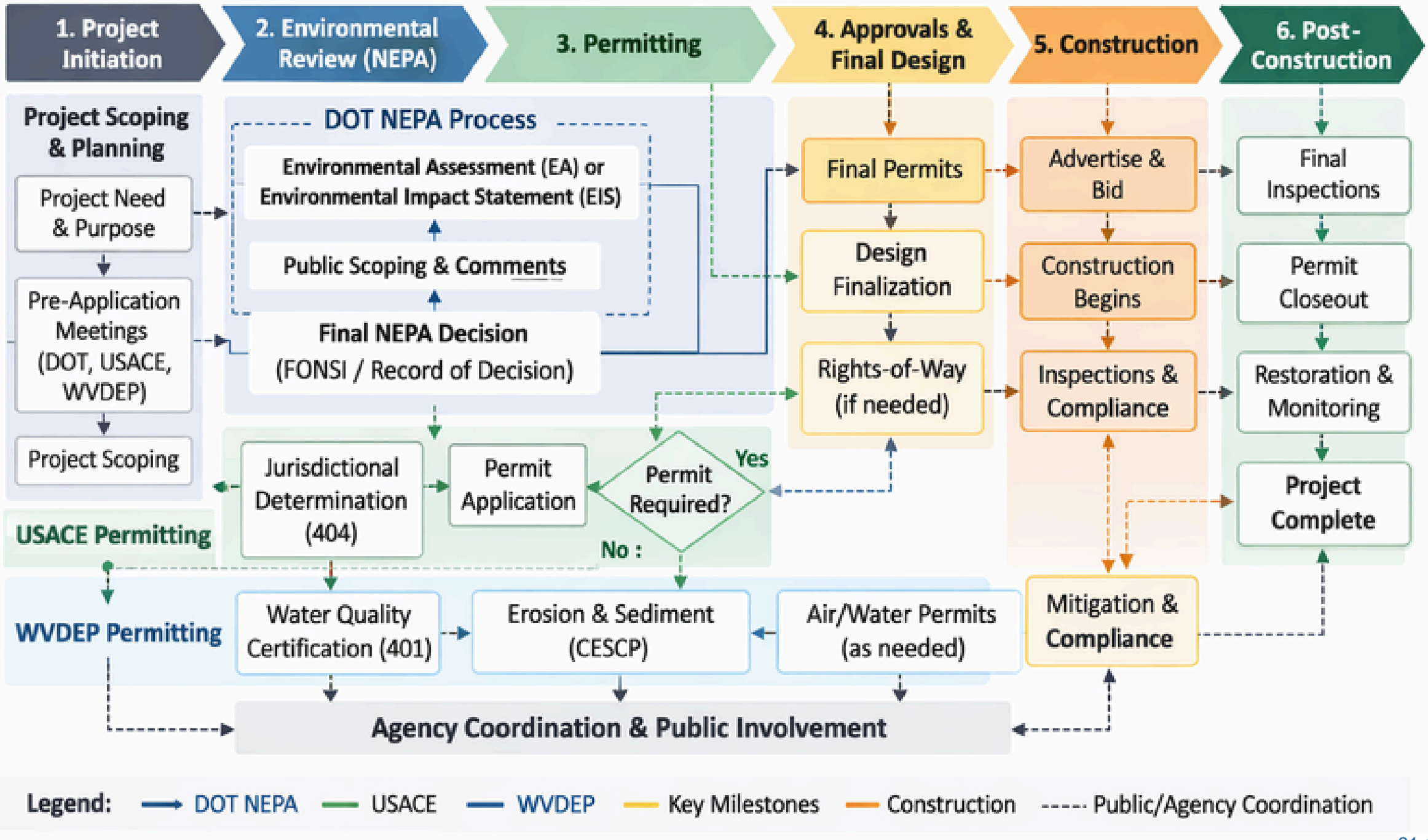
20. ATTACHMENTS / FORMS / EXAMPLES

21. FLOWCHARTS

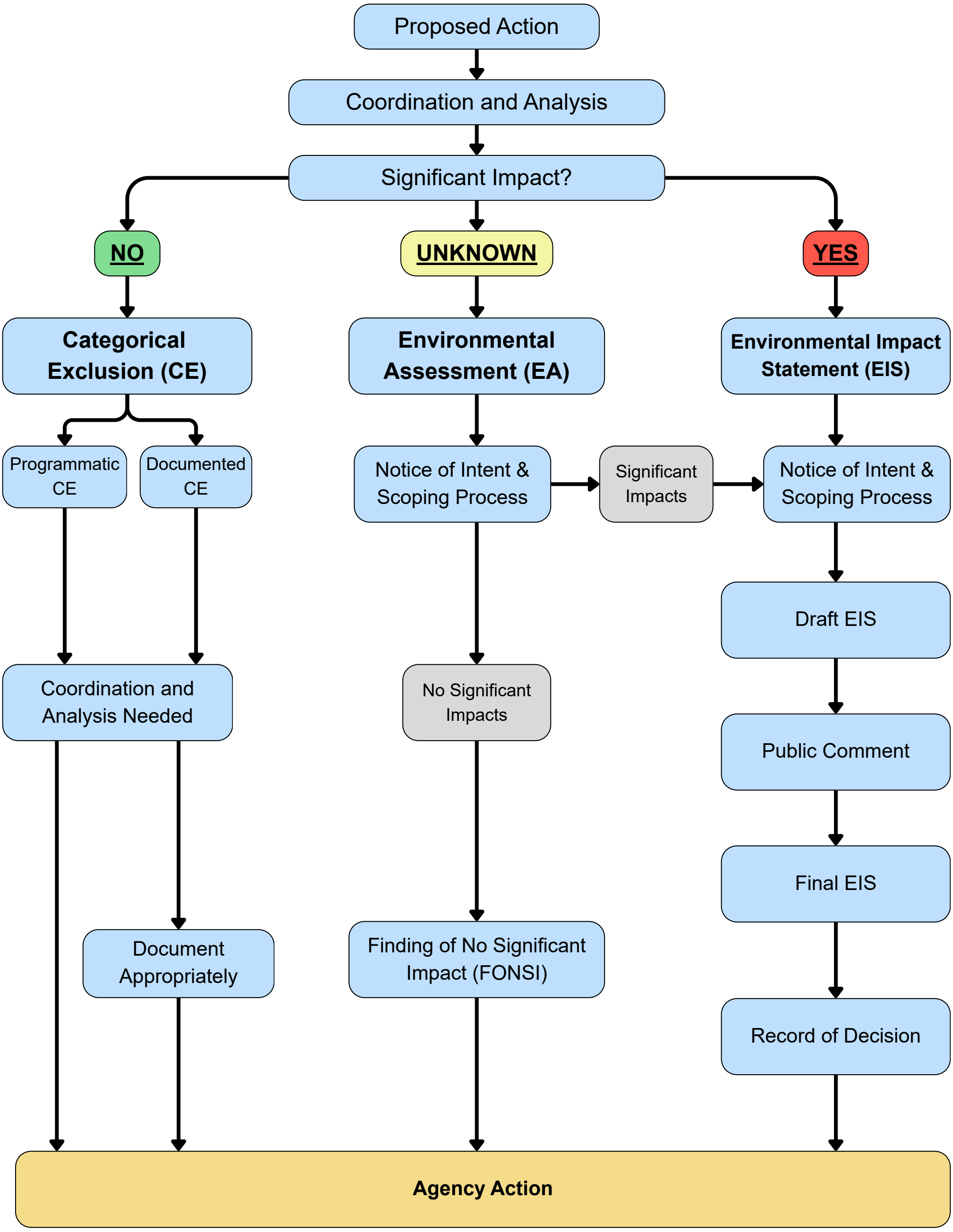
Flowchart 21.1

DOT NEPA, USACE & WVDEP Permitting Process

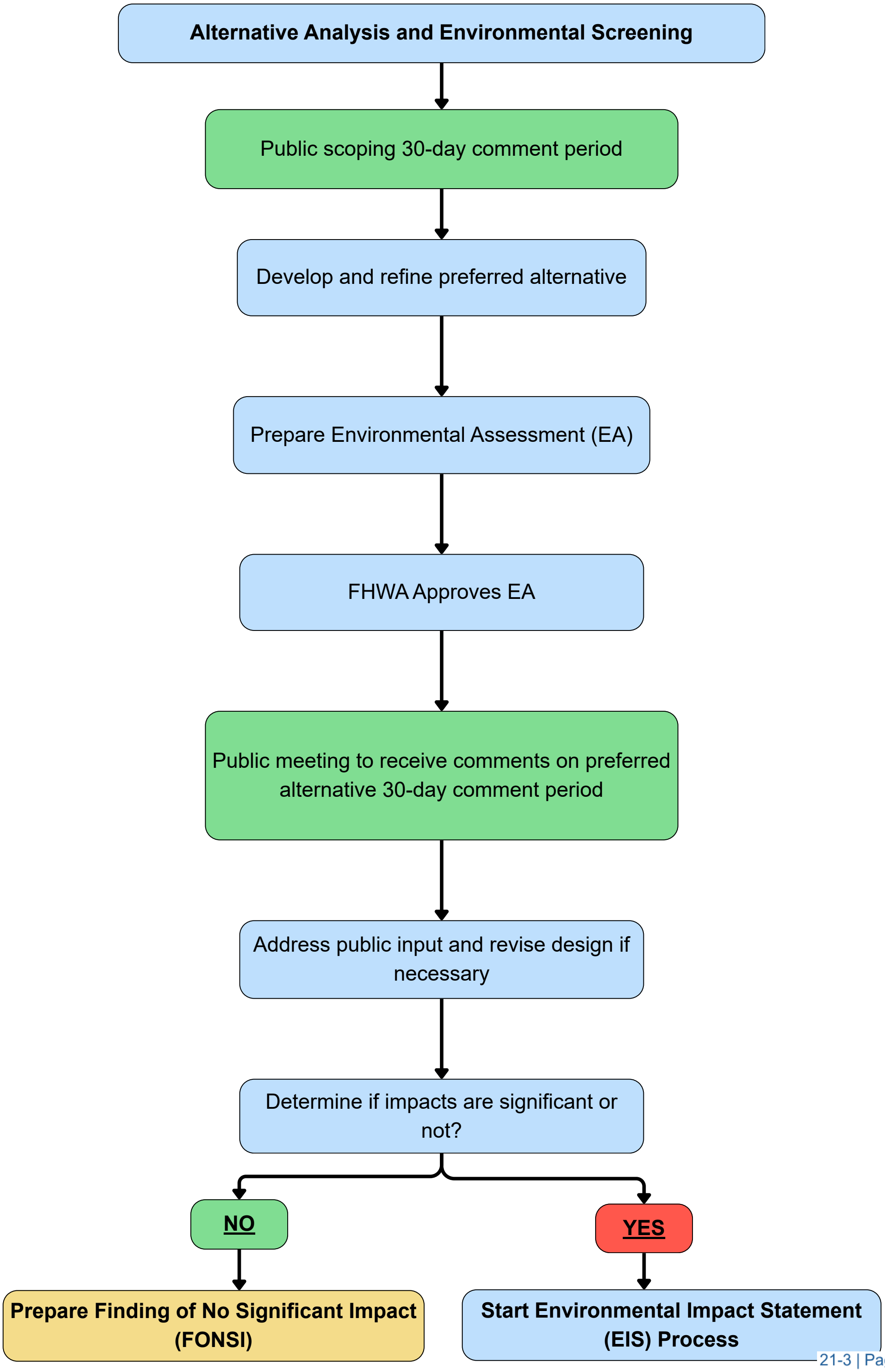
From Project Initiation to Construction



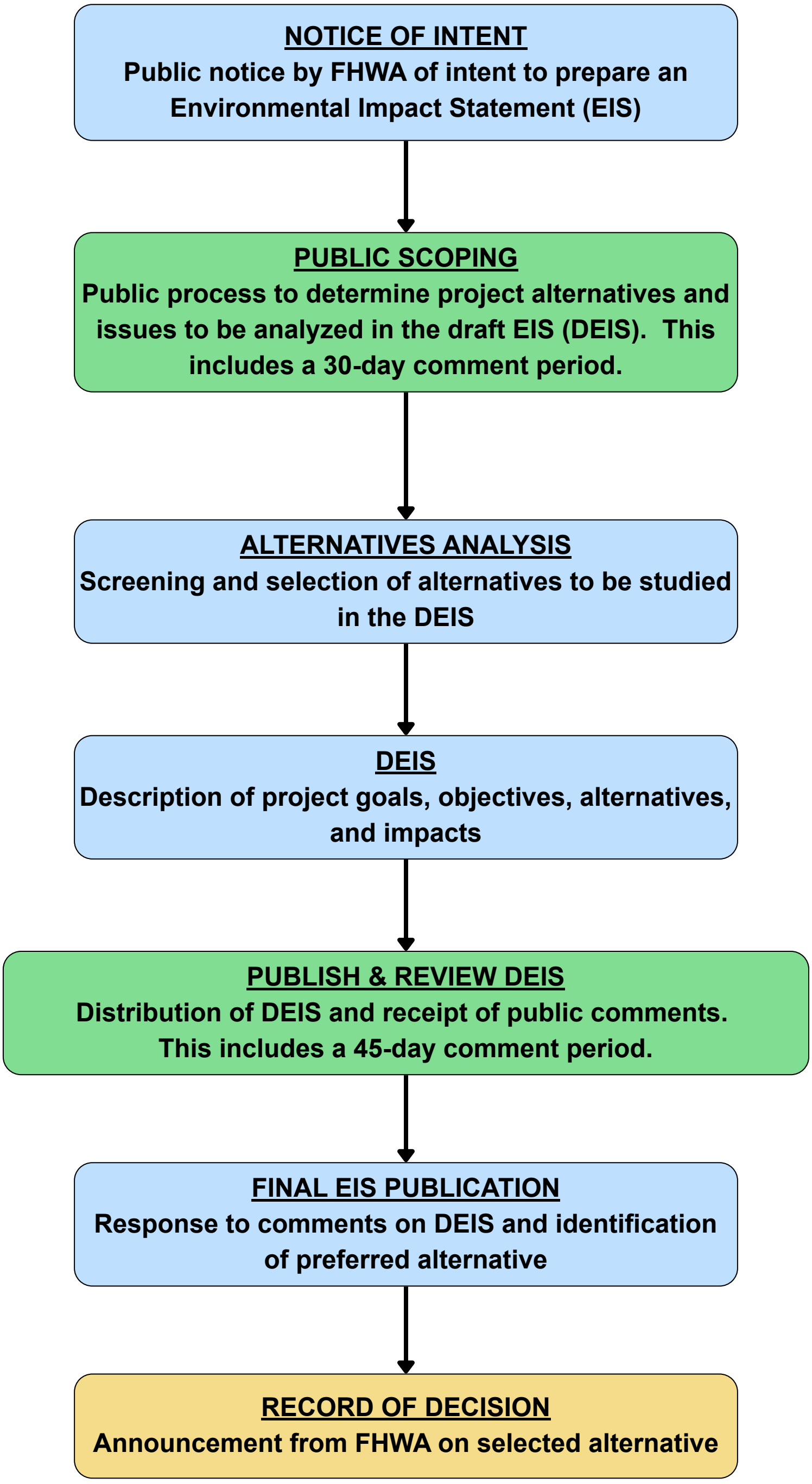
Flowchart 21.2: NEPA Process - Levels of Documentation



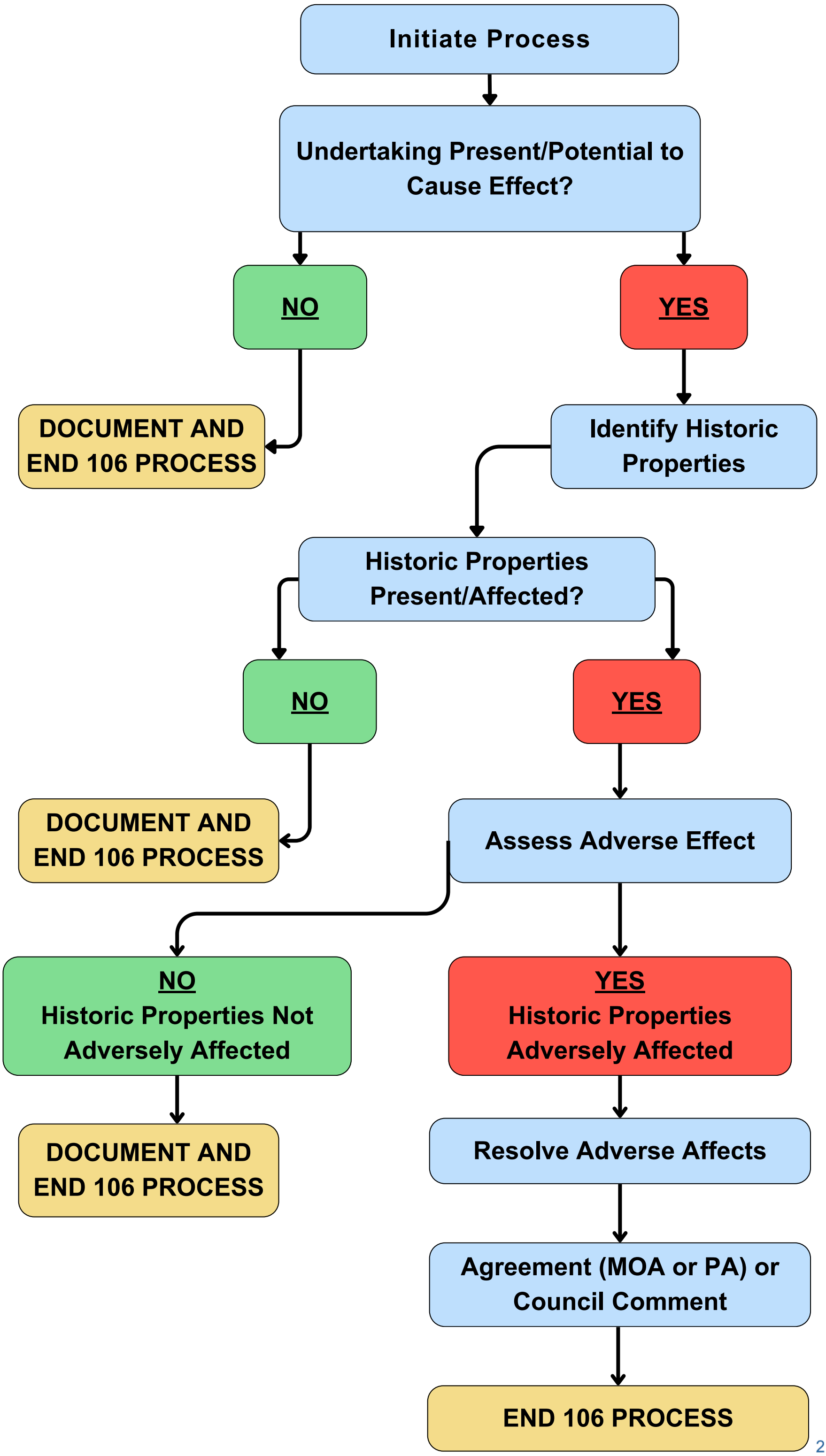
Flowchart 21.3: EA/FONSI Process



Flowchart 21.4: EIS/ROD Process



Flowchart 21.5: Section 106 Process Overview



Flowchart 21.6: Section 106 Architecture / History

WVDOH

Initial Environmental Screening of Historic Resources

Apply Pre-Screening Checklist

NO Historic Resources Present

Programmatic Agreement Applies - WVDOH Historial Completes State Review Exempt Form to Finalize NHPA Section 106 Review

WVDOH OR CONSULTANT

Historic Resources May Be Present - Project Needs Additional Review and Assessment By Historian.

NO Historic Resources Present

Programmatic Agreement Applies - WVDOH Historial Completes State Review Exempt Form to Finalize NHPA Section 106 Review

Potential Historic Resources Identified

Consultant Prepares Report for WVDOH and WVSHPO

Involve Consulting Parties and Continue Consultation Throughout Duration of the Project

NO Eligible or Listed Historic Resources Present

Programmatic Agreement Applies - WVDOH Historial Completes State Review Exempt Form to Finalize NHPA Section 106 Review

Evaluate NRHP Eligibility of Historic Resources

Eligible or Listed Historic Resources Present

NO Adverse Affect on the Historic Resource Anticipated

Document and Consult

Assess Potential Project Effects on Historic Resources

If there's No Objection, Section 106 is Concluded

Adverse Affect to Historic Resource Anticipated

If there's an Objection:

Resolve the Adverse Affect by Developing Mitigation Measures through Consultation

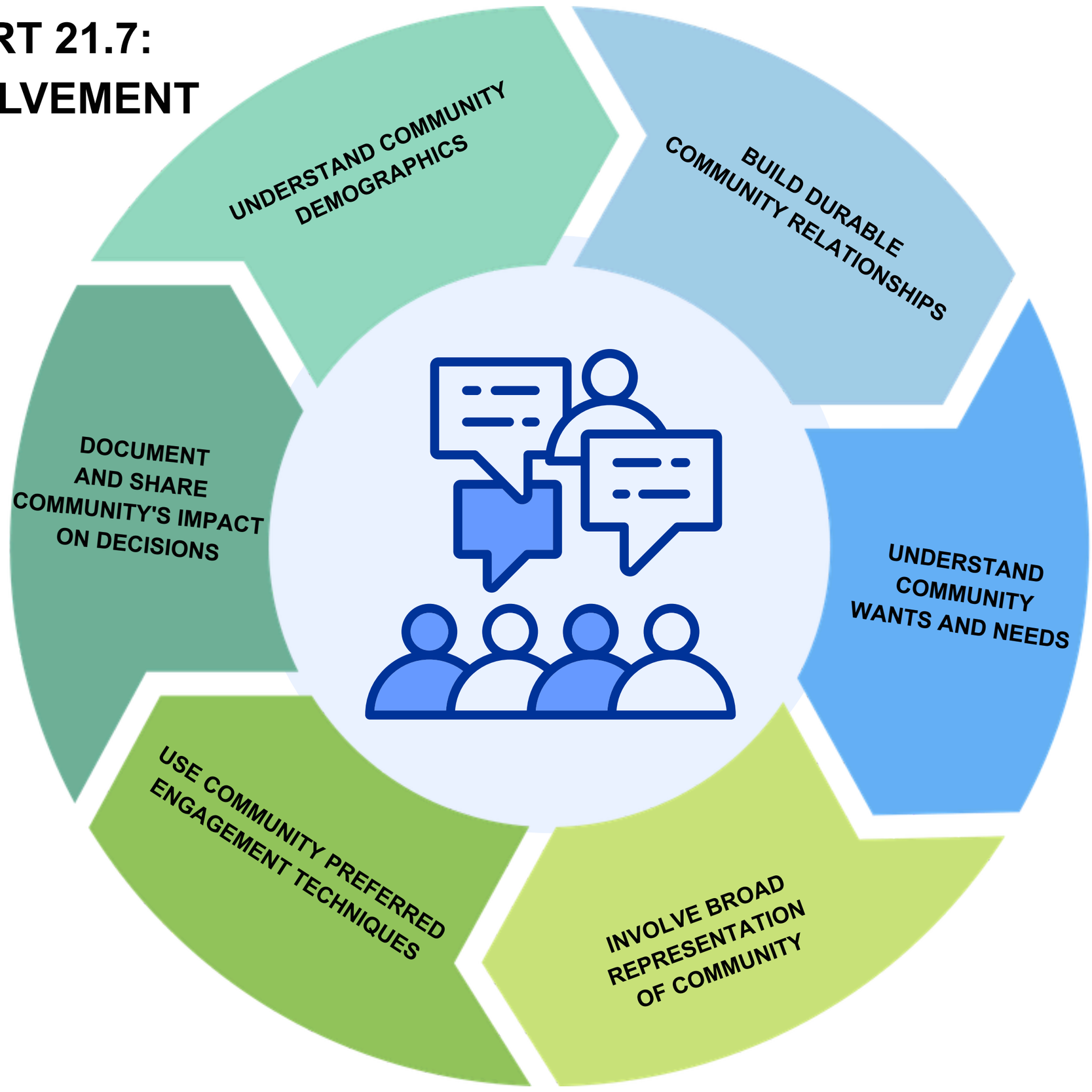
Failure to Agree

ACHP Comment

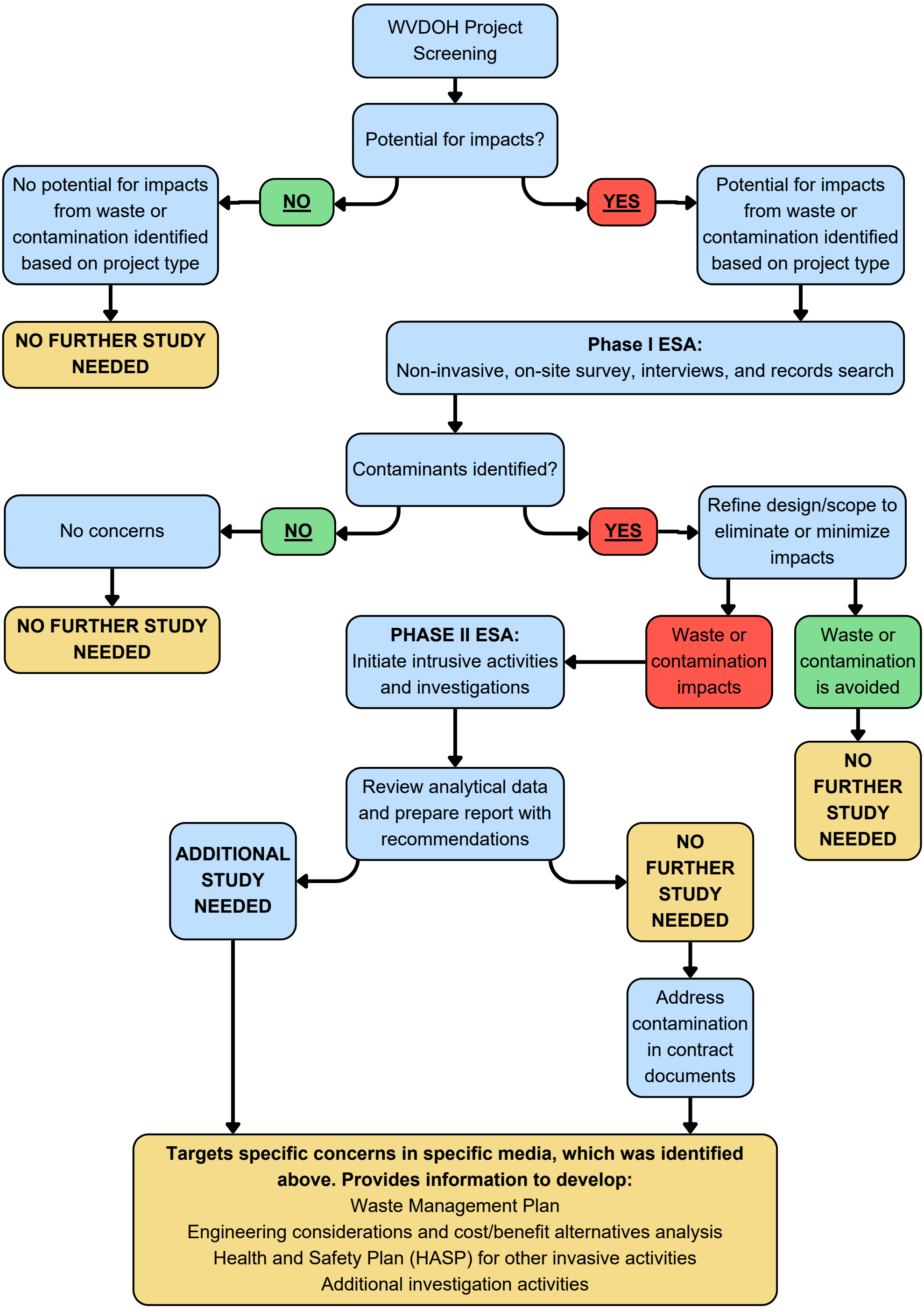
Prepare and Execult an Agreement Document

Section 106 is Concluded

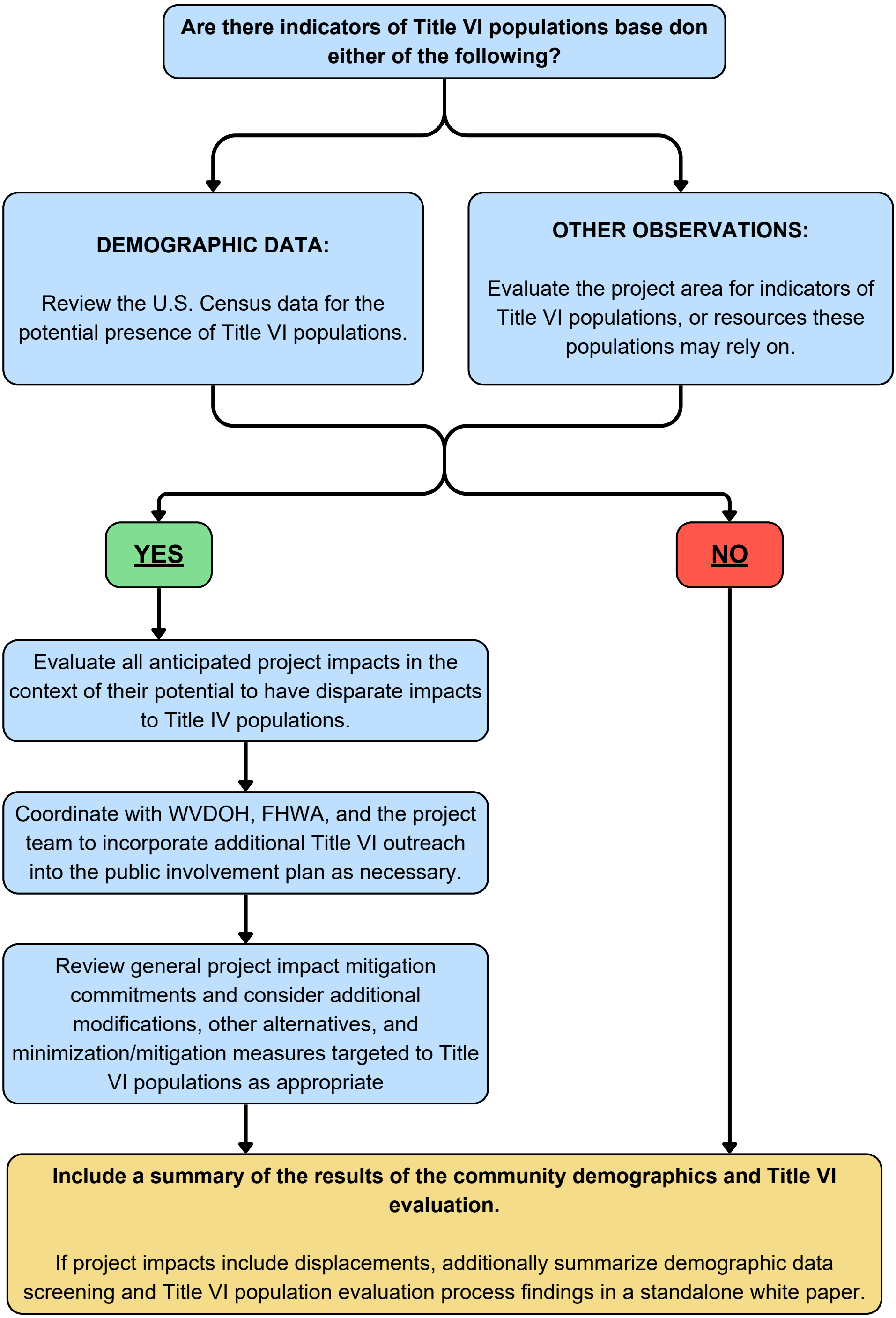
FLOWCHART 21.7:
PUBLIC INVOLVEMENT



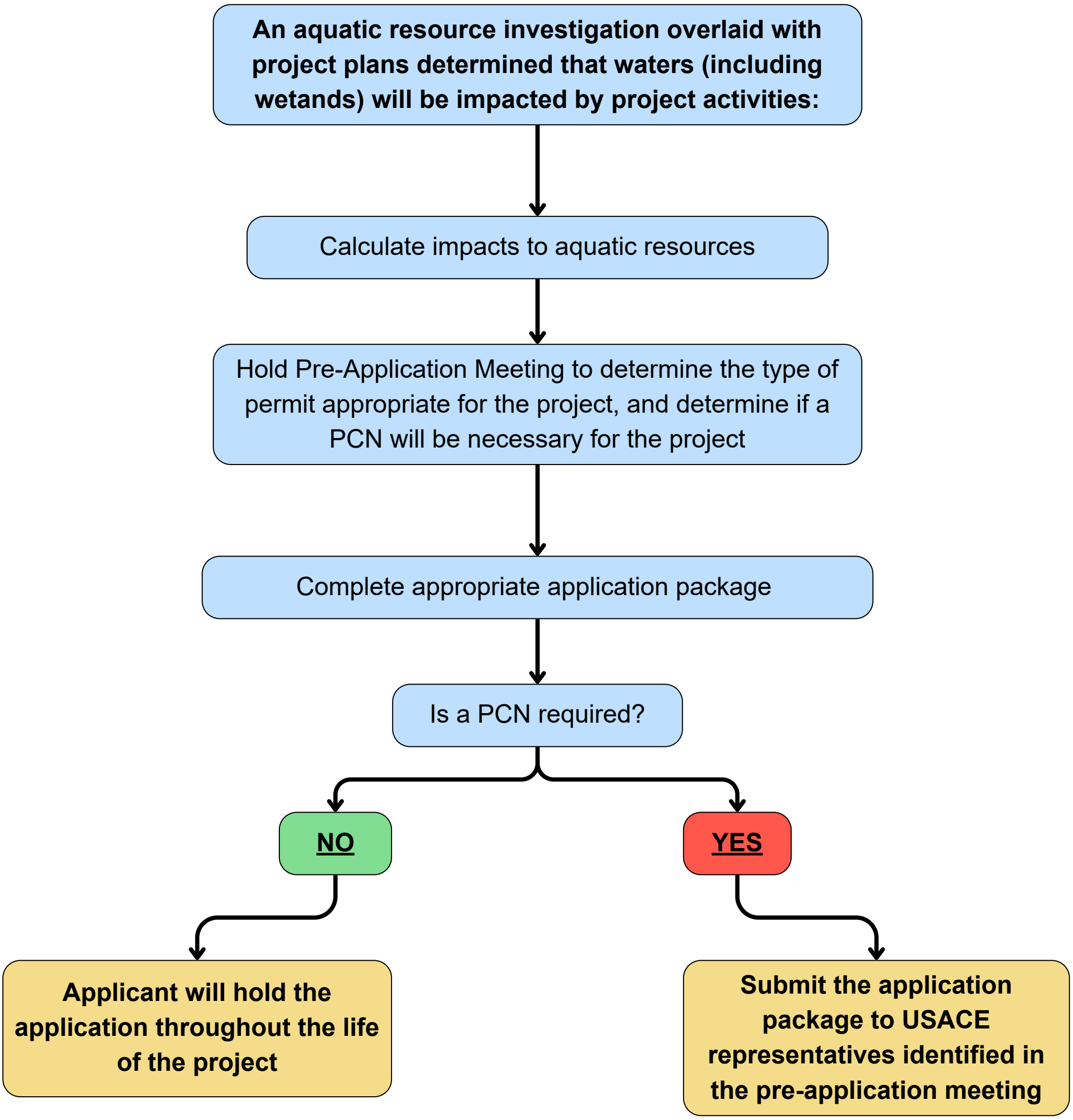
Flowchart 21.8: Hazardous Materials Investigation



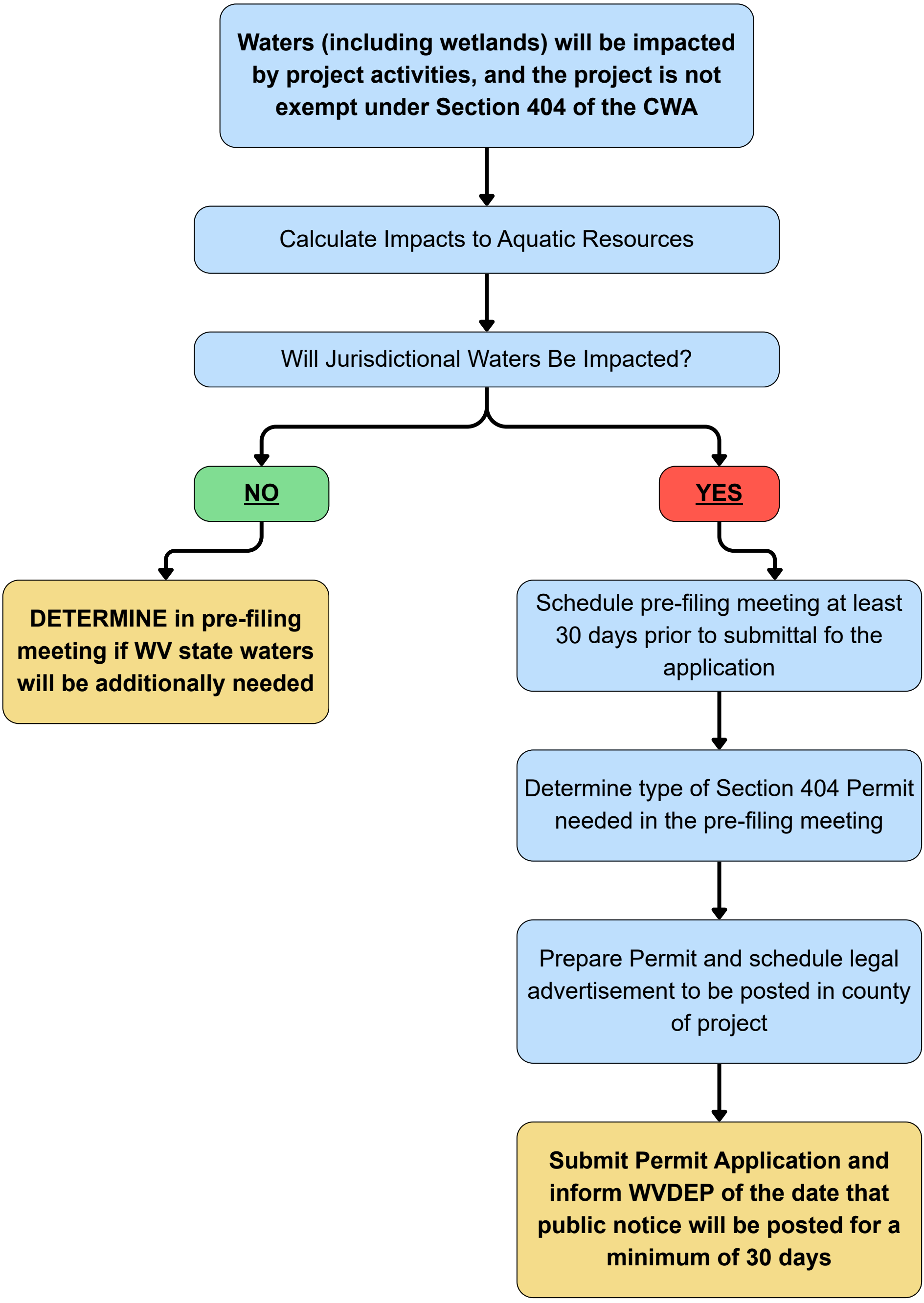
Flowchart 21.9: Title VI



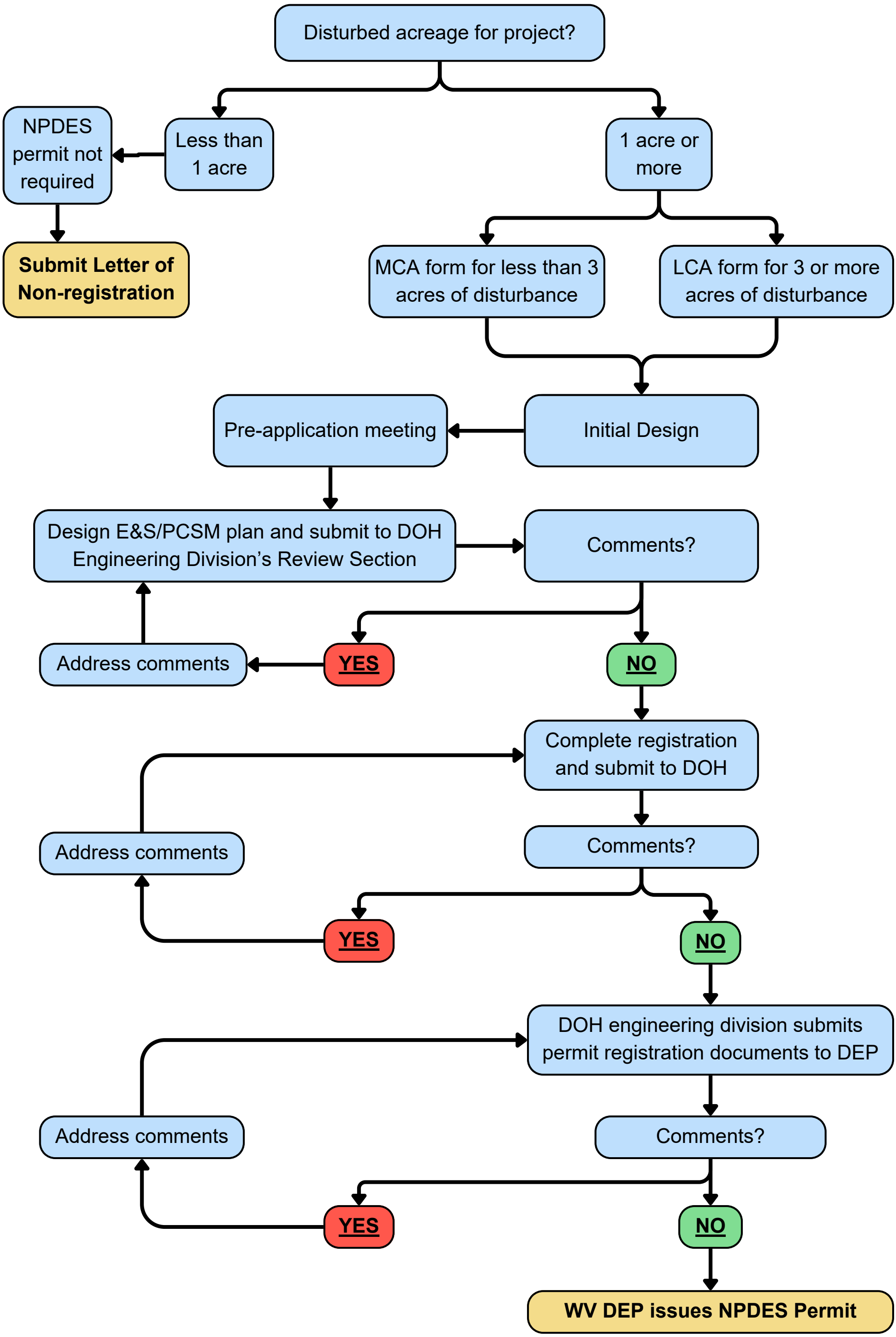
Flowchart 21.10: Section 404 Permitting Process



Flowchart 21.11: Section 401 Permitting Process



Flowchart 21.12: WV NPDES Construction Stormwater General Permit Process



SECTION BREAK

NEW BUSINESS ITEMS

Chapter 5: Storm Drainage Systems

West Virginia
Department of Transportation
Division of Highways
Drainage Manual

TABLE OF CONTENTS

5.1 INTRODUCTION 1
5.2 DESIGN POLICY AND CRITERIA 1
5.2.1 GENERAL POLICY 1
5.2.2 HYDROLOGY 1
5.2.3 DESIGN FREQUENCY 2
5.2.4 PAVEMENT GEOMETRY 2
5.2.5 INLETS 2
5.2.6 STORM DRAIN DESIGN AND MINIMUM SIZE 3
5.2.7 ACCESS STRUCTURES 3
5.2.8 HYDRAULIC GRADE LINE 4
5.2.9 OUTLET PROTECTION 4
5.3 DESIGN GUIDELINES 4
5.3.1 SYSTEM PLANNING 4
5.3.2 ROADWAY FEATURES 7
5.3.2.1 LONGITUDINAL SLOPE 8
5.3.2.2 CROSS SLOPE 9
5.3.2.3 CURB AND GUTTER 10
5.3.2.4 MEDIANS AND MEDIAN BARRIERS 11
5.3.2.5 ROADSIDE AND MEDIAN DITCHES 11
5.3.2.6 BRIDGE DECKS 11
5.3.2.7 HYDROPLANING 12
5.3.2.8 DEBRIS 13
5.3.2.9 PAVEMENT TEXTURE 13
5.3.2.10 PAVEMENT STRUCTURE 13
5.3.2.11 UNDERDRAINS 13
5.3.3 DESIGN SPREAD 14
5.3.4 DRAINAGE INLETS 18

5.3.4.1 INLET TYPES 18
5.3.4.2 INLET SPACING 21
5.3.4.3 INLET CAPACITY 23
5.3.4.4 GRATE AND COMBINATION INLET CAPACITY ON GRADE 24
5.3.4.5 CURB OPENING AND SLOTTED INLET CAPACITY ON GRADE 34
5.3.4.6 OVERLAND FLOW INLET CAPACITY 38
5.3.4.7 GRATE INLET CAPACITY IN A SAG LOCATION 46
5.3.4.8 CURB-OPENING INLET CAPACITY IN A SAG LOCATION 52
5.3.4.9 COMBINATION INLET CAPACITY IN A SAG LOCATION 59
5.3.4.10 FLANKING INLETS AT SAG LOCATION 63
5.3.5 ACCESS STRUCTURES / MANHOLES 67
5.3.5.1 HEIGHT 67
5.3.5.2 SPACING 68
5.3.6 STORM DRAINS 68
5.3.6.1 HYDRAULIC DESIGN 68
5.3.6.2 HYDRAULIC CAPACITY 70
5.3.6.3 MINIMUM VELOCITY, MINIMUM GRADES 71
5.3.6.4 HYDRAULIC GRADE LINE 71
5.3.6.5 TAILWATER 72
5.3.6.6 ENERGY LOSSES 73
5.3.6.7 MAJOR LOSSES 75
5.3.6.8 MINOR LOSSES 76
5.3.6.9 THE STATE OF FLOW 77
5.3.6.10 TOTAL HEAD LOSSES 79
5.3.6.11 MATERIALS AND ALTERNATES 79
5.3.7 ECONOMIC CONSIDERATIONS 79
5.3.8 STORM DRAINAGE IN KARST AREAS 80
5.3.9 ENVIRONMENTAL CONCERNS 80

5.3.9.1 SAFETY....80
5.3.9.2 ADA CONSIDERATIONS....81
5.3.9.3 BICYCLE SAFETY....81
5.3.10 OUTLET PROTECTION....81
5.4 INSTRUCTIONS, DESIGN FORMS, AND PROGRAMS....83
5.5 REFERENCES....110

LIST OF TABLES

TABLE 5-1 ALLOWABLE SPREAD FOR THE DESIGN SPEED....15
TABLE 5-2 GRATE INLET WEIR AND ORIFICE FLOW DETAILS....19
TABLE 5-3 COMBINATION INLET WEIR AND ORIFICE FLOW DETAILS....20
TABLE 5-4 TRANSITIONAL FLOW LINE EQUATIONS FOR TYPE A, B, C INLETS....52
TABLE 5-5 TRANSITIONAL FLOW LINE EQUATIONS FOR TYPE D & E INLETS....59
TABLE 5-6 TRANSITIONAL FLOW LINE EQUATIONS FOR TYPE F & H INLETS....63
TABLE 5-7 FLANKING WITH THE SAME EFFECTIVE PERIMETER AS THE SAG....65
TABLE 5-8 TYPE F OR A INLET IN THE SAG WITH TYPE B FLANKING....66
TABLE 5-9 TYPE F OR A INLET IN THE SAG WITH TYPE C FLANKING....67
TABLE 5-10 JOINT PROBABILITY ANALYSIS....72
TABLE 5-11 ALLOWABLE VELOCITIES OF STREAMBED MATERIAL....83

LIST OF FIGURES

FIGURE 5-1 GUTTER FLOW GEOMETRY....23
FIGURE 5-2 FLOW AREA RATIO GRATE WIDTH LESS THAN GUTTER WIDTH....26
FIGURE 5-3 INTERCEPTED FLOW WITH BYPASS....26
FIGURE 5-4 DEPTH AT 80% CAPACITY IN A SAG....47
FIGURE 5-5 AVERAGE DEPTH OVER A GRATE....48
FIGURE 5-6 FLANKING INLETS WITH SAME EFFECTIVE PERIMETER AS THE SAG INLET....64
FIGURE 5-7 HYDRAULIC DESIGN....68
FIGURE 5-8 ENERGY LOSSES IN A STORM DRAIN SYSTEM....75

FIGURE 5-9 ELEMENTARY GRAVITY WAVE 77
FIGURE 5-10 A SYSTEM ILLUSTRATION 94

DRAINAGE COMPUTATION FORMS

FORM 5-1 INLET SPACING DESIGN FORM 86
FORM 5-2 STORM SEWER, HYDRAULIC DESIGN FORM 92
FORM 5-3 STORM SEWER, HYDRAULIC GRADE LINE FORM 106
FORM 5-4 STORM SEWER, MINOR LOSSES FORM 107

LIST OF CHARTS

CHART 5-1 SPREAD AND DEPTH BASED ON A UNIFORM CROSS SLOPE.....16
CHART 5-2 SPREAD AND DISCHARGE BASED ON A UNIFORM CROSS SLOPE 17
CHART 5-3 RATIO OF FRONTAL FLOW TO TOTAL GUTTER FLOW FOR A UNIFORM CROSS SLOPE.....28
CHART 5-4 COMPOSITE CROSS SLOPE CONVEYANCE 1% - 6%.....29
CHART 5-5 COMPOSITE CROSS SLOPE CONVEYANCE 2% - 6%.....30
CHART 5-6 COMPOSITE CROSS SLOPE CONVEYANCE 4% - 6%.....31
CHART 5-7 GRATE INLET FRONTAL FLOW INTERCEPTION EFFICIENCY.....32
CHART 5-8 GRATE INLET SIDE FLOW INTERCEPTION EFFICIENCY 33
CHART 5-9 CURB OPENING & SLOTTED INLET LENGTH FOR TOTAL INTERCEPTION ..36
CHART 5-10 CURB OPENING & SLOTTED INLET INTERCEPTION EFFICIENCY.....37
CHART 5-11 CONCRETE BOX WITH TYPE A GRATE (8”, 10”).....39
CHART 5-12 CONCRETE BOX WITH TYPE A GRATE (12”, 14”).....40
CHART 5-13 CONCRETE BOX WITH TYPE A GRATE (17”, 20”).....41
CHART 5-14 CONCRETE BOX WITH TYPE C GRATE (8”, 10”) 42
CHART 5-15 CONCRETE BOX WITH TYPE C GRATE (12”, 14”) 43
CHART 5-16 CONCRETE BOX WITH TYPE C GRATE (17”, 20”) 44
CHART 5-17 CONCRETE BOX WITH TYPE P GRATE (14”).....45
CHART 5-18 CONCRETE BOX WITH VANE STYLE GRATE (14”) 46
CHART 5-19 TYPE A GRATE INLET IN A SAG LOCATION 49

CHART 5-20 TYPE B GRATE INLET IN A SAG LOCATION 50
CHART 5-21 TYPE C GRATE INLET IN A SAG LOCATION 51
CHART 5-22 TYPE D CURB-OPENING INLET IN A SAG LOCATION.....54
CHART 5-23 TYPE E (6', 8') CURB-OPENING INLET IN A SAG LOCATION.....55
CHART 5-24 TYPE E (10', 12') CURB-OPENING INLET IN A SAG LOCATION.....56
CHART 5-25 TYPE E (14', 16') CURB-OPENING INLET IN A SAG LOCATION.....57
CHART 5-26 TYPE E (18', 20') CURB-OPENING INLET IN A SAG LOCATION.....58
CHART 5-27 TYPE F (2' WIDE, 6% GUTTER) COMBINATION INLET IN A SAG LOCATION.....61
CHART 5-28 TYPE H (2' WIDE, 6% GUTTER) COMBINATION INLET IN A SAG LOCATION.....62
CHART 5-29 LENGTH OF BLANKET FOR OUTLET PROTECTION 82
CHART 5-30 HYDRAULIC ELEMENTS FOR PARTIALLY FULL CIRCULAR STORM DRAINS.....108
CHART 5-31 HYDRAULIC ELEMENTS: EXAMPLE 109

CHAPTER 5 STORM DRAINAGE

5.1 INTRODUCTION

The primary goal of storm drainage design is to limit the amount of water on the traveled way so that the passage of traffic is not interrupted for the design storm. This is accomplished by:

- Provide adequate profile grade and cross slope to ensure proper drainage. Special attention should be given to superelevation transition zones.
- Placing inlets at appropriate locations and at appropriate intervals to intercept flow and control the spread of water on the roadway.
- Properly sizing a storm drain conduit to convey flow from the inlets to a suitable outfall location.
- Providing an outfall with acceptable backwater conditions

The most serious effects of an inadequate roadway drainage system are:

- Damage to surrounding property resulting from water overflowing the roadway curb
- Erosion at pipe outlets
- Risk of accidents and traffic delays due to excessive spread or flow of water along the roadway
- Weakening of the roadway base and sub-grade due to saturation from frequent ponding of long duration

5.2 DESIGN POLICY AND CRITERIA

5.2.1 GENERAL POLICY

Highway storm drainage facilities shall be designed to collect storm water runoff and convey it in a manner that adequately drains the roadway and minimizes the potential for adverse effects to adjacent properties and traffic service requirements.

5.2.2 HYDROLOGY

The Rational Method should be used for the design of storm drainage systems with inlet drainage areas of 200 acres or less. The minimum time of concentration shall be 5 minutes. Areas larger than 200 acres should use the TR-55 Method. Storm drainage systems involving detention storage shall require the development of a runoff hydrograph.

5.2.3 DESIGN FREQUENCY

Pavement drainage and inlet spacing shall be designed for a 10-year frequency. The design frequency for storm drains shall also be designed for a 10-year frequency. When a storm drain drains a sag location or depressed area of the roadway that may be subject to ponding, a 50-year frequency shall be used. It is important to note that the storm sewer outlet pipe from an inlet in a sag location or depressed area should also be designed for a 50-year frequency.

5.2.4 PAVEMENT GEOMETRY

Longitudinal slope and gutter grades in curbed pavements shall not be less than 0.5 percent. The minimum longitudinal slope in sag vertical curves shall not be less than 0.3 percent within 50 feet of the level point in the curve. The minimum longitudinal slope in extremely flat crest vertical curves shall not be less than 0.3 percent.

The minimum longitudinal slope for bridge deck drainage shall be 0.5 percent. Zero gradients, sag vertical curves, and superelevation transitions with flat pavement sections shall be avoided on bridges. The coincidental occurrence of superelevation transitions and sag points or zero grades shall be avoided on pavements.

The minimum pavement cross-slope shall not be less than 2 percent except during the occurrence of a superelevation transition. Maximum allowable cross slope on superelevated sections shall be 8%.

5.2.5 INLETS

Inlets shall be spaced along a curb, median barrier, or bridge parapets on continuous grades to pick up flow as it accumulates. Curbs and inlets shall be used where runoff from the pavement could erode highway fill slopes and/or to reduce the right-of-way needed for shoulders and roadside ditches.

In addition to inlets spaced along a curb, the following locations shall require inlets:

- Immediately upstream of median breaks, crosswalks, street intersections, and bridges.
- Immediately downstream of a bridge to prevent water from the bridge deck from eroding the roadway shoulder.
- Immediately before the pavement cross slope reverses in a transition to prevent accumulated flow from crossing the pavement.
- In pavements with sag points in the gutter grade.
- Behind curbs, shoulders, or sidewalks to drain low areas.
- At concentrated flow interception points for offsite flow sources.

Depressions of grate and curb inlets shall be located outside the through traffic lanes to minimize the shifting of vehicles attempting to avoid them.

Grate inlets should be bicycle safe unless located on highways where bicycles are not permitted.

5.2.6 STORM DRAIN DESIGN AND MINIMUM SIZE

Storm drain systems shall have adequate capacity to accommodate the design runoff that enters the system. Where feasible, storm drains shall be designed to avoid existing utilities that are to remain in place. The minimum horizontal clearance shall be at least equal to the pipe diameter when the system is parallel to an underground waterline. When the storm drain system crosses a waterline, the minimum clearance shall be at least equal to the utility pipe or utility casing diameter or 1 foot, whichever is greater. Coordination with utility companies is required.

Storm drains shall be designed to prevent sedimentation in the conduit. Leak resistant joints are required in accordance with ASTM C443 or C877 for rigid pipes and ASTM D3212 for flexible pipes.

The minimum size of storm drain conduit shall be 18 inches in diameter (or its equivalent for non-circular shapes) parallel to or generally along the direction of travel of a multi-lane or two-lane highways. Storm drain conduit which drains the first inlet in a series or a lone inlet may be 15 inches in diameter with approval by the Engineering Division. Storm drain conduit which crosses a multi-lane highway shall be a minimum of 24 inches in diameter. Storm drain conduit which crosses a two highway shall be a minimum of 18 inches in diameter. Conduit size shall not decrease in the downstream direction (regardless of the available pipe gradient) thus a connection to an existing multi-lane crossing is subject to this rule. In cases where a downstream existing conjoining pipe to the multi-lane crossing is of a smaller diameter, the decision for possible length of downstream improvement shall be made with approval by the Engineering Division. The conduit design depth of flow (normal depth) shall be equal to or less than 0.8 of the diameter (0.8D).

The following two cases cause the storm drain conduit to function as a culvert and be subject to the criteria of Chapter 8. If no inflow pipe is connected to the inlet structure (grate is the only source of the inflow, thus a leg of the system) the storm drain conduit is designed as a culvert. If the inlet structure has an offsite source of inflow from a stream or natural water course, the storm drain conduit is designed as a culvert.

Storm drain outfalls shall be designed to ensure that the potential for erosion is minimized.

5.2.7 ACCESS STRUCTURES

The maximum spacing of storm drain access structures, whether manholes or inlets, shall not be more than 400 feet for 12-inch through 54-inch diameter storm drains and shall not be more than 800 feet for storm drains 60 inches and larger in diameter. Minimum manhole diameter shall be determined by the maximum pipe size and the deflection angle of the pipes, but in no case should the diameter be less than 4 feet.

5.2.8 HYDRAULIC GRADE LINE

The hydraulic grade line shall be checked for all storm drain systems. The storm drain shall be designed such that the hydraulic grade line does not exceed any critical elevation for the design storm. A critical elevation is defined as the point above which there would be unacceptable flooding of the traveled way or adjoining property. This includes the tops of manholes, junctions, and inlets. Because the inlet design is predicated on free-fall conditions, the hydraulic grade line for a particular design frequency shall not exceed an elevation that interferes with the proper functioning of the inlet (see Section 5.3.6.4).

5.2.9 OUTLET PROTECTION

Rock channel protection at the outlet of storm drain pipe is essential to the protection of the downstream channel. It protects the channel from erosion due to scour from high velocity flows. This is accomplished by reducing the velocity of the flow to an acceptable level before it enters the downstream channel. For these structures to work properly, it is essential that these rocks remain stable and have enough resistance to shear forces to handle peak flows during large rain events.

5.3 DESIGN GUIDELINES

5.3.1 SYSTEM PLANNING

System planning is critical prior to commencing the design of a storm drainage system. The design of any storm drainage system should involve the accumulation of basic data, familiarity with the project site, a basic understanding of hydrologic and hydraulic principles, and the applicable drainage policies and design criteria.

5.3.1.1 DESIGN APPROACH

The typical steps of the design process for a storm drainage system are listed below:

Step 1: Collect data

- Coordinate with other agencies.
- Conduct site survey, including the existing drainage system, if present.
- Evaluate existing drainage system for comparison of effects of proposed improvements.

- Determine and document effects of offsite drainage on the project.

Step 2: Draw preliminary layout.

- Locate inlets and determine spacing.

Step 3: Prepare the plan layout of the proposed storm drainage system:

- Locate pipe outfall.
- Layout the existing drainage system if present.
- Determine the direction of flow.
- Locate existing utilities.
- Locate connecting mains.
- Locate manholes.

Step 4: Size pipes

Step 5: Calculate the hydraulic grade line.

Step 6: Prepare plans and documentation.

5.3.1.2 DATA COLLECTION

The designer should become familiar with the land use patterns, the nature of the physical development, the area to be served by the storm drainage system, local storm water management plans, and the ultimate pattern of drainage (both overland and by storm drains) to some existing outfall location. Furthermore, the designer should understand the nature of the outfall location since it usually has a significant influence on the storm drainage system. Environmentally sensitive areas must comply with applicable water quality rules and regulations.

One or more field reviews and a topographic survey are generally required before beginning the design of a storm drainage system. Research should be conducted to obtain existing topographic maps from sources such as the United States Geological Survey (USGS), Natural Resource Conservation Service (NRCS), municipalities, county governments, or private developers.

Developers and governmental planning agencies should be consulted regarding drainage and development plans for the area in question. The physical characteristics of rapidly growing urban areas can change drastically in a short time. For such areas, the designer should consider future development in the storm drainage design. Comprehensive stormwater management plans, land use zoning, and floodplain ordinances should be reviewed, if available.

5.3.1.3 PRELIMINARY LAYOUT

Preliminary layout sketches or schematic diagrams showing the basic components of the system can be useful to the designer. Unless the proposed system is very simple and small, the preliminary layout should not be ignored. Such sketches should show:

- watershed areas and land use
- existing drainage patterns and problems
- plan and profile of the roadway
- street and driveway layout with respect to the project roadway
- underground utility locations and elevations
- locations of proposed retaining walls, bridge abutments and piers
- logical inlet and access hole locations
- preliminary lateral and trunk line layout
- clear definition of the outfall location and characteristics

The preliminary layout sketches should be included in the final design documentation. It should be reviewed for conflicts in conjunction with the traffic staging plans and the soils report recommendations.

5.3.1.4 SPECIAL CONSIDERATIONS

Special attention should be directed toward avoiding utilities and deep cuts. Some cases may require maintenance of traffic, including temporary bypasses and temporary drainage during the construction phase. Special consideration should also be given to the actual trunk line layout and its constructability regarding the maintenance of the traffic plan. Some sites may require a trunk line on both sides of the roadway with very few laterals while others might require a single trunk line. Such requirements are usually a function of the project cost but may also be controlled by other physical features.

5.3.2 ROADWAY FEATURES

The roadway right-of-way can generally be divided into the roadway pavement and the roadside. The roadway pavement generally consists of the travel lanes, shoulders, parking lanes, bicycle lanes, the median area, and the curb. The roadside generally consists of pedestrian sidewalks, and drainage ditches.

Roadway features that should be considered for pavement drainage calculations include:

- Longitudinal Slope

- Cross Slope
- Curb and Gutter Sections
- Medians and Median Barriers
- Roadside and Median Ditches
- Bridge Decks
- Hydroplaning
- Debris
- Pavement Texture
- Pavement Structure
- Underdrains

The pavement width, cross slope, and profile control the time it takes for the stormwater to drain to the gutter section. The gutter cross-section and longitudinal slope control the quantity of flow that can be carried in the gutter section.

5.3.2.1 LONGITUDINAL SLOPE

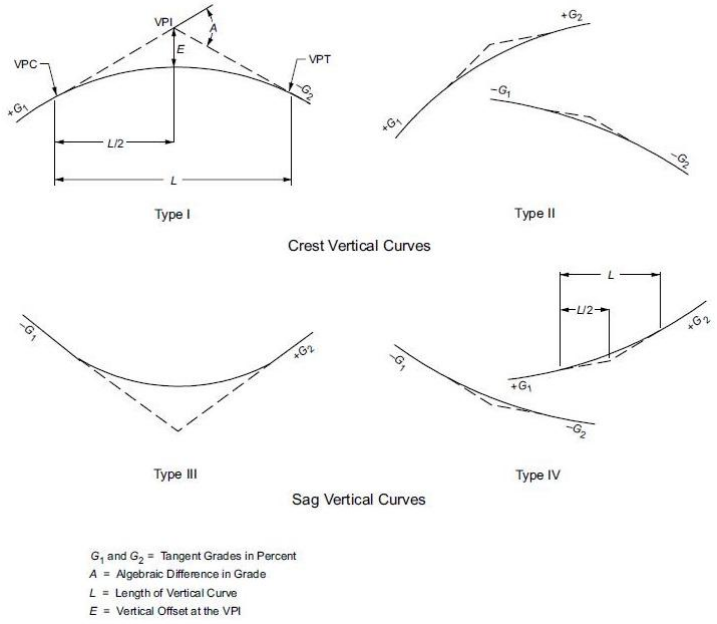
The minimum longitudinal slope should be maintained to facilitate good pavement drainage. This is more important for curbed pavements because they are susceptible to the spread of stormwater against the curb. Flat gradients in curbed sections can lead to ponded conditions and poor drainage. Flat gradients on uncurbed pavements can also lead to the ponding if vegetation can build up along the pavement edge. Minimum grades can be maintained in very flat terrain by using a rolling profile.

5.3.2.2 SAG AND CREST VERTICAL CURVES

Type I and Type III vertical curves demand special attention when Grade 1 and Grade 2 are flat longitudinal slopes (such as ±0.75% to ±0.5%). The crest or sag of these curves can possess a level area at the point of intersection. This level area is prone to slow the drainage of runoff causing a depth of sheet flow which can induce hydroplaning.

Figure 5-1

Types of Vertical Curves



A minimum longitudinal slope of 0.3 percent within 50 feet on either side of the level point in the crest or sag vertical curves (mentioned in Section 5.2.4) can be verified by dividing the length of the vertical curve by the algebraic difference in grades. This value is the rate of vertical curvature (K value) and it will be equal to or less than 167 for the stated criteria. For crest or sag vertical curves with K values larger than 167 (usually higher design speed facilities) the hydroplaning risk demands more attention to the surface drainage. This is termed the Drainage Maximum K value. Beyond a K value of 167 additional measures should be taken at the crest or sag curve, such as increasing the cross slope or increasing the micro-texture of the pavement with a high friction surface treatment to reduce the hydroplaning risk.

5.3.2.3 CROSS SLOPE

Crowned sections require drainage design for both sides of the highway, which may complicate traversing at-grade intersections due to several abrupt changes in the cross section. Flatter cross slopes can improve the ability to traverse highway intersections and are

better suited for divided highways with wide depressed medians and full or partial access control.

Proper cross slope is very important in providing adequate drainage by removing water from the pavement. Pavement cross slope will vary with the road surface material. Drainage of superelevated pavements requires careful consideration.

A uniform slope toward the outside edge of the pavement can improve the ability to traverse at-grade intersections. This requires drainage design for one side of each roadway. But with each lane contributing to runoff, the potential for hydroplaning is increased. Freeze-thaw periods can also create a safety problem when snow plowed to the median melts and drains across the travel lanes.

On multi-lane pavements with normal crown sections when three or more lanes are inclined in the same direction, it is desirable that each successive pair of lanes have an increased cross-slope. The two lanes adjacent to the crown line should be pitched at the normal slope and successive lane pairs should be pitched at an increased slope of about 0.5 to 1%. Cross slope breaks should preferably be at two lanes, with three lanes as the upper limit.

The hazard potential due to hydroplaning should be considered in superelevated curve transitions and areas with flat profile grades and wide pavement sections. The design should be carefully checked to minimize the number and length of flat pavement sections in cross-slope transition areas. Consideration should be given to increasing cross-slopes in sag vertical curves, crest vertical curves, and in sections of flat longitudinal grades.

5.3.2.4 CURB AND GUTTER

The use of a curb and gutter is normal practice for low-speed urban highways. Curbs on the outside edge of pavements contain and control surface runoff within the roadway section and direct it away from adjacent properties.

The curb and gutter form a triangular channel that can efficiently convey runoff of a lesser magnitude without interrupting the flow of traffic. Flow in gutters is governed by the principles of open channel flow. When a design storm flow occurs, the water can spread across the gutter width, shoulders, parking lanes and portions of the travel lanes. The gutter may have a uniform cross-slope with the same slope as the adjacent pavement, or a composite cross-slope with a steeper slope than the adjacent pavement. The total width of the flow spread is controlled by the proper placement of inlets.

It is desirable to intercept runoff from cut slopes and other areas draining toward the roadway before it reaches the curbed section, thereby minimizing sediment and other debris on the roadway and reducing the amount of water that must be carried in the gutter section.

5.3.2.5 MEDIANS AND MEDIAN BARRIERS

Medians are commonly used to separate opposing lanes of traffic on divided highways. Where median barriers are used, it is necessary to provide inlets and connecting storm drains to collect water that accumulates against the barrier. Slotted drains adjacent to the median barrier can also be used for this purpose.

5.3.2.6 ROADSIDE AND MEDIAN DITCHES

Roadside ditches or swales may be used where curbs are not needed for traffic control. The advantages include: a lesser hazard to traffic than a near-vertical curb and hydraulic capacity that is not dependent on the pavement spread. Ditches can be used in cut sections, depressed sections and other locations where sufficient right-of-way is available and driveways or intersections are infrequent.

It is preferable to slope median areas and inside shoulders to a center swale to prevent drainage from running across the pavement. This is particularly important for high-speed facilities and facilities with more than two lanes of traffic in each direction.

5.3.2.7 BRIDGE DECKS

Bridge deck drainage is similar to roadway sections with a curb. Deck drainage is often less efficient due to flatter cross slopes and smaller drainage inlets (scuppers) that have a higher potential for clogging from debris. It is difficult to provide and maintain adequate deck drainage systems; therefore, gutter flow from the roadway should be intercepted before it reaches a bridge. In many cases, deck drainage must be carried over several spans to the end of the bridge for disposal.

Many bridges may not require any drainage structures. To determine the permitted length of deck without drainage structures and without exceeding the allowable spread, the following equation may be utilized.

$$L = \frac{24400\left(S_x^{1.67}\right)\left(S^{0.5}\right)\left(T^{2.67}\right)}{CnIW}$$

This equation is based on a uniform cross slope (FHWA Report No. RD-79-31, 1979).

L = length of deck (ft)

S_x = cross slope (ft/ft)

S = longitudinal slope along the toe of the parapet (ft/ft)

T = allowable spread (ft)

C = runoff coefficient

n = Manning's Roughness Coefficient

I = rainfall intensity (in/hr)

W = width of drained deck (ft)

The use of scuppers should be evaluated for site-specific concerns. Scupper outlets should not be located over driving lanes, embankments, near pier foundations, navigation channels, railroad tracks, or other sensitive locations. More detailed guidance on the design of bridge deck drainage can be found in Chapter 10, Section 10.6.

5.3.2.8 HYDROPLANING

Hydroplaning occurs when water causes vehicle tires to lose contact with the pavement surface. The National Transportation Safety Board reports that about 13% of fatal accidents and 25% of all accidents occur on wet pavements. The Urban Drainage Design Manual (HEC-22) published by the FHWA should be consulted for a more detailed discussion on hydroplaning. The National Cooperative Highway Research Program (NCHRP) Research Project 1-29, “Improved Surface Drainage of Pavements,” suggests that hydroplaning conditions can develop for relatively low vehicle speeds and at low rainfall intensities for storms that frequently occur each year. Analysis methods developed through this research effort provide guidance in identifying potential hydroplaning conditions. Wide pavement sections are especially prone to hydroplaning conditions during high intensity rainfall. Some of the primary factors controlling hydroplaning are:

- Vehicle speed
- Tire conditions (pressure and tire tread)
- Pavement micro and macro texture
- Roadway geometries (pavement width, cross slope, grade)
- Pavement conditions (rutting, depressions, roughness)

Since speed is an important factor that affects hydroplaning, it is the responsibility of the driver to exercise caution while driving during wet conditions. Designers do not have control over all the factors involved in hydroplaning. However, many remedial measures can reduce hydroplaning potential. The following guidance should be considered in accordance with the AASHTO Policy on Geometric Design of Highways:

- Maximize transverse slope on pavement
- Maximize pavement roughness
- Limit spread on the traveled way (inlet spacing)

- Maximize interception of gutter flow above superelevation transitions
- Limit duration and depth of ponded water in sag locations
- Limit depth and duration of overtopping flow

5.3.2.9 DEBRIS

The potential for debris should be considered when selecting the type of inlet. A grate inlet generally traps debris before it can enter the adjoining pipe. The use of a curb inlet will usually allow the debris to flow into the inlet and be discharged through the pipe outfall unless the debris is large enough to become lodged in the pipe and restrict the flow. Due to the possibility of clogging, the storm drainage system must be made accessible for cleanout of debris.

5.3.2.10 PAVEMENT TEXTURE

Pavement texture is an important consideration for roadway surface drainage. Although the hydraulic engineer will have little control over its selection, it should be recognized that the pavement texture has an impact on the build-up of water depth on the pavement during rainstorms. A good macro texture provides a channel for the water to escape from the tire-pavement interface and thus reduces the potential for hydroplaning.

Macro texture in a concrete pavement can be achieved by longitudinal and transverse grooving. Combinations of longitudinal and transverse grooving provide the most adequate drainage for high-speed conditions.

5.3.2.11 PAVEMENT STRUCTURE

Drainage aspects in the design of the pavement structure are important for areas with high groundwater tables where excess moisture can attack the pavement sub-grade. Pavement structure drainage is generally accomplished by using a free draining base course, which usually includes an underdrain system connected to a free draining base trench. The free draining base course shall be in accordance with the furnished pavement design for the project.

5.3.2.12 UNDERDRAINS

In soils where groundwater is a problem, a system of underdrains should be used to remove excess moisture from the pavement structure. Underdrains typically consist of a network of perforated pipes, French drain, or collector fields. The available types include pipe with granular-filled trench and filter-fabric-wrapped granular material in a trench. Details for size and installation are provided in the Standard Details Book, Volume I, Sheets 3 and 4 of DR8. The following items address considerations for placement:

- They should be placed transversely on the downgrade end of cuts approaching a major fill to intercept water that may saturate the fill, subsequently causing pavement failure (see the grading transition detail in design directive 405). Outlet spacing shall not exceed 250 feet in fill sections. Outlets in cut sections shall be connected to the nearest drainage structure.

- Longitudinal underdrains should be specified where the rock strata are dipping in such a manner that flow would saturate and damage the base course, or in special cases where the water table after would create a pressure head under the base course construction.

- They should be specified at known locations of constant sources of water, such as wells or springs, and in sag vertical curves where water in the subgrade is expected to accumulate and flow to the surface.

- In urban locations with curb and no side ditches, underdrains should be used to drain the base course.

- Consideration should be given to placing them in existing channels located under embankments. For these installations, the designer should specify that they are installed to conform to the existing channel alignment. The use of select rock fill obtained from unclassified excavation should always be considered in lieu of underdrains.

The following note shall be on the plans when there is reason to believe that ground water will be encountered during construction which requires indeterminate amounts of underdrain installation: “The quantities of underdrain have been increased for control of ground water that could be detrimental to the completed facility. This quantity shall be used as directed by the Engineer.”

The elevations of the proposed storm drainage system must account for the depth of underdrain and underdrain outfalls. The outfalls may go directly into an inlet, to a culvert, ditch, or channel with the use of a slope-wall.

5.3.3 DESIGN SPREAD

The design spread governs the amount of runoff allowed in the curb and gutter section and on the adjacent roadway. The designer calculates the spread and when the allowable amount is reached, an inlet is proposed to intercept all or a portion of the flow.

For roadways designed for speeds of 40 mph or greater, spread of the flow on a bridge deck or curbed section of pavement is limited to the shoulder width. If the design speed is less than 40

mph, spread is limited to the shoulder width plus 3 feet into the traveled way. If a parking lane is present, then the spread will be limited to 8 feet.

Table 5-1

Allowable Spread for the Design Speed

Design Speed	Allowable Spread	
	10-year Design Storm	50-year Check Storm for Sag Vertical Curves
less than 40 mph	shoulder + 3 feet	one lane open to traffic
40 mph or greater	shoulder	

Use of a gutter slope of 0.06 is recommended for most projects because of the reduction in spread and the increased flow efficiency resulting from carrying a larger amount of water near the curb. Most inlets are more efficient in intercepting concentrated flow rather than flow spread over a wide, flat cross-slope.

Gutter flow calculations are necessary to relate the quantity of flow (Q) in the gutter to the total spread of water on the pavement. The following equation is used to calculate the spread T, in a uniform cross slope gutter section. Chart 5-1 and Chart 5-2 are utilized to solve for spread for the uniform cross slope gutter sections and V shape gutter sections.

$$T = 1.243\left(Qn\right)^{3/8} S_x{}^{-5/8} S^{-3/16}$$

T = Spread (ft)

Q = Gutter flow rate (ft^3/s)

n = Manning's roughness coefficient

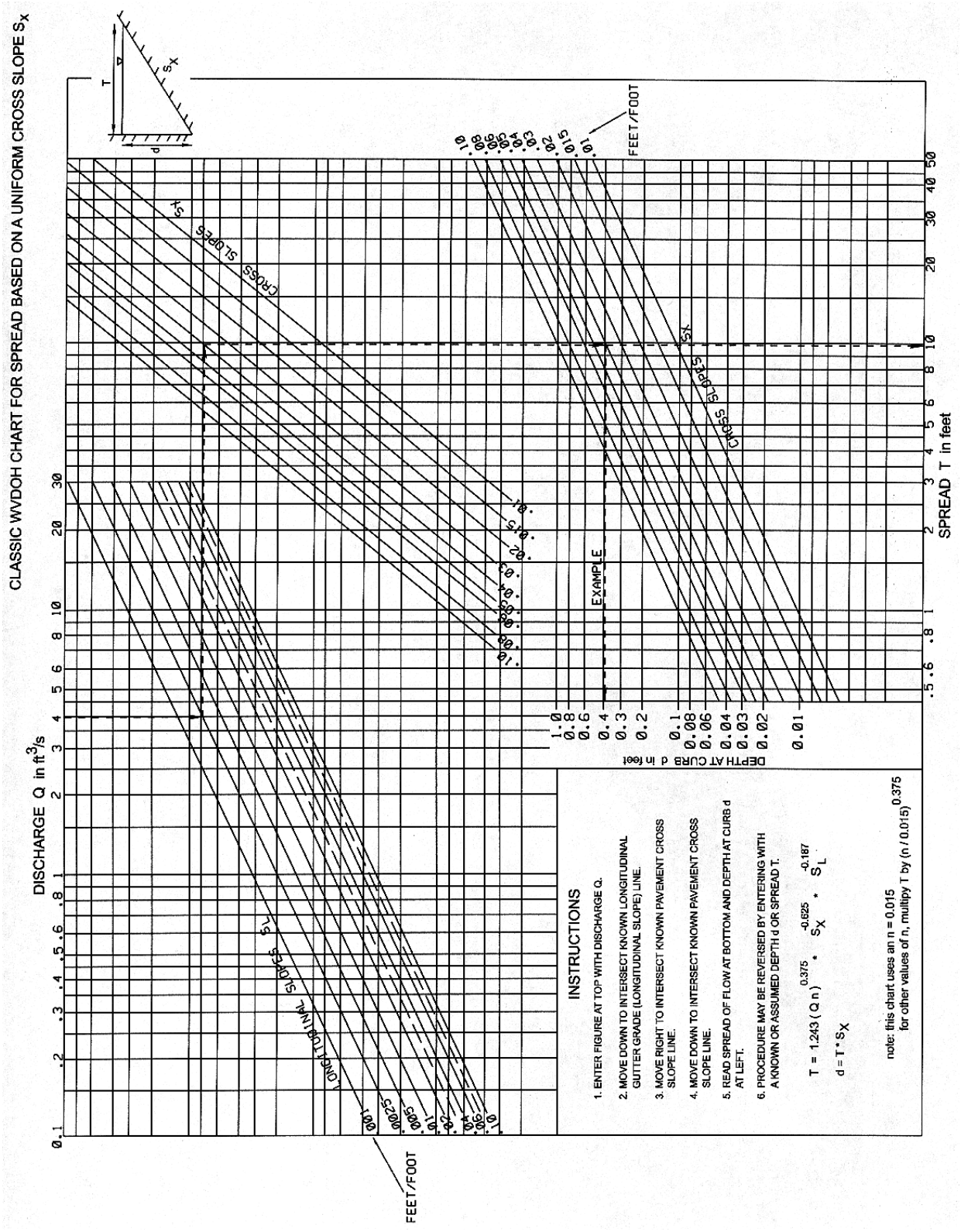
S_x = Pavement cross slop (ft/ft)

S = Longitudinal (gutter) slope (ft/ft)

Calculation of spread in sag conditions requires attention to the transitional flow state. Grate inlets in sag conditions operate as a weir to a depth of about 0.4 feet above the grate. When the depth exceeds 1.4 feet above the grate, the inlet operates as an orifice. Between these two depths, flow is in a transitional state. Curb opening inlets operate as a weir at depths up to the curb opening height and as an orifice at depths greater than 1.4 times the opening height. At depths between 1.0 and 1.4 times the opening height, flow is in a transitional state. See Section 5.3.4.10 for design of a flanking inlet on each side of the sag.

Chart 5-1

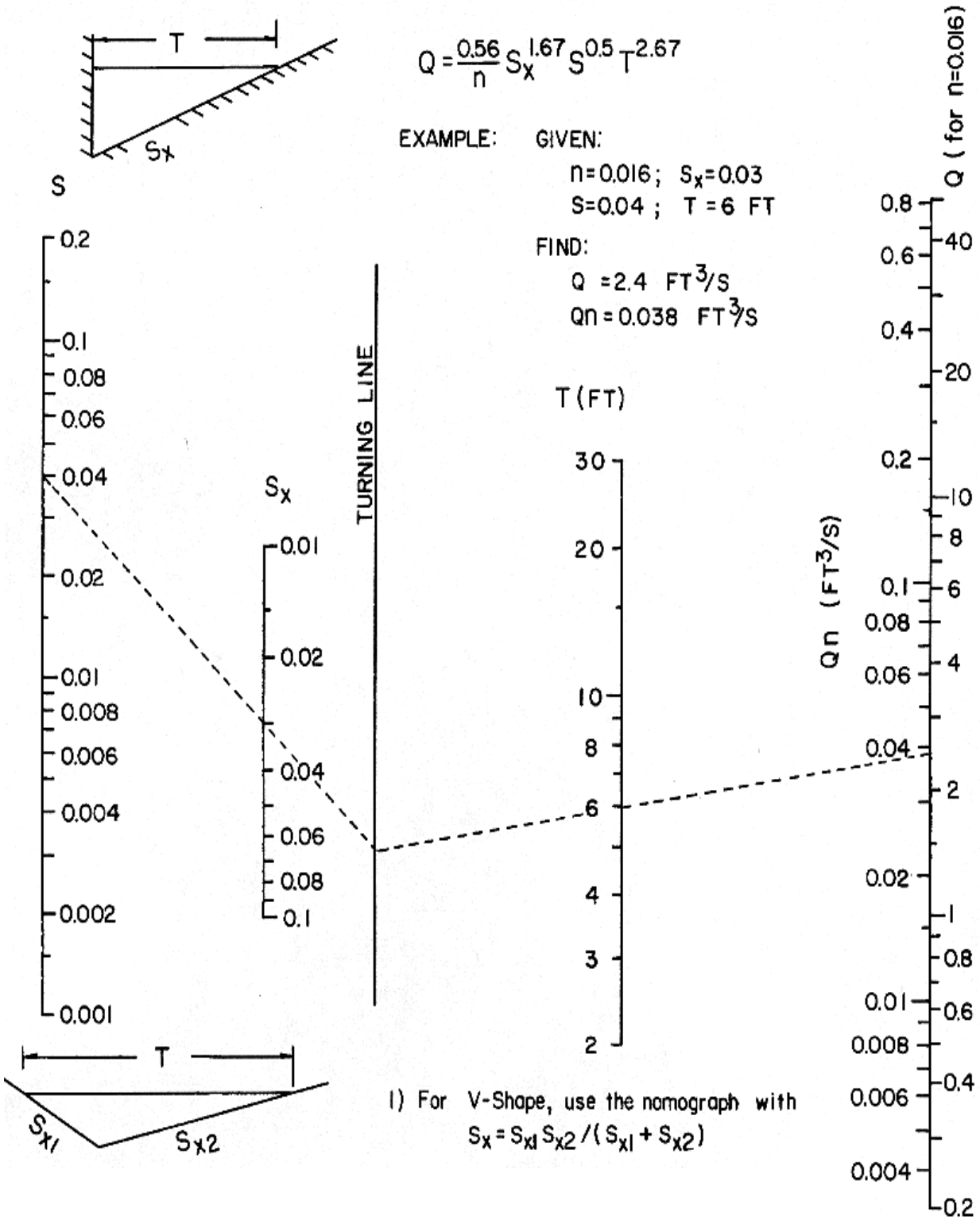
Spread and Depth Based on A Uniform Cross Slope



Source: WVDOH 1984 Drainage Manual

Chart 5-2

Spread and Discharge Based on a Uniform Cross Slope



Source: Federal Highway Administration Hydraulic Engineering Circular-22

5.3.4 DRAINAGE INLETS

Inlets are drainage structures utilized to collect surface water through grate or curb openings and convey it to storm drains or direct outlet to culverts.

In general, inlet type, location, and spacing should consider the following factors:

- Inlet capacity, width of gutter spread (i.e., spread of flow), and depth of flow at the curb line.
- Movement of vehicles to and from adjacent property on turnouts
- Pedestrian and bicycle safety
- Maximum pipe length without maintenance access
- Roadway geometry
- Hydraulic efficiency of the system
- Ability to be self-cleaning.
- Potential for flooding and erosion of/from off-site property

Ditches, swales, or other collection systems beyond the curb shall be considered to intercept runoff from cut-slopes and areas outside the right of way. These interceptor and collection systems will reduce the amount of water that has to be picked up by inlets and will help prevent mud and debris from being carried onto the pavement, particularly at the high side of superelevated curves. Inlets or other collection systems shall be used to intercept runoff from side streets before it reaches the roadway.

Details for grate, curb opening, combination, and slotted drain inlets are provided in the Standard Details Book, Volume I, Sheets DR6-A through DR6-X. Details for concrete box and grate inlets are provided in the Typical Sections and Related Details Book, dated 2000, Sheet 81.

5.3.4.1 INLET TYPES

Grate Inlets

These inlets consist of an opening in the gutter covered by one or more grates. They are best suited for use on continuous grades where clogging is not a problem. The use of grate only inlets at sag points should be limited to minor sag locations without debris potential. Special design (oversized) grate inlets or combination inlets should be utilized at major sag points if sufficient capacity is provided to combat clogging. Grate inlets should be bicycle safe unless located on highways where bicycles are not permitted. Grates should also be structurally

designed to handle the appropriate wheel loads when subject to traffic. WVDOH standard grate inlets include:

- Type A, two 24” X 24” 30˚ tilt bar grates, parallel to the curb
- Type B, one 24” X 24” 30˚ tilt bar grate against the curb
- Type C, two 24” X 24” 30˚ tilt bar grates, perpendicular to the curb
- Type G, grate size ranging from 32” X 38” to 60” X 66”. The type 1 grate has 1” bars, 2” on center. The type 2 grate has 1” bars, 4” on center. This grate inlet is primarily used in median and roadside ditches. Its design use is addressed in Section 6.4.3.

Table 5-2

Grate Inlet Weir and Orifice Flow Details

Inlet Type	Effective Weir Perimeter	Clear Open Area Against Curb	
A	21 ¾ “+42”+21 ¾” = 85.5” = 7.1’	2.7 ft^2	
B	21 ¾”+19”+21 ¾” = 62 ½” = 5.2’	1.4 ft^2	
C	45 ½”+19”+45 ½” = 110” = 9.2’	2.7 ft^2	
		Clear Open Area for All Sides	
		Type 1 Grate	Type 2 Grate
32X 38 G	31 ¾”+37 ¾”+31 ¾”+37 ¾” = 139” = 11.6’	4.4 ft^2	6.4 ft^2
36 X 42 G	35 ¾”+41 ¾”+35 ¾”+41 ¾” = 155” = 12.9’	6.5 ft^2	7.9 ft^2
42 X 48 G	41 ¾”+47 ¾”+41 ¾”+47 ¾” = 179” = 14.9’	8.8 ft^2	10.1 ft^2
45 X 51 G	44 ¾”+50 ¾”+44 ¾”+50 ¾” = 191” = 15.9’	9.3 ft^2	11.8 ft^2
48 X 54 G	47 ¾”+53 ¾”+47 ¾”+53 ¾” = 203” = 16.9’	10.6 ft^2	13.6 ft^2
54 X 60 G	53 ¾”+59 ¾”+53 ¾”+59 ¾” = 227” = 18.9’	13.5 ft^2	16.3 ft^2
60 X 66 G	59 ¾”+65 ¾”+59 ¾”+65 ¾” = 251” = 20.9’	15.7 ft^2	20.7 ft^2

Curb-Opening Inlets

These inlets provide vertical openings in the curb covered by a top slab. They function as a weir with flow entering from the side and are best suited on flatter slopes and at sag points since they can convey large quantities of water with debris. They are a viable alternative to grates on continuous grades where the grates would be hazardous for pedestrians or bicyclists. Curb-opening inlets are generally not recommended for use on steep continuous grades due to significant bypass of flow. WVDOH standard curb-opening inlets include:

- Type D, a 4’ wide, 4” high curb opening depressed 2” below adjacent pavement. The lateral width of the depression is 1’. This inlet has a 45˚ inclined throat.
- Type E, widths of 6’, 8’, 10’, 12’, 14’, 16’, 18’, and 20’ long, 4” high curb opening depressed 2” below adjacent pavement. The lateral width of the depression is 1’. This inlet also has a 45˚ inclined throat.

The depression provides superelevation for the flow to turn the water into the inlet opening.

Combination Inlets

There are various types of combination inlets with the curb opening and grate combination being the most common. Two types of the curb and grate combination are inlets with the curb opening adjacent to the grate and inlets with the curb opening upstream and adjacent to the grate. The latter are referred to as “sweeper” inlets. Slotted inlets are also used in combination with grates, located either longitudinally upstream of the grate or transversely adjacent to the grate. The interception capacity of the curb opening and grate combination on a continuous grade is no greater than that of the grate alone. The curb opening provides some capacity in the event of the clogging of the grate, but it does not significantly help in reducing the spread of flow.

The efficiency of inlets in passing debris is critical in sag locations because all runoff which enters the sag must be passed through the inlet. Total or partial clogging of inlets in these locations can result in hazardous ponding conditions. Combination inlets are recommended for use in these locations because of the tendencies of grates to become clogged. WVDOH standard combination inlets include:

- Type F, a 4’ wide, 4” high curb opening depressed 2” below adjacent pavement with two 24” X 24” 30˚ tilt bar grates, parallel to the curb. This inlet has a vertical throat.
- Type H, a 2’ wide, 4” high curb opening with no depression below the adjacent pavement. This inlet has one 24” X 24” 30˚ tilt bar grate and a vertical throat.

Table 5-3

Combination Inlet Weir and Orifice Flow Details

Inlet Type	Effective Weir Perimeter	Clear Open Area Against Curb
F	21 ¾ “+42”+21 ¾” = 85.5” = 7.1’	2.7 ft^2
H	21 ¾”+19”+21 ¾” = 62 ½” = 5.2’	1.4 ft^2

Slotted Drain Inlets

These inlets consist of a slotted opening with bars perpendicular to the opening. They can be used to intercept sheet flow, to collect gutter flow (with or without curbs), to modify existing systems to accommodate roadway widening or increased runoff, and to reduce ponding depth

and spread at grate inlet locations. FHWA tests of slotted inlets indicate that the length of inlet required for total interception is applicable to both curb-opening inlets and slotted inlets. Therefore, the capacities and efficiencies of the two are calculated in the same fashion. The two types of slotted inlets in general use are the vertical riser type and the vane type. The WVDOH standard slotted inlet has two types of slot design. Type 1 consists of a slot width of 1-3/4" that may be flared to 3" at the bottom and a slot height of 2.5", 6" or 8.5". Type 2 consists of a 2" wide slot with a minimum slot height of 4".

Concrete Box & Grate Inlets

These inlets consist of a formed or pre-cast concrete box trench covered by a grate that is bolted to a frame support anchored to the trench. These inlets are typically placed perpendicular to the flow with the invert of the trench having a 1% slope. They are used to intercept sheet flow from side streets or driveways before the flow encounters the primary roadway. The WVDOH standard concrete box & grate inlet has three types of grates available in 2' long sections. The length refers to the direction perpendicular to flow; therefore, installations shall be in increments of 2' across the side street or driveway. Type A grates have 1 1/8" long by 2 1/2" wide holes spaced 1 inch apart along the length of the grate. The long axes of the holes are parallel to the direction of flow. Type C grates have 4 7/8" long by 7/8" wide holes spaced 7/8" apart along the length of the grate. The long axes of the holes are perpendicular to the direction of flow. Type P grates have 1/4" long by 2 5/16" wide holes spaced 1" apart along the length of the grate. The long axes of the holes are parallel to the direction of flow. Type P grates are meant for areas with heavy pedestrian traffic. Type A grates are available in widths from 8 to 51 inches wide. Type C grates are available in widths from 8 to 45 inches wide. A Type P grate is available in widths from 8 to 20 inches wide.

It is important to note that there are advantages and disadvantages to the use of each type of inlet in a design situation. These should be examined against the physical surroundings for frequency of maintenance.

5.3.4.2 INLET SPACING

The spacing of inlets on a continuous grade is based upon the spread of flow. The spread of flow increases as runoff is contributed to the gutter section in the downstream direction. An inlet is located where the spread of flow in the gutter reaches the allowable design spread. The factors that determine the inlet spacing include tributary drainage area, longitudinal slope of the gutter, the gutter/roadway cross section geometry, the capacity of the inlet grate and the effect debris has on that capacity.

For a continuous grade, the designer may establish uniform spacing between inlets of a given design if the contributing drainage area to each inlet has reasonably uniform runoff characteristics and is rectangular in shape. In this case, the drainage areas generally consist

of pavement only and the time of concentration is assumed to be the same for each of the inlets.

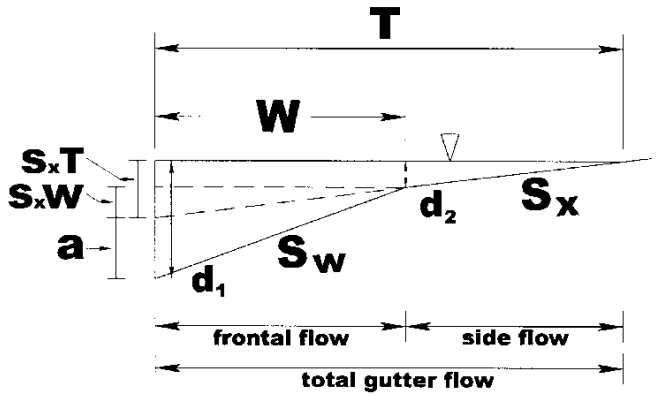
The process for the spacing of inlets begins with the gutter/roadway cross section geometry. Conveyance “K” describes the geometric carrying capacity of a hydraulic conduit and is defined as the flow divided by the square root of the longitudinal slope. In this case, the hydraulic conduit is the gutter section. Using the integrated form of the Manning’s equation, conveyance is a function of the flow depth, roughness, and the cross slope of the gutter section (see Figure 5-2). For composite gutter sections, the conveyance is calculated separately for flow in the gutter (frontal flow) and flow outside of the gutter (side flow). The total conveyance is equal to the sum of the parts.

The spread of flow “T” is dependent upon the flow depth; therefore, conveyance can be put in terms of spread. By defining an allowable spread, the flow that causes the spread can be determined. For drainage areas that consist of pavement only, the width of the area is known from the roadway cross section geometry and the length of the area can be determined from the flow that causes the allowable spread. Length is equal to area divided by width. The area that causes the runoff that creates the allowable spread on the pavement at the inlet location creates the link between spread and length of flow. This length would be the maximum allowable spacing between inlets. Interception capacity of the inlet opening and offsite drainage areas that contribute flow to the gutter must also be considered when determining this length of spacing.

Flow area is used to determine an average flow velocity in the gutter, which is important for calculating grate inlet capacity on grade. Flow depth at the curb is important for determining grate, curb, and combination inlet capacities in a sag location.

Figure 5-2

Gutter Flow Geometry



flow depth at the curb

$$d_1 = a + S_x T$$

flow depth at the break in slope

$$d_2 = (T - W) S_x$$

conveyance in the gutter

$$\frac{Q_w}{\sqrt{S}} = \frac{0.56 (d_1^{2.67} - d_2^{2.67})}{n S_w}$$

conveyance outside of the gutter

$$\frac{Q_s}{\sqrt{S}} = \frac{0.56 d_2^{2.67}}{n S_x}$$

total conveyance

$$\frac{Q}{\sqrt{S}} = \frac{0.56 (d_1^{2.67} - d_2^{2.67})}{n S_w} + \frac{0.56 d_2^{2.67}}{n S_x}$$

flow area

$$A = \frac{1}{2} T^2 S_x + \frac{1}{2} a W$$

gutter depression

$$a = S_w W - S_x W$$

$$d_2 = d_1 - S_w W$$

5.3.4.3 INLET CAPACITY

Inlet interception capacity is the flow intercepted by an inlet under a given set of conditions. The efficiency of an inlet is the percent of total flow that the inlet will intercept for those conditions. Efficiency of an inlet differs with changes in cross slope, longitudinal slope, total gutter flow, and pavement roughness. Flow that is not intercepted by an inlet is termed carryover or bypass. Factors that affect the gutter flow geometry also affect inlet interception capacity.

The interception capacity of a grate inlet increases with increasing flow rate, but the efficiency generally decreases. Factors for the grate capacity include the amount of water flowing over the grate, the velocity of flow in the gutter, the number of grates, the size of the grate, the configuration of the grates, and orientation of the grate. For concrete box and grate inlets, depth of flow, velocity of flow, and hole orientation are the controlling factors for capacity.

Interception capacity of a curb-opening inlet is largely dependent on flow depth at the curb and the opening length. The flow depth at the curb, interception capacity, and inlet efficiency are increased using a local gutter depression at the curb opening.

Slotted inlets function in essentially the same manner as curb opening inlets on grade. Both accept flow that passes parallel to the inlet. Interception capacity is dependent on the flow depth at the curb and the inlet length. For slot inlets, depth of flow, velocity of flow, and slot width parallel to flow are the controlling factors for capacity.

5.3.4.4 GRATE AND COMBINATION INLET CAPACITY ON GRADE

Grates are effective highway pavement drainage inlets where clogging with debris is not a problem. Where clogging may be a problem, combination inlets should be used. When the flow velocity approaching the front of the grate is less than the “splash-over” velocity, the grate will intercept all the flow. A small portion of the gutter flow along the side of the grate will be intercepted. This portion is dependent on the cross slope of the pavement, the length of the grate, and the flow velocity. The ratio of frontal flow to total gutter flow (E_o) for a uniform cross slope is expressed by:

$$E_o = \frac{Q_W}{Q} = 1 - \left(1 - \frac{W}{T} \right)^{2.67}$$

W = width of the grate (ft)

T = flow spread (ft)

The ratio of frontal flow to total gutter flow (E_o) for a composite cross slope is expressed by:

$$E_o = \frac{1}{1 + \frac{\frac{S_W}{S_X}}{\left[1 + \frac{\frac{S_W}{S_X}}{\frac{T}{W} - 1}\right]^{2.67} - 1}}$$

S_W = depressed gutter slope (ft/ft)

S_X = cross slope outside of the depressed gutter (ft/ft)

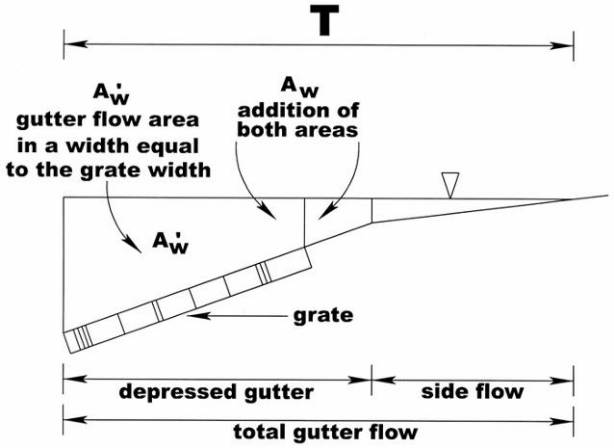
It is important to note that the frontal flow to total gutter flow ratio (E_o) for composite gutter sections assumes a frontal flow width equal to the depressed gutter section width. The use of this ratio when determining a grate's efficiency requires that the grate width be equal to the width of the depressed gutter section (W, see Figure 5-2). If a grate having a width less than W (in other words, the gutter width is more than the grate width) is specified, E_o must be modified to accurately evaluate the grate's efficiency. Since an average velocity has been assumed for the entire width of total gutter flow, the grate's frontal flow ratio, E_o' can be calculated by multiplying E_o by a flow area ratio. The area ratio is defined as the depressed gutter flow area in a width equal to the grate width divided by the flow area in the depressed gutter section (see Figure 5-3). This adjusted frontal flow area ratio is:

$$E_o' = E_o \left(\frac{A_W'}{A_W} \right)$$

A'_w = depressed gutter flow area in a width equal to the grate (ft^2)

A_w = flow area in the depressed gutter width (ft^2)

Figure 5-3
Flow Area Ratio Grate Width Less Than Gutter Width



The ratio of side flow to total gutter flow (Q_s/Q) is:

$$\frac{Q_S}{Q} = 1 - \frac{Q_W}{Q} = 1 - E_o$$

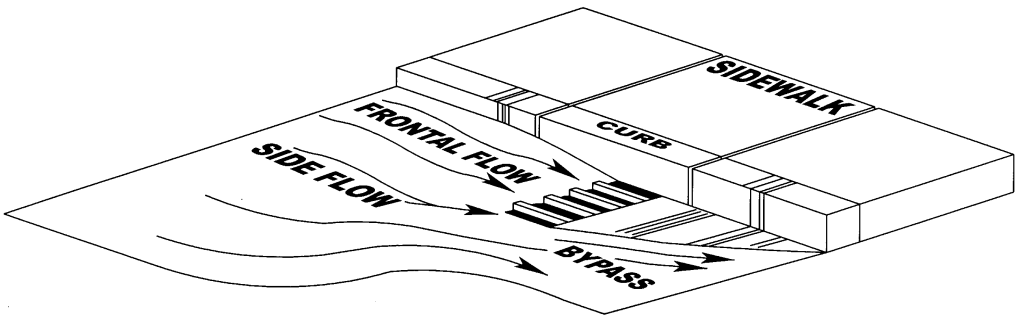
The ratio of frontal flow intercepted to total frontal flow (R_f) is:

$$R_f = 1 - 0.09\left(V - V_o\right)$$

V = average gutter velocity (ft/s)

V_o = gutter velocity where splash-over occurs (ft/s see Chart 5-7)

Figure 5-4
Intercepted Flow with Bypass



This ratio is equivalent to frontal flow interception efficiency or the ability of the inlet grate to accept the frontal flow approaching it. The average gutter velocity or total gutter flow divided by the gutter flow area is needed to calculate this ratio. Note that this ratio cannot exceed one. If it is equal to one, all the flow is within the depressed gutter width and the grate is accepting the entire flow with no bypass.

The ratio of side flow intercepted to total side flow (R_s), or the ability of the inlet grate to accept the flow going by beside it (side flow efficiency) is:

$$R_S = \frac{1}{1 + \frac{0.15\,V^{1.8}}{S_X\,L^{2.3}}}$$

L = length of clear opening area (ft)

The total efficiency of a grate (E) is:

$$E = R_f\,E_o + R_S\left(1 - E_o\right)$$

The right side of the equation becomes the frontal flow intercepted / total gutter flow plus the side flow intercepted / total gutter flow. The second term on the right side is insignificant with high velocities and short grates. This leads to the total intercepted flow or capacity of the inlet grate being:

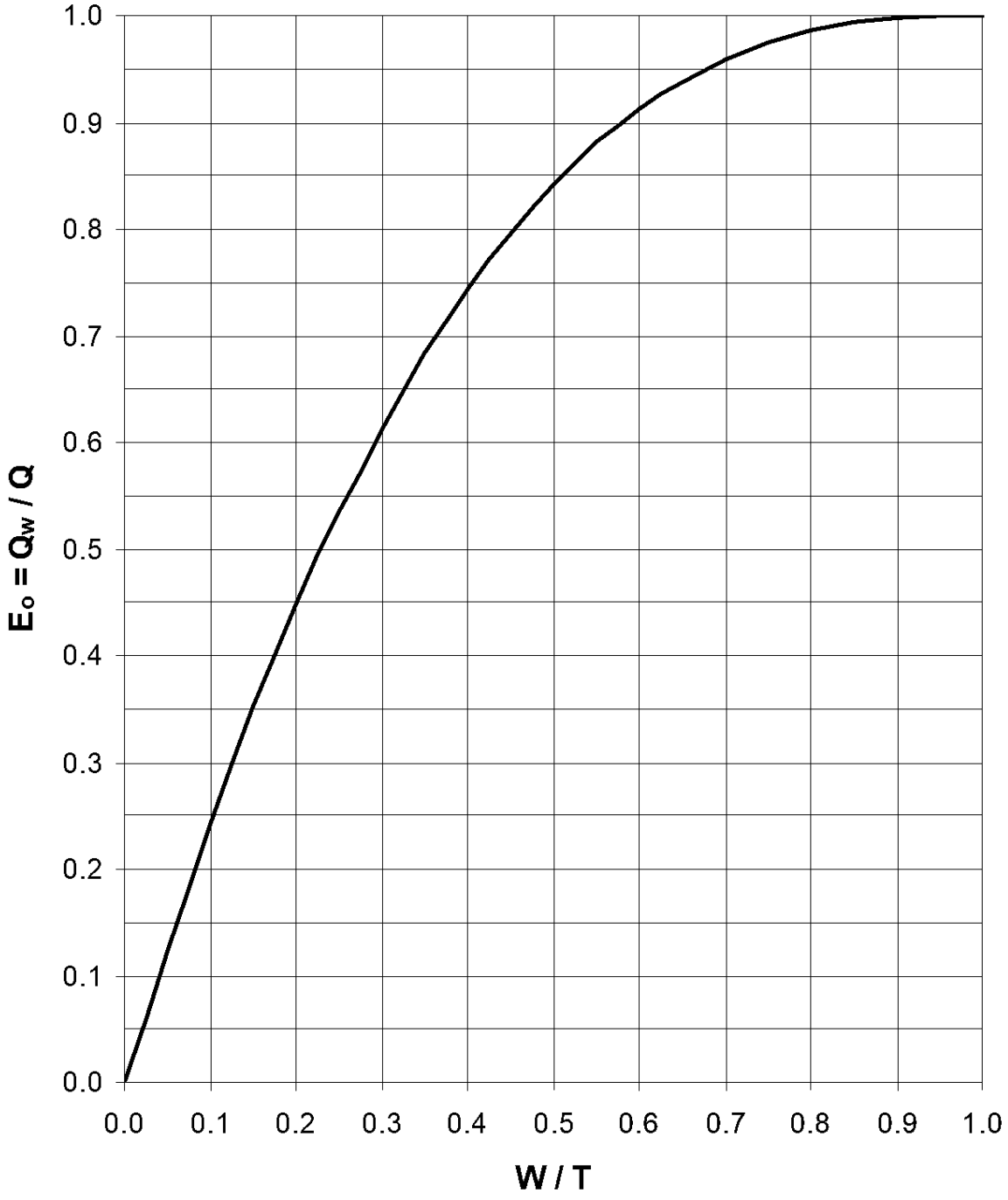
$$Q_i = E\,Q$$

The interception capacity of the curb opening and grate combination on a continuous grade is no greater than that of the grate alone; therefore, the above formulas are applicable to the combination inlets as well.

Chart 5-3 provides the ratio of frontal flow to total gutter flow (E_o or Q_w/Q) for uniform cross slopes. Chart 5-4 through Chart 5-6 are multi-purpose graphs that provide information for composite cross slopes based on the spread of flow. They are applicable for the composite cross slope that is diagramed at the bottom of each chart. Enter the chart with the conveyance then read the spread for that conveyance at the bottom. Where the vertical line crosses E_o, flow area and flow depth at the curb, read across to the left for the respective value. For values other than the composite cross slopes that are diagramed, use the provided formulas. Chart 5-7 and Chart 5-8 give the interception efficiency for frontal (R_f) and side (R_s) flow for the WVDOH standard inlets.

Chart 5-3

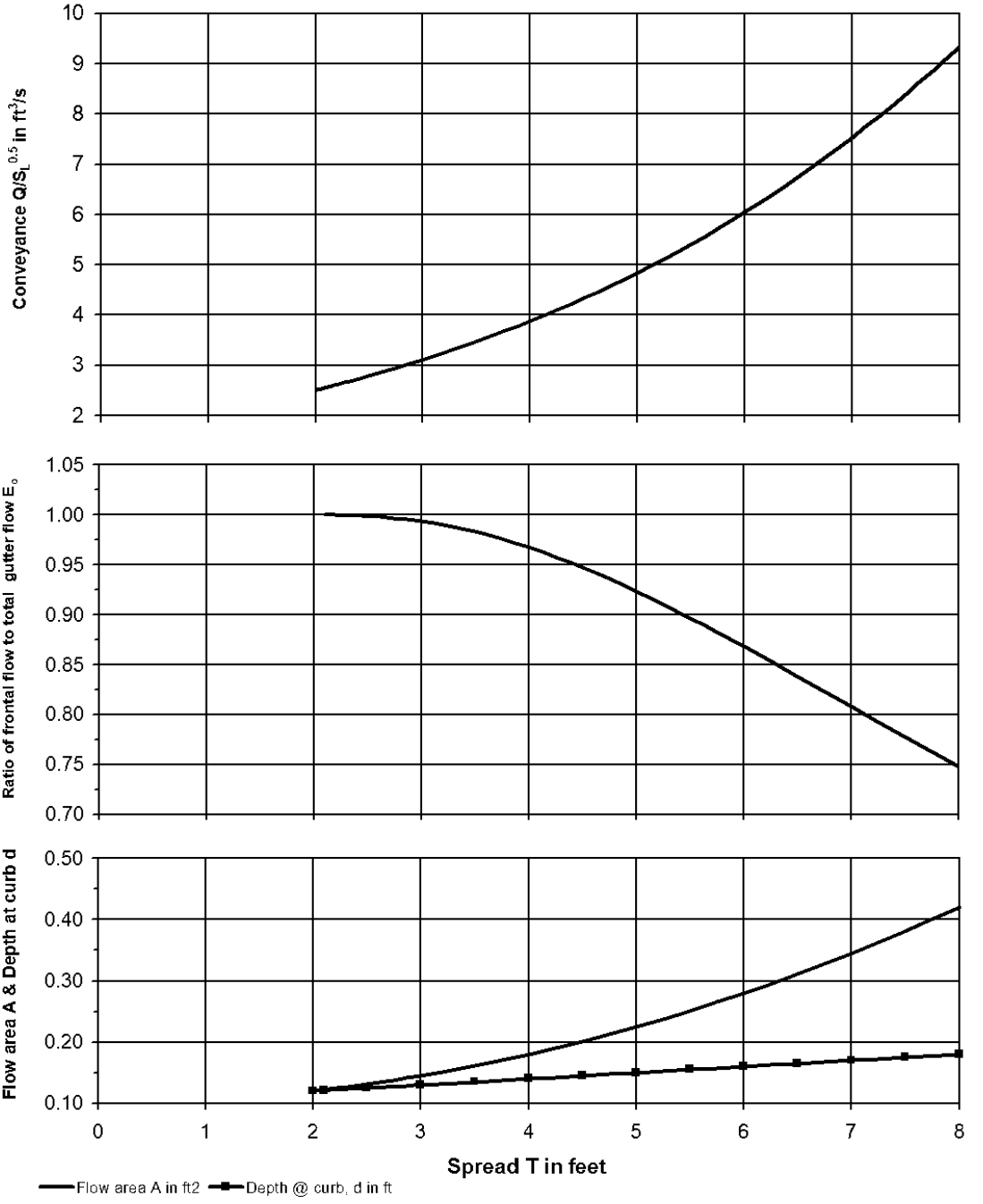
Ratio of Frontal Flow to Total Gutter Flow for a Uniform Cross Slope



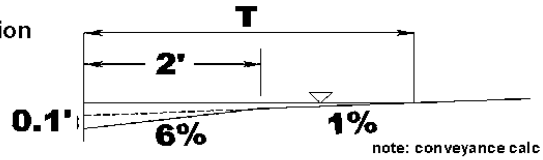
Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-4

Composite Cross Slope Conveyance 1% - 6%



Composite Gutter Section

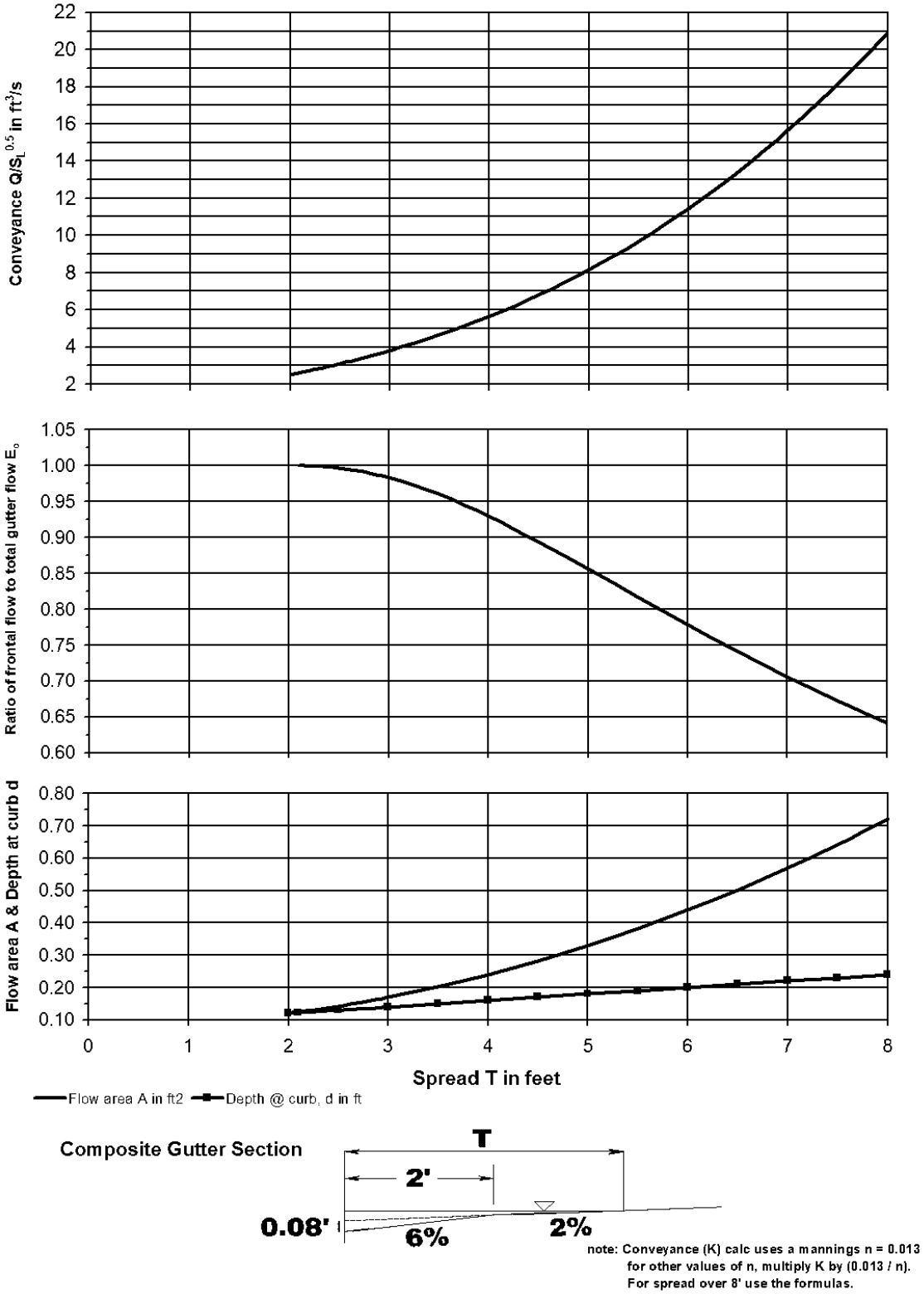


note: conveyance calc uses a mannings n = 0.013
for other values of n, multiply K by (0.013 / n)
for spread over 8' use the formulas

Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-5

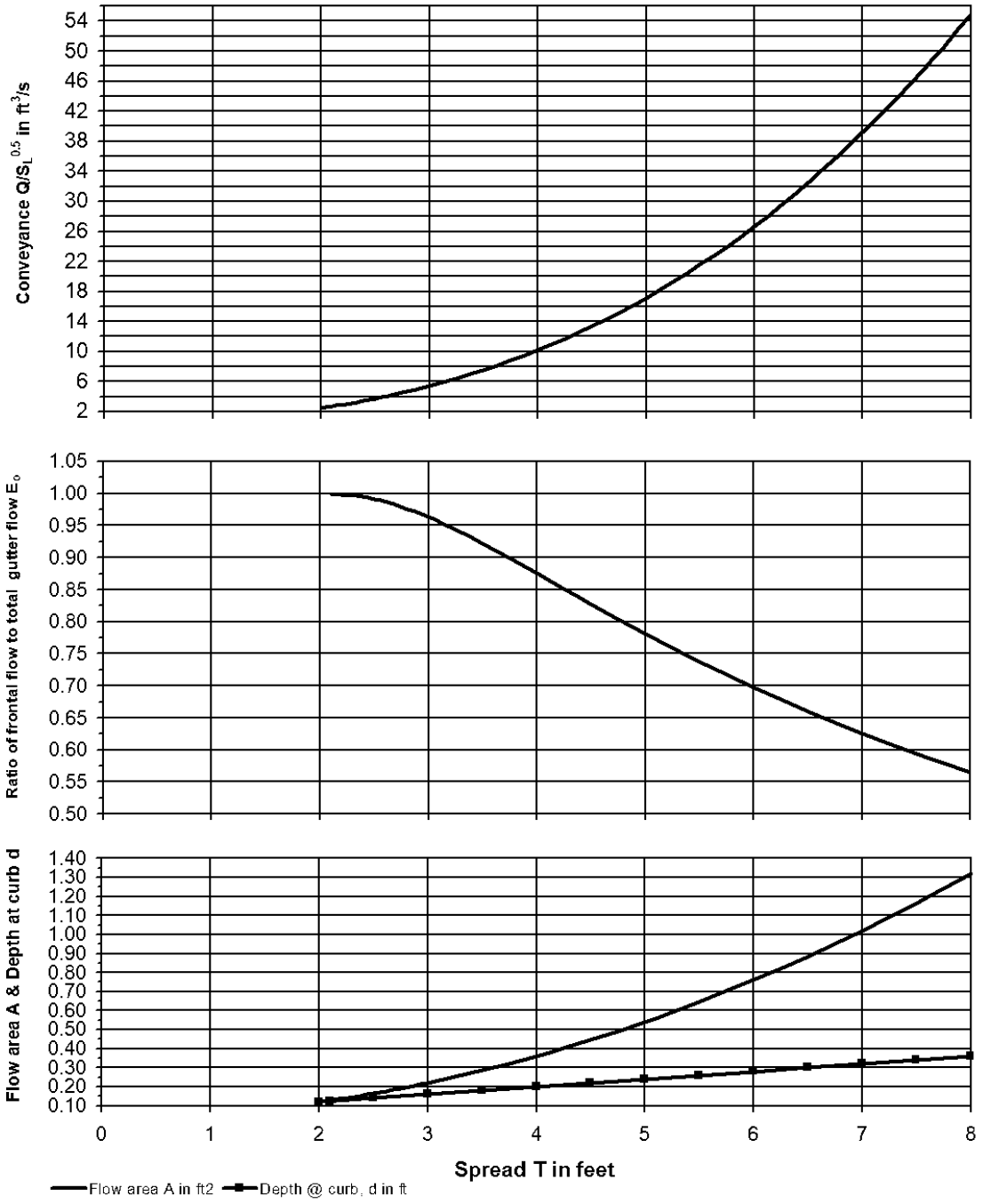
Composite Cross Slope Conveyance 2% - 6%

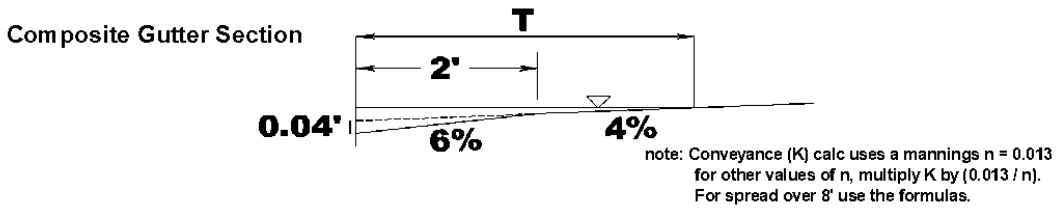


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-6

Composite Cross Slope Conveyance 4% - 6%



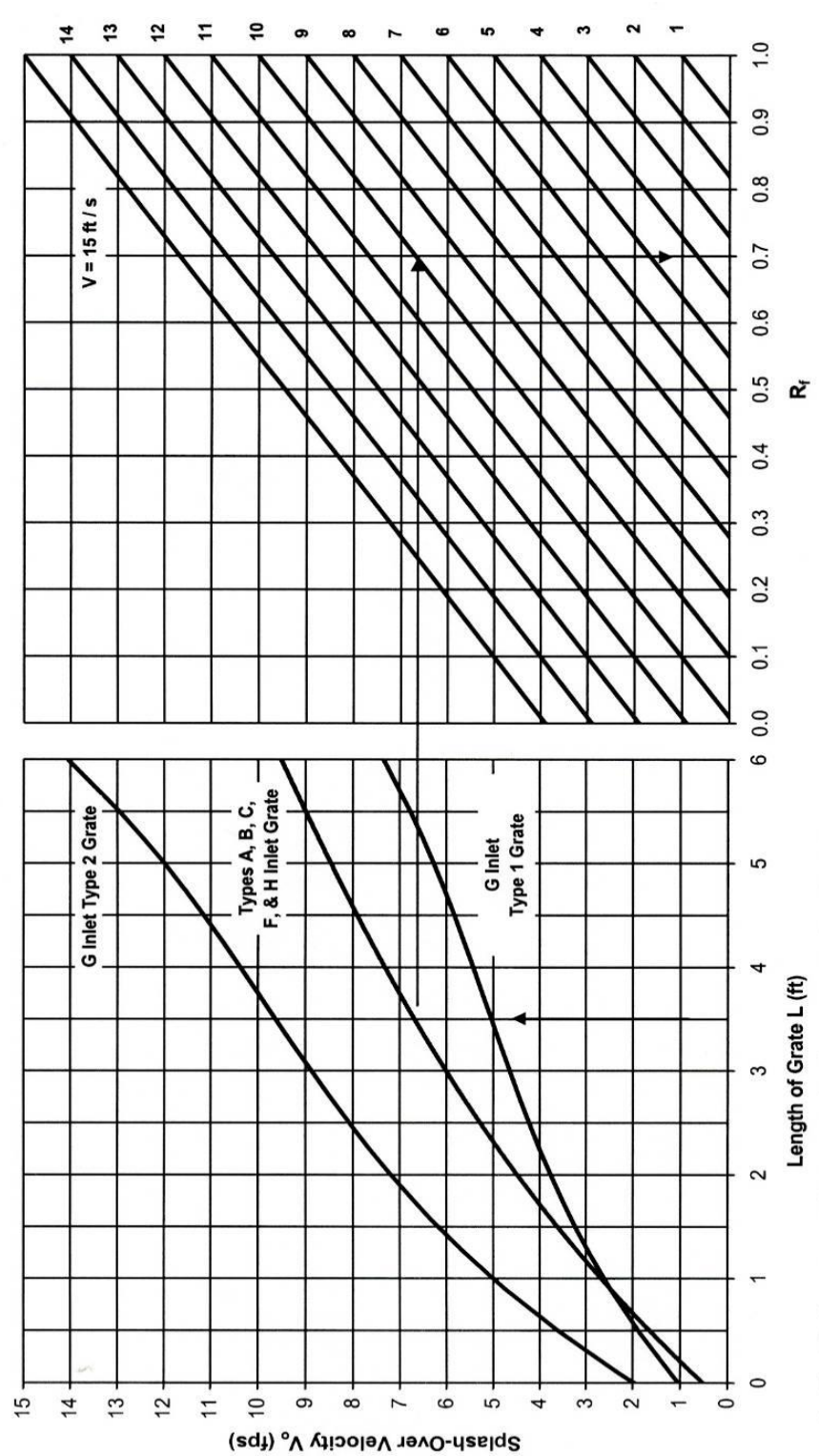


note: Conveyance (K) calc uses a mannings n = 0.013
for other values of n, multiply K by (0.013 / n).
For spread over 8' use the formulas.

Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-7

Grate Inlet Frontal Flow Interception Efficiency



Example: Find R_f for a type A inlet grate flowing at a velocity of 10 ft / s.

Solution: Type A inlet has a length of 42" or 3.5' $R_f = 0.7$

Splash-over velocity for G inlet Type 1 grate* $V_o = 0.46(2.22 + 4.03L - 0.65L^2 + 0.06L^3)$

Splash-over velocity for G inlet Type 2 grate** $V_o = 0.88(2.22 + 4.03L - 0.65L^2 + 0.06L^3)$

Splash-over velocity for types A, B, C, F, and H inlet grates*** $V_o = 0.51 + 2.34L - 0.20L^2 + 0.01L^3$

Ratio of frontal flow intercepted to total frontal flow $R_f = 1 - 0.09(V - V_o) \leq 1$

* The splash-over velocity curve for G inlet Type 1 grate is based upon an 54% reduction of the splash over velocity curve for the FHWA P-50 inlet grate.

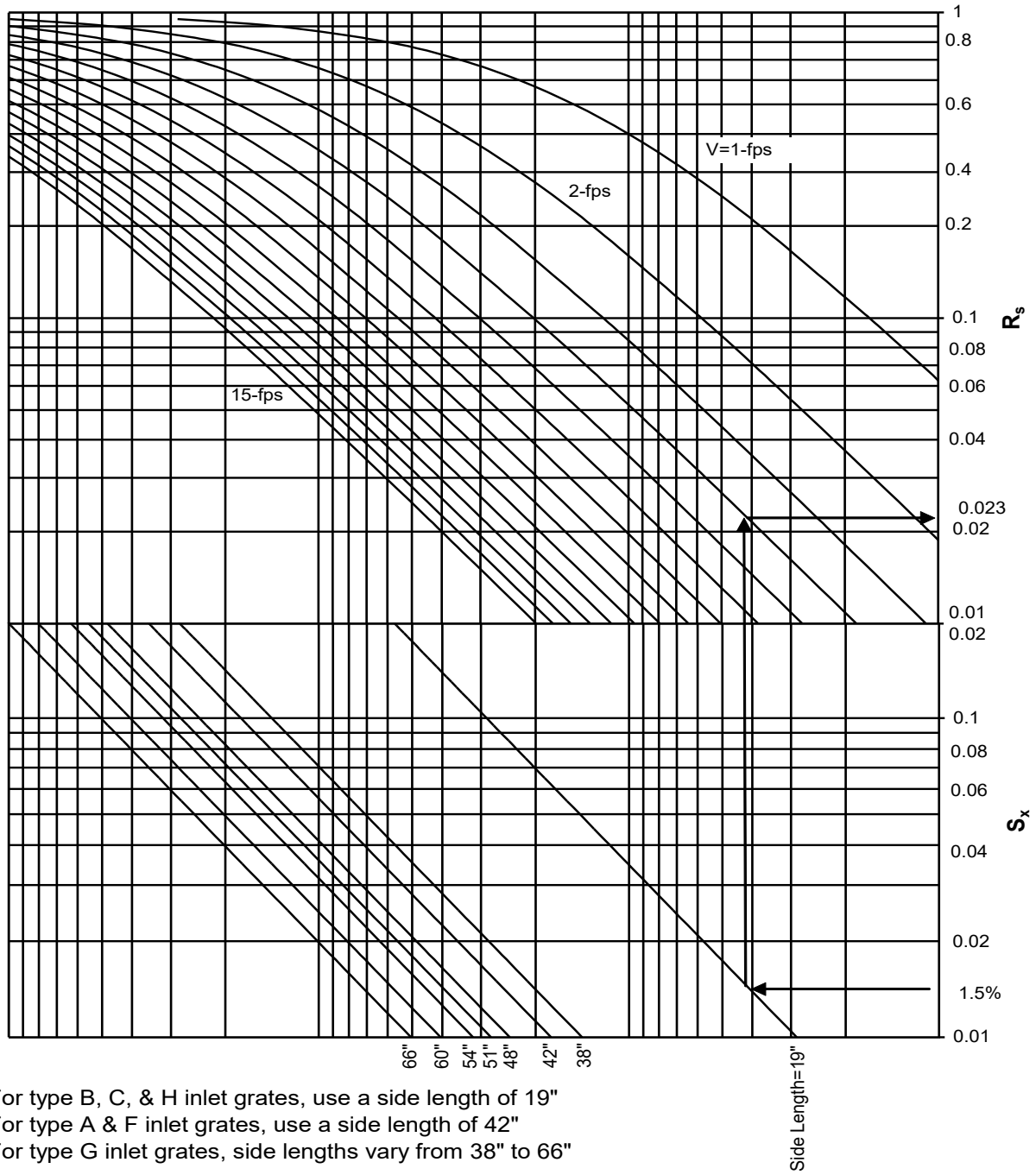
**The splash-over velocity curve for G inlet Type 2 grate is based upon a 12% reduction of the splash over velocity curve for the FHWA P-50 inlet grate.

*** The 30° tilt bar grate is used for types A, B, C, F, and H inlets.

Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-8

Grate Inlet Side Flow Interception Efficiency



For type B, C, & H inlet grates, use a side length of 19"
For type A & F inlet grates, use a side length of 42"
For type G inlet grates, side lengths vary from 38" to 66"

Ratio of side flow intercepted to total side flow

$$R_s = \frac{1}{1 + \frac{0.15 V^{1.8}}{S_x L^{2.3}}}$$

Example: Find Rs for a type C inlet grate on a slope of 1.5% moving at a velocity of 4-fps.
Solution: R_s=0.023

Created by the WVDOH Hydraulic and Drainage Unit

5.3.4.5 CURB OPENING AND SLOTTED INLET CAPACITY ON GRADE

Curb opening are less susceptible to clogging and offer little interference to traffic operation. They are a viable alternative to grates on flatter grades where grates would be in traffic lanes or would be hazardous for pedestrians or bicyclists. Slotted inlets are less susceptible to clogging in an urban setting but tend to clog in the presence of foliage in a rural setting. The method for determining the interception capacity of the curb opening inlet starts by calculating the length of opening required to intercept all the flow approaching it. The efficiency of the actual curb opening is then determined using a ratio of the actual length to the required length.

The length of the curb-opening inlet required for total interception of gutter flow (L_T) on a pavement section with a uniform cross slope is expressed by:

$$L_T = 0.6\, Q^{0.42}\; S_L^{0.3} \left(\frac{1}{n\, S_X} \right)^{0.6}$$

S_L = longitudinal slope (ft/ft)

S_X = cross slope (ft/ft)

Q = gutter flow (ft^3/s)

n = Mannings roughness coefficient

The efficiency of curb-opening inlets shorter than the length required for total interception is expressed by:

$$E = 1 - \left(1 - \frac{L}{L_T} \right)^{1.8}$$

L = actual curb opening length (ft)

For composite cross slopes, the length of inlet required for total interception can be found using an equivalent cross slope, S_e in place of S_X, S_e is expressed by:

$$S_e = S_X + S'_W\; E_o$$

S'_W = a / (12 W) or = $S_W - S_X$ see Figure 5-2

W = depressed gutter width (ft)

a = gutter depression (in)

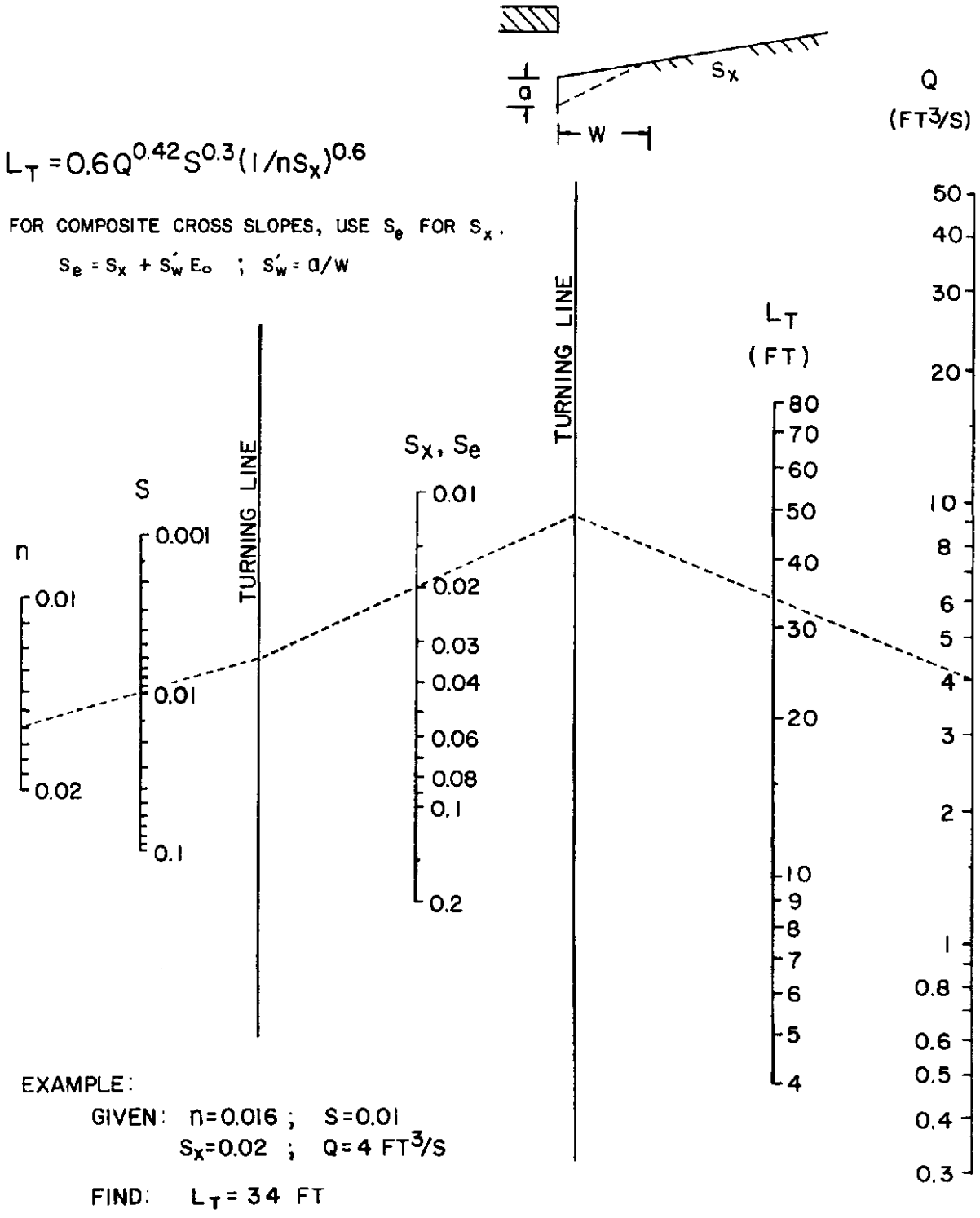
E_o = ratio of frontal flow to total gutter flow for a composite cross slope as defined in section 5.3.4.4

Flow interception by slotted inlets and curb-opening inlets is similar in that each is a side weir, and the flow is subjected to lateral acceleration due to the cross slope of the pavement. Analysis of data from the FHWA tests of slotted inlets with slot widths greater than 1 ¾" indicates that the length of slotted inlet required for total interception can be computed with the same equation used for curb openings. Similarly, the same equation can be used to obtain the inlet efficiency for the selected length of inlet.

Chart 5-9 provides the required inlet length for total interception for curb opening and slotted inlets with reference to composite cross slopes. Chart 5-10 provides the inlet interception efficiency for curb opening and slotted inlets.

Chart 5-9

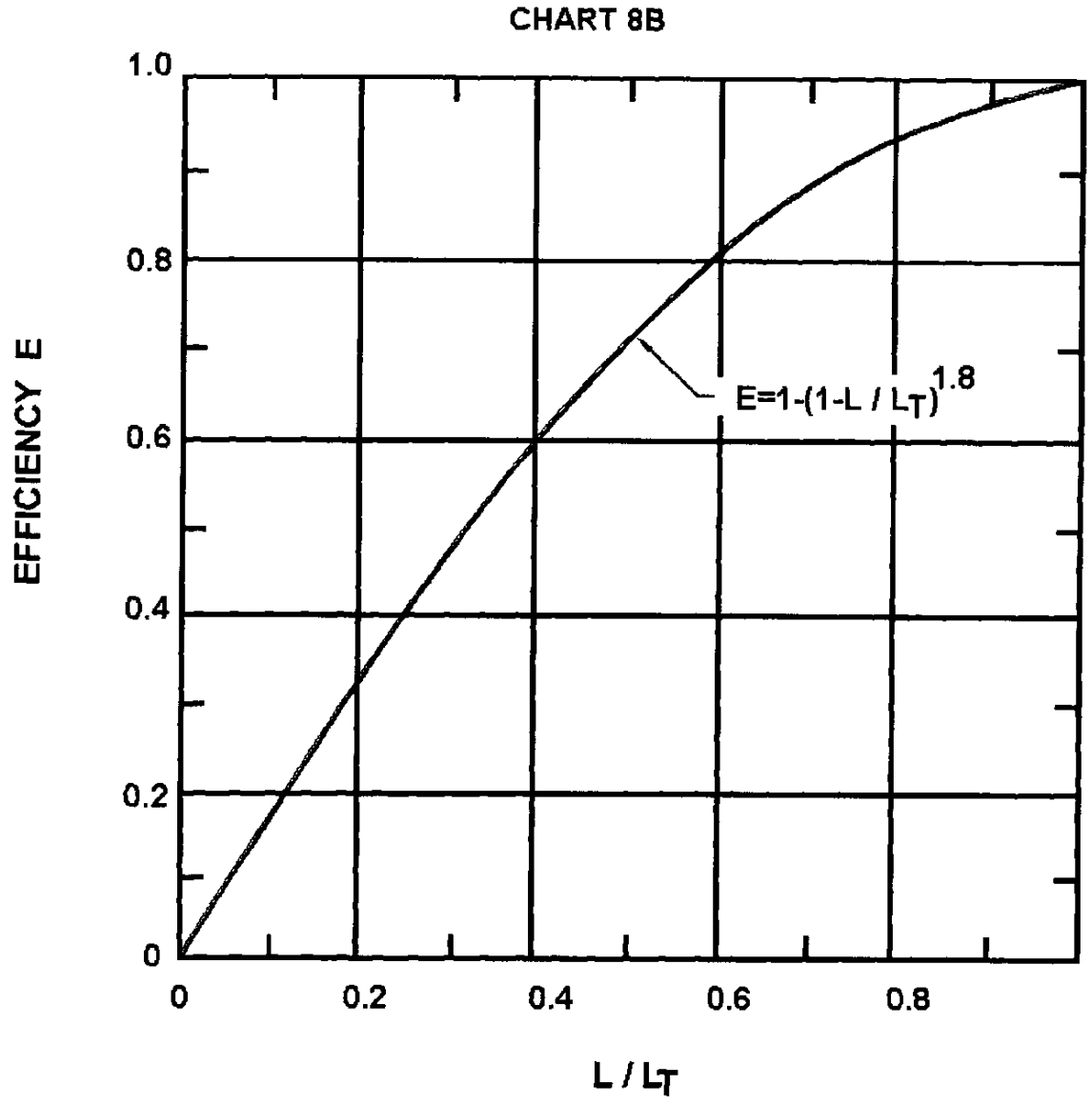
Curb Opening & Slotted Inlet Length for Total Interception



Source: Federal Highway Administration Hydraulic Engineering Circular-22

Chart 5-10

Curb Opening & Slotted Inlet Interception Efficiency



Source: Federal Highway Administration Hydraulic Engineering Circular-22

5.3.4.6 OVERLAND FLOW INLET CAPACITY

In situations where a side road (such as a driveway or commercial access road) intersects a major route, overland flow from the side road shall not be allowed to cross onto the major route. It shall be intercepted by an inlet and carried to a neighboring ditch, inlet, or storm sewer. Since many of these side roads are not crowned to facilitate shallow concentrated flow conditions at the edges, wide sheet flow results. Thus, it is necessary to intercept flow over the entire width of the side road. Continuous inlets such as slotted or concrete box and grate inlets should be used across the entire width of the side road to capture the wide, shallow sheet flow. Short sag vertical curves located just off the mainline shoulder can be used to increase interception efficiency.

When slotted inlets are used in a transverse direction to capture overland flow, research has indicated that for water depths ranging from 0.38 inches to 0.56 inches, the 1-, 1.75-, and 2.5-inch-wide slots can accommodate a flow of 0.03 $ft^3/s/ft$. This capacity is applicable for longitudinal slopes ranging from 0.5% to 9%. Slotted vane drains provide additional capacity due to the geometric properties of the vane. On longitudinal slopes of 0.5% to 6% they can accommodate a flow of 0.50 $ft^3/s/ft$.

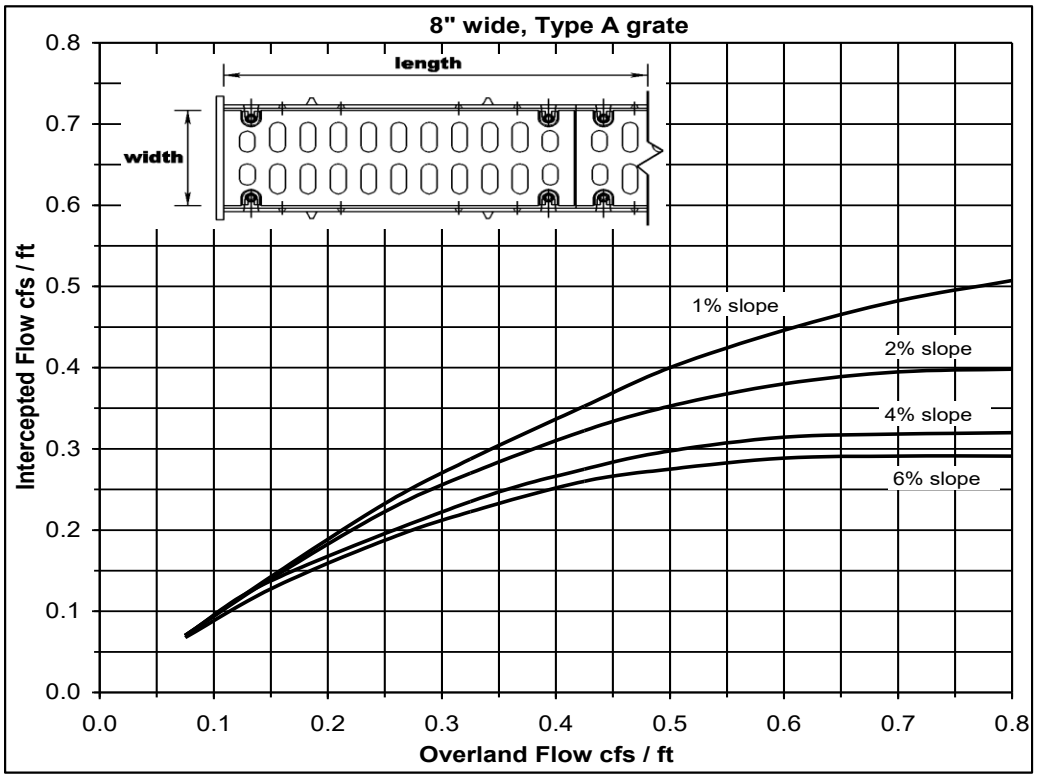
Capacity testing performed in 1976 by a major grate manufacturer provides data for interception and bypass of flow for various sizes of continuous concrete box and grate inlets. The testing was performed on two types of grates (Type A and Type C) for widths of 8 to 20 inches and a third type (Type P) for a width of 14 inches. The types vary by the size and configuration of the holes (see Section 5.3.4.1).

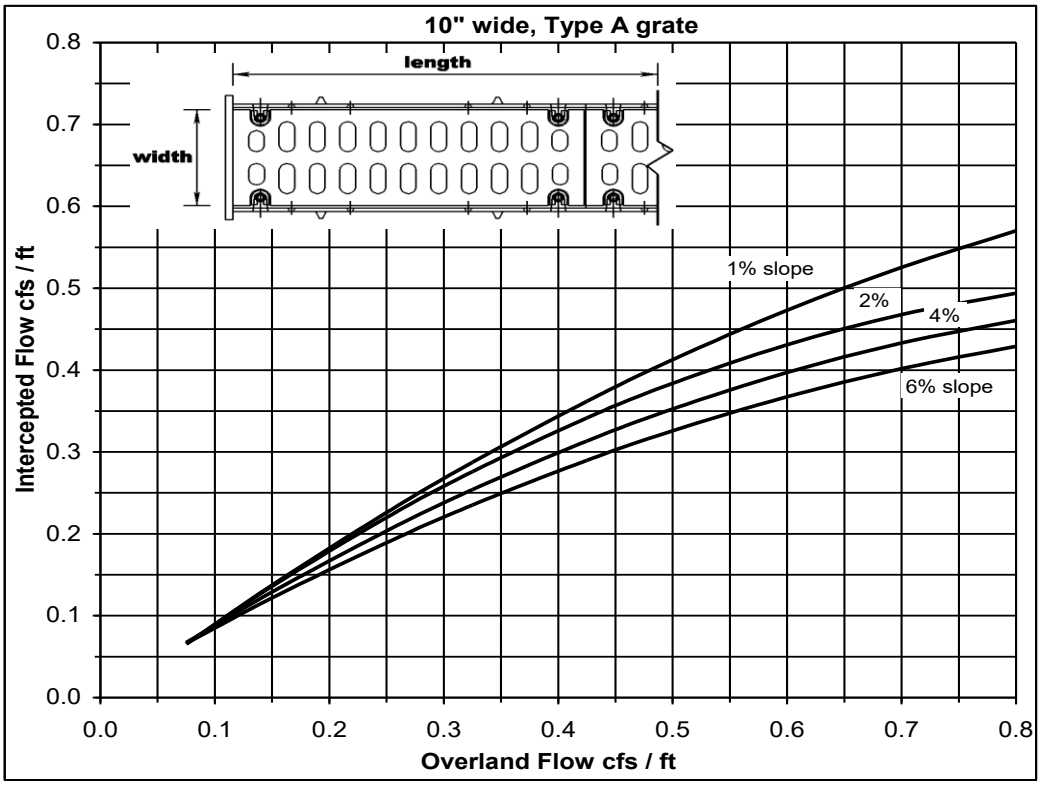
Chart 5-11 through Chart 5-17 provide illustrations and interception capacities for the types and sizes of grates tested for various longitudinal slopes. Type A and Type C grates have a 92% interception capacity for flows less than 0.60 $ft^3/s/ft$. Type P grates are intended for high pedestrian areas and only provide about 28% interception capacity for the same flow.

The flow rate entered on the x-axis of these charts is only that portion of overland flow that is directly approaching the inlet as frontal flow. The direction of the overland flow is perpendicular to the grate length shown on the schematic in each chart.

Chart 5-11

Concrete Box with Type A Grate (8”, 10”)

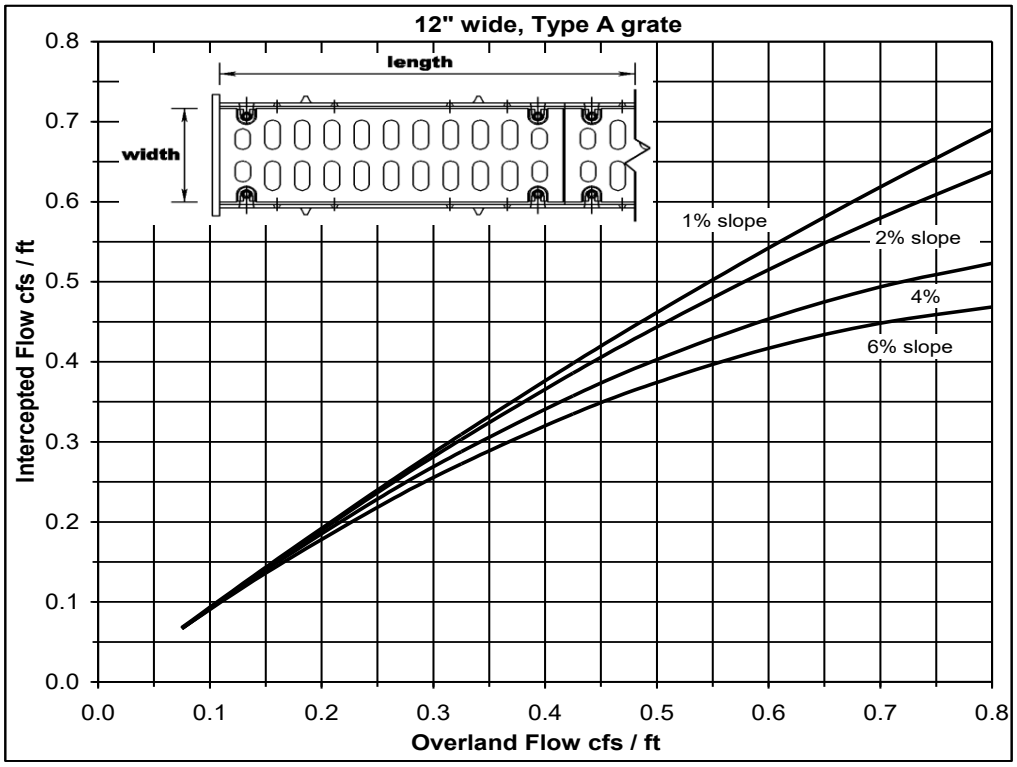


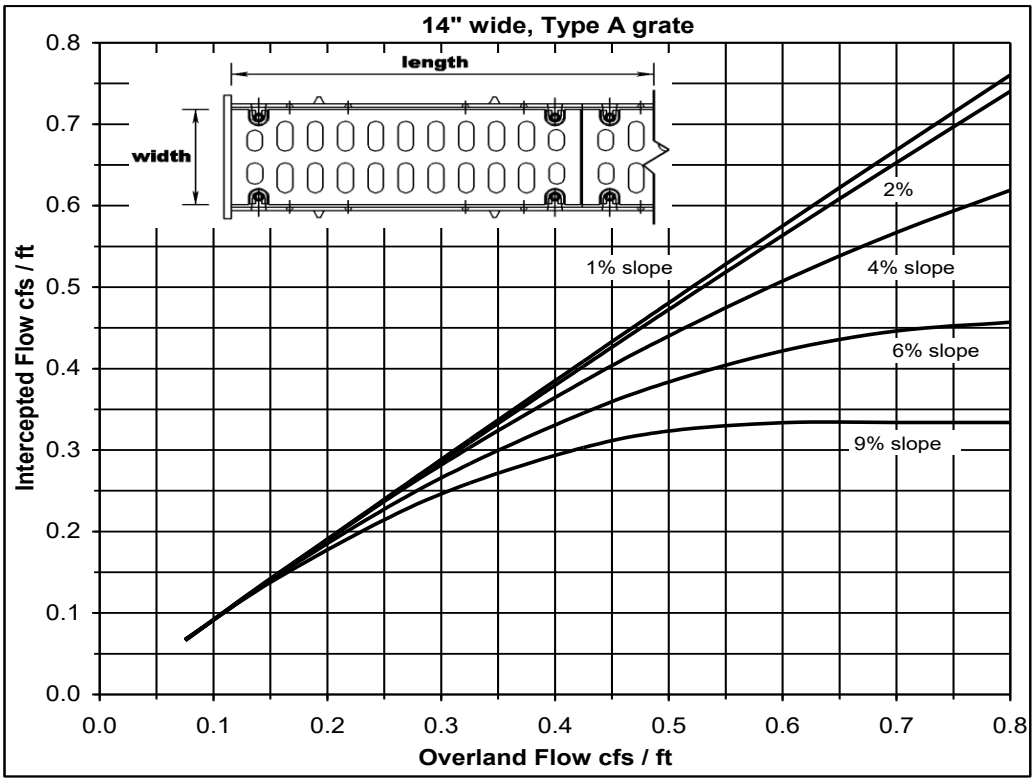


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-12

Concrete Box with Type A Grate (12”, 14”)

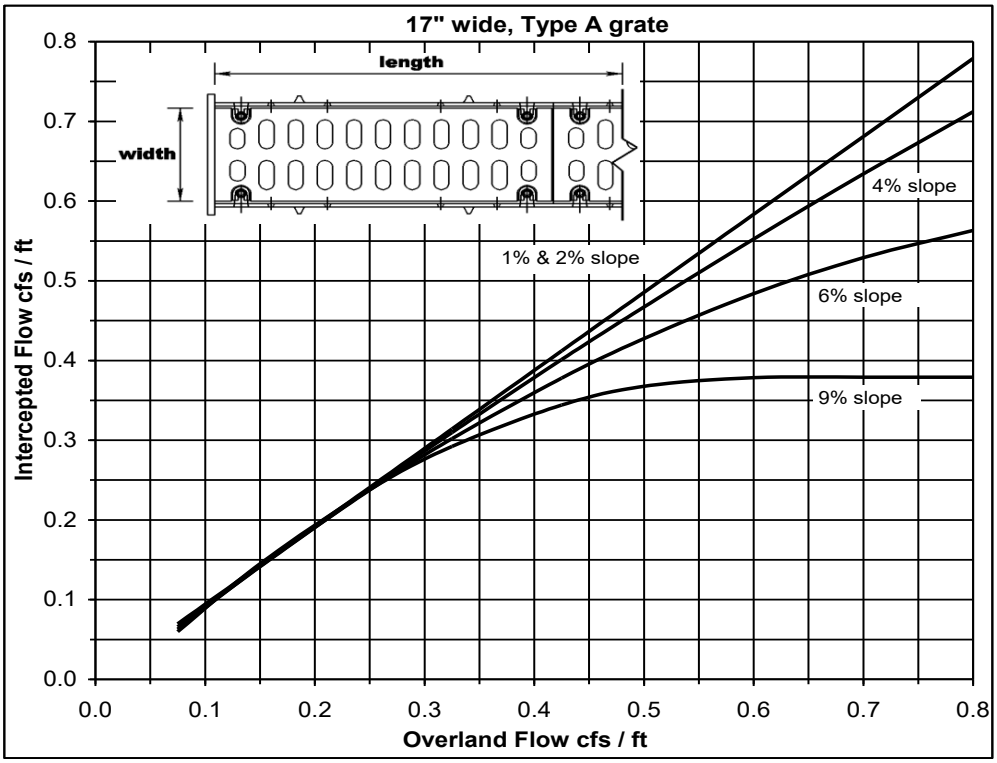


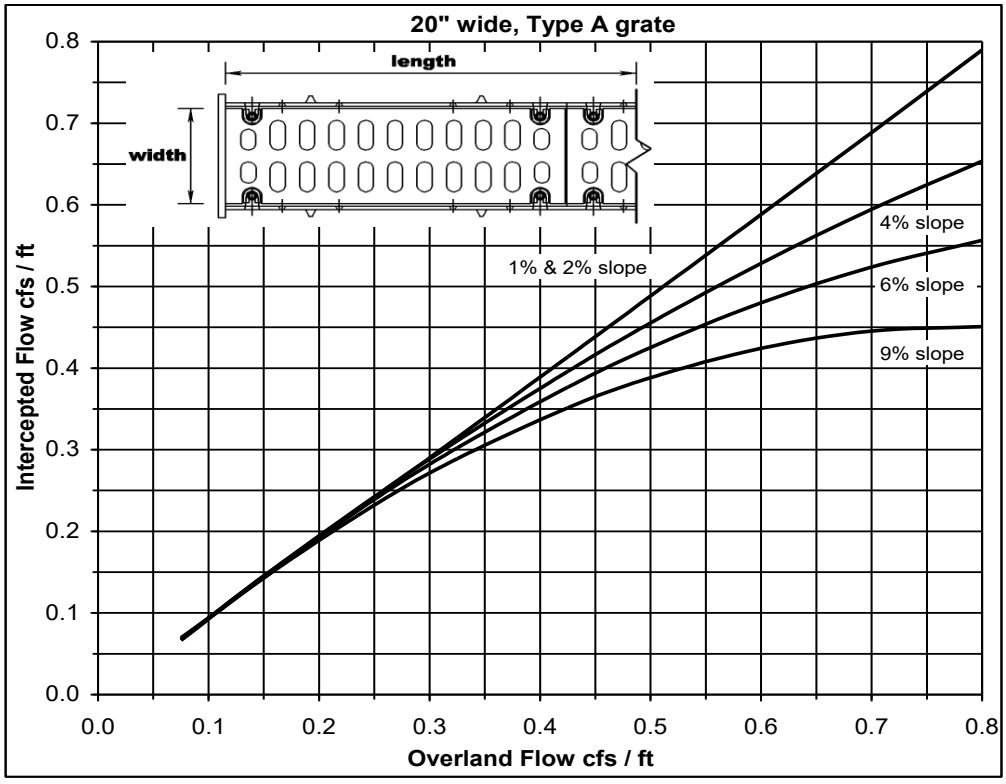


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-13

Concrete Box with Type A Grate (17”, 20”)

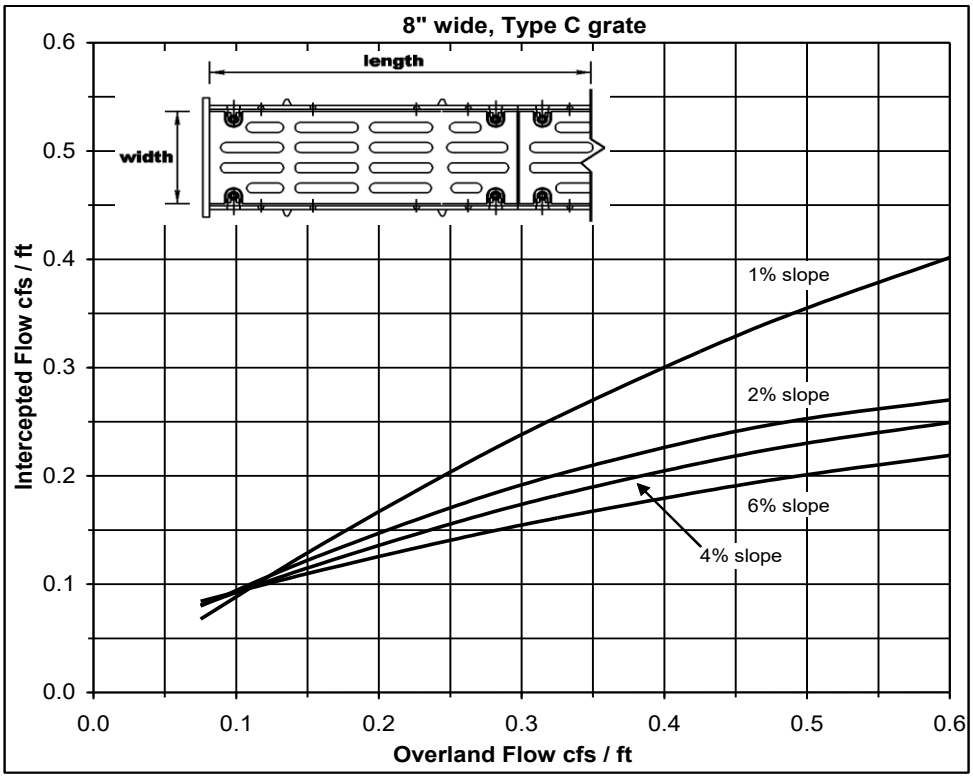


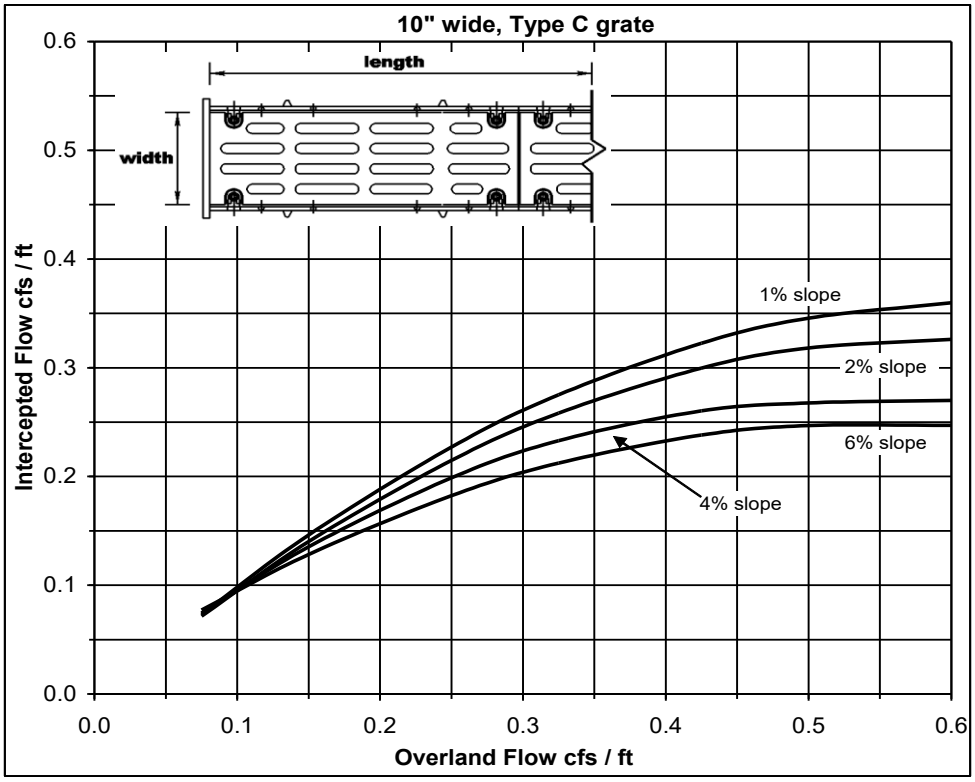


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-14

Concrete Box with Type C Grate (8”, 10”)

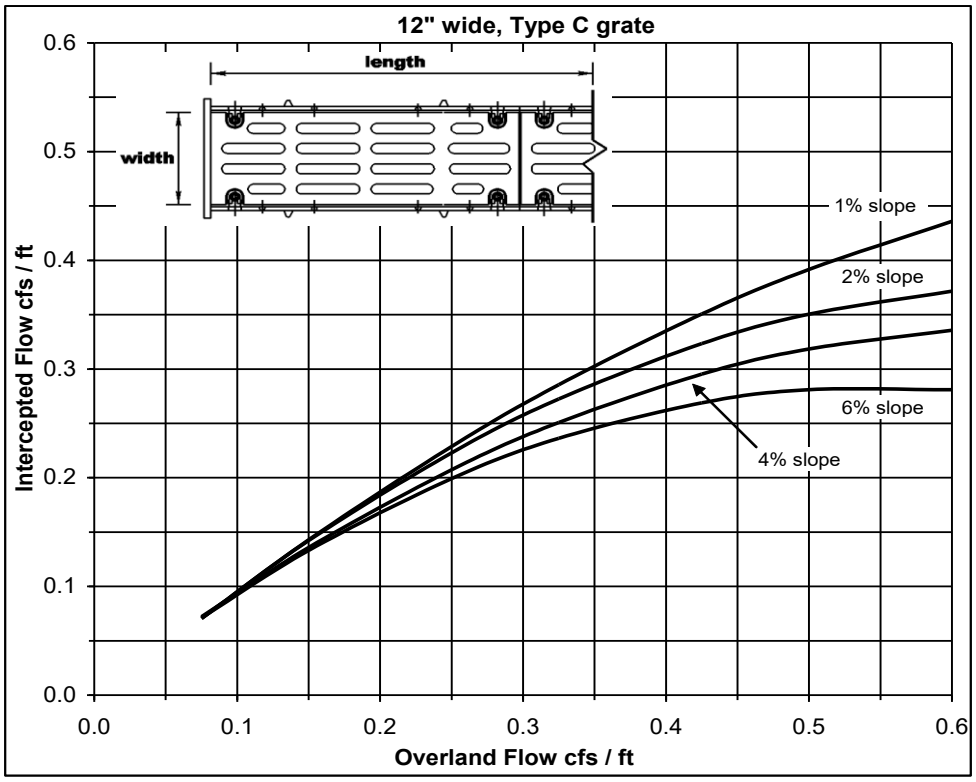


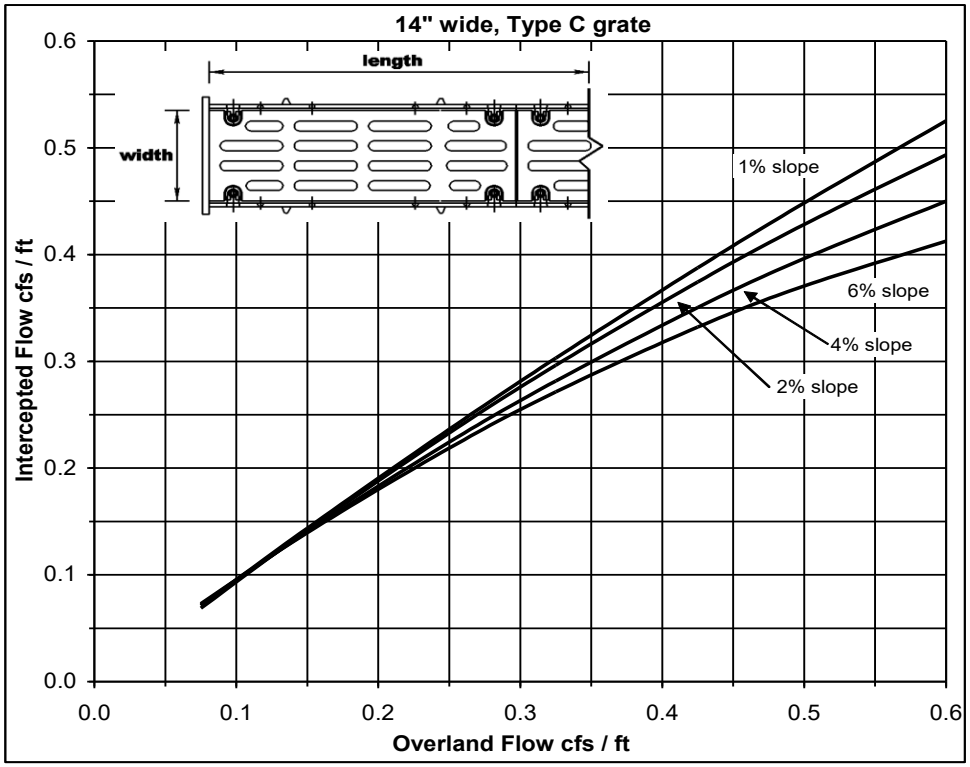


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-15

Concrete Box with Type C Grate (12”, 14”)

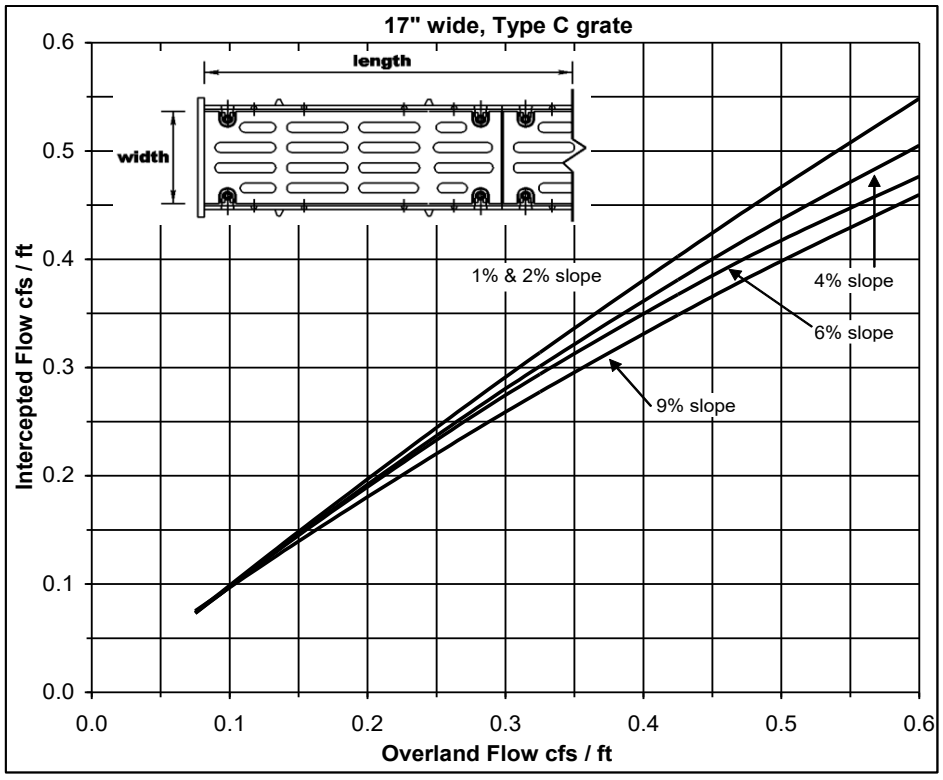


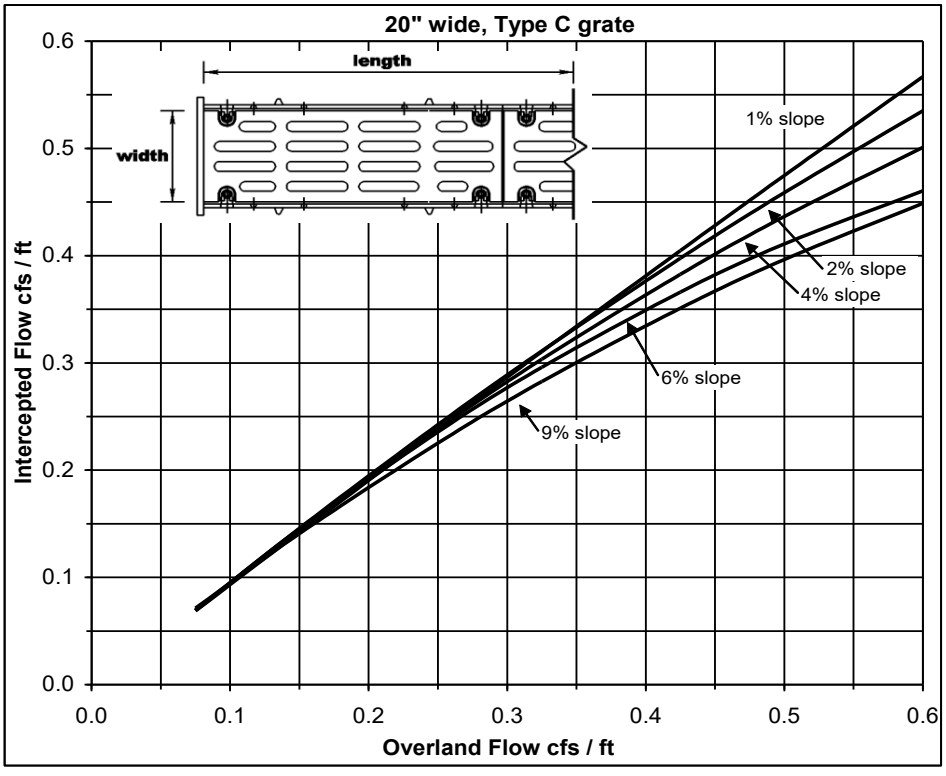


Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-16

Concrete Box with Type C Grate (17”, 20”)

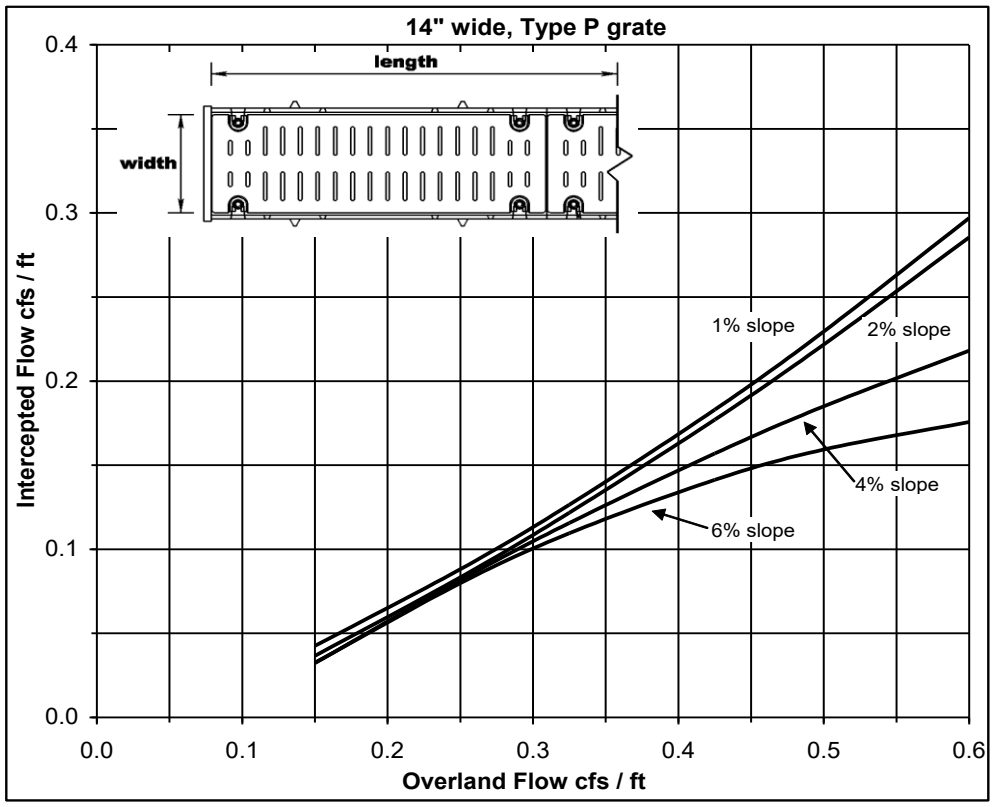




Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-17

Concrete Box with Type P Grate (14”)

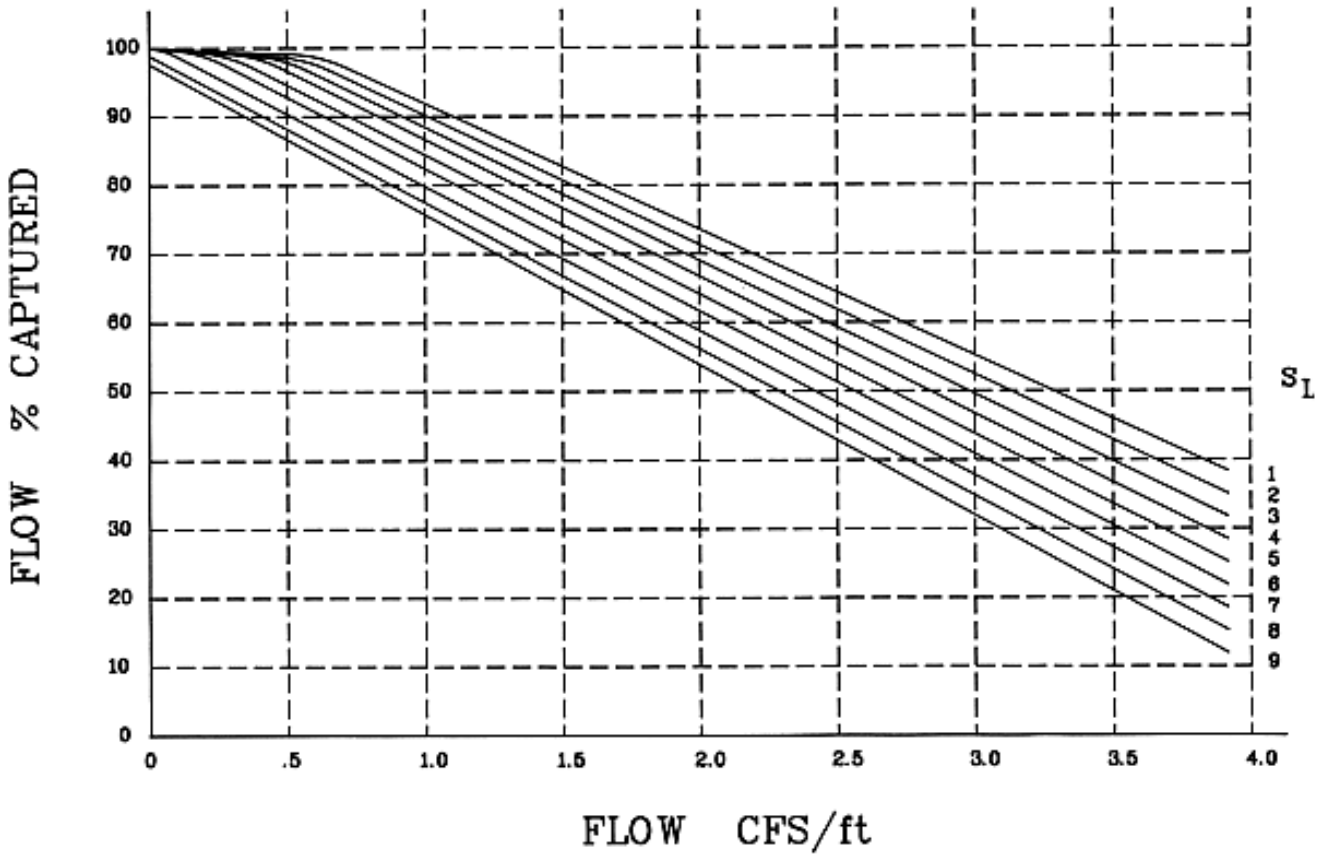


Created by the WVDOH Hydraulic and Drainage Unit

Continuous vane style inlet grates are also available for the cast in place concrete box drains. These provide additional capacity for flow over a longitudinal grade than the Type A or C grates. Testing was performed by the same major grate manufacturer for a 14” wide vane grate and is provided in Chart 5-18. Further research should be done for the inlet capacity of grate sizes that were not tested. If no information is available for the desired grate width, engineering judgment may be used, utilizing the data available as an estimate.

Chart 5-18

Concrete Box with Vane Style Grate (14")



Source: Neenah Inlet Grate Capacities, 1987

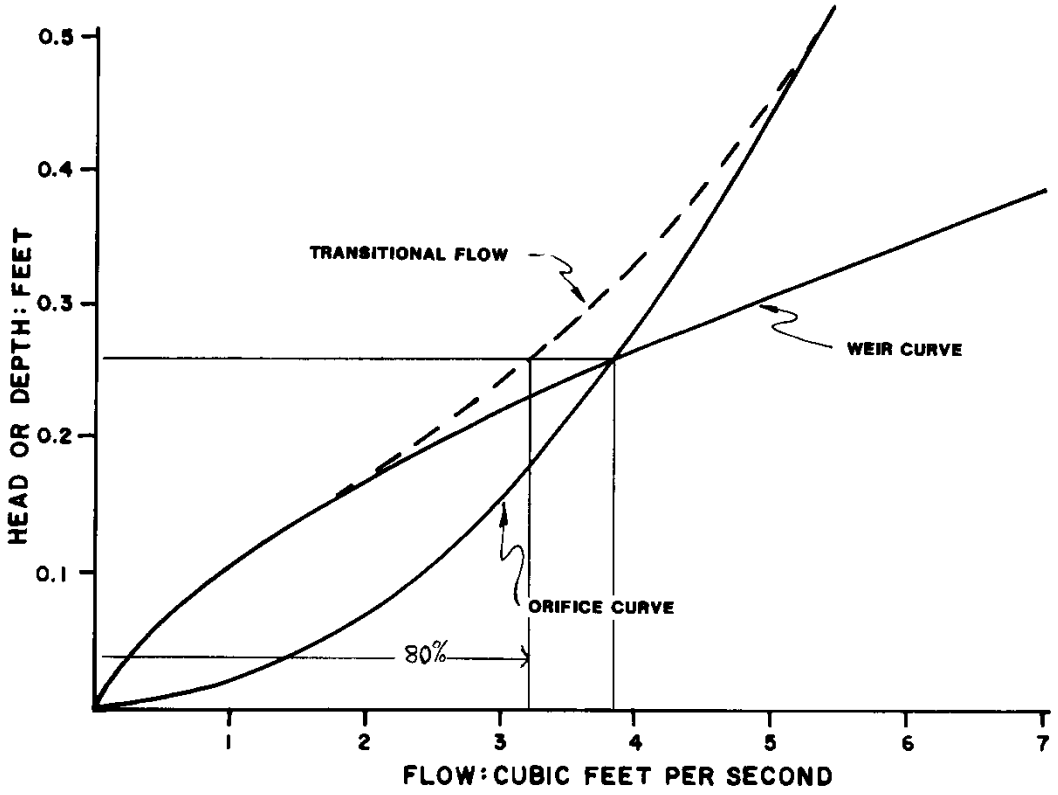
5.3.4.7 GRATE INLET CAPACITY IN A SAG LOCATION

A grate inlet in a sag location operates as a weir to depths that are dependent on the size of the grate and as an orifice at greater depths. Grates of larger dimension will operate as weirs to greater depths than smaller grates. The capacity controlling parameters for weir and orifice flow are the effective perimeter (or footage of the sides subject to flow) and the clear opening area, respectively.

The transition from weir to orifice flow results in an interception capacity that is less than that computed by either the weir or the orifice equation. According to research performed by a major grate manufacturer, this capacity can be approximated by drawing a curve between the lines representing the weir and orifice flow. When both weir and orifice flow rates are approximately the same, a vortex appears over the grate causing this reduction in capacity. A conservative estimate of 80% of capacity at the depth where this vortex occurs was used to approximate the curve for transitional flow.

Figure 5-5

Depth at 80% Capacity in a Sag



Source: Neenah Inlet Grate Capacities, 1987

For example, a 2' X 2' tilt bar grate inlet (Type B) in a curb and gutter section, in a sag location operates as a weir up to a depth of about 8 inches (0.68'). For this 30˚ tilt bar grate used by the WVDOH, the effective clear opening area that determines orifice flow capacity is 34% of the total area of the grate. This yields a clear opening area of 1.36 ft2 with orifice flow beginning at a depth of about 11.5 inches (0.89'). At a depth of 0.47 feet the weir and orifice flow were equal. Eighty percent of the capacity at this depth yields a flow rate of 3.99 ft3/s which gives a fixed point on the transitional flow line. Once drawn, the transitional flow line extends from a point before the limit of weir flow to a point after the limit of orifice flow for a conservative representation of flow behavior of a 2' X 2' tilt bar grate in a sag location.

The capacity of a grate inlet operating as a weir is:

$$Q_i = 3 P d^{1.5}$$

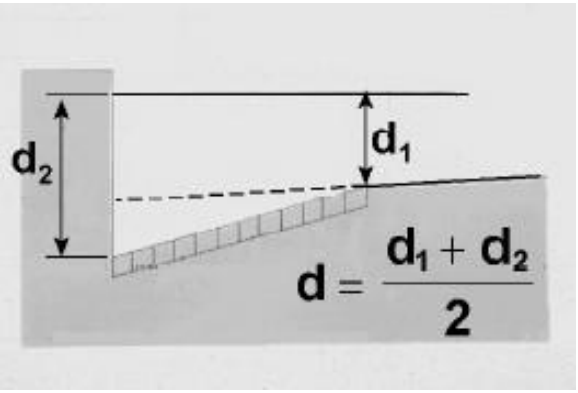
P = effective perimeter of grate (ft)

d = average depth across the grate (ft)

($d_{1\ (adjacent\ to\ road)}$ + $d_{2\ (adjacent\ to\ curb)}$) / 2, (ft)

Figure 5-5

Average Depth Over a Grate



The capacity of a grate inlet operating as an orifice is:

$$Q_i = 0.67 A (2 g d)^{0.5}$$

A = effective clear opening area of the grate (ft^2)

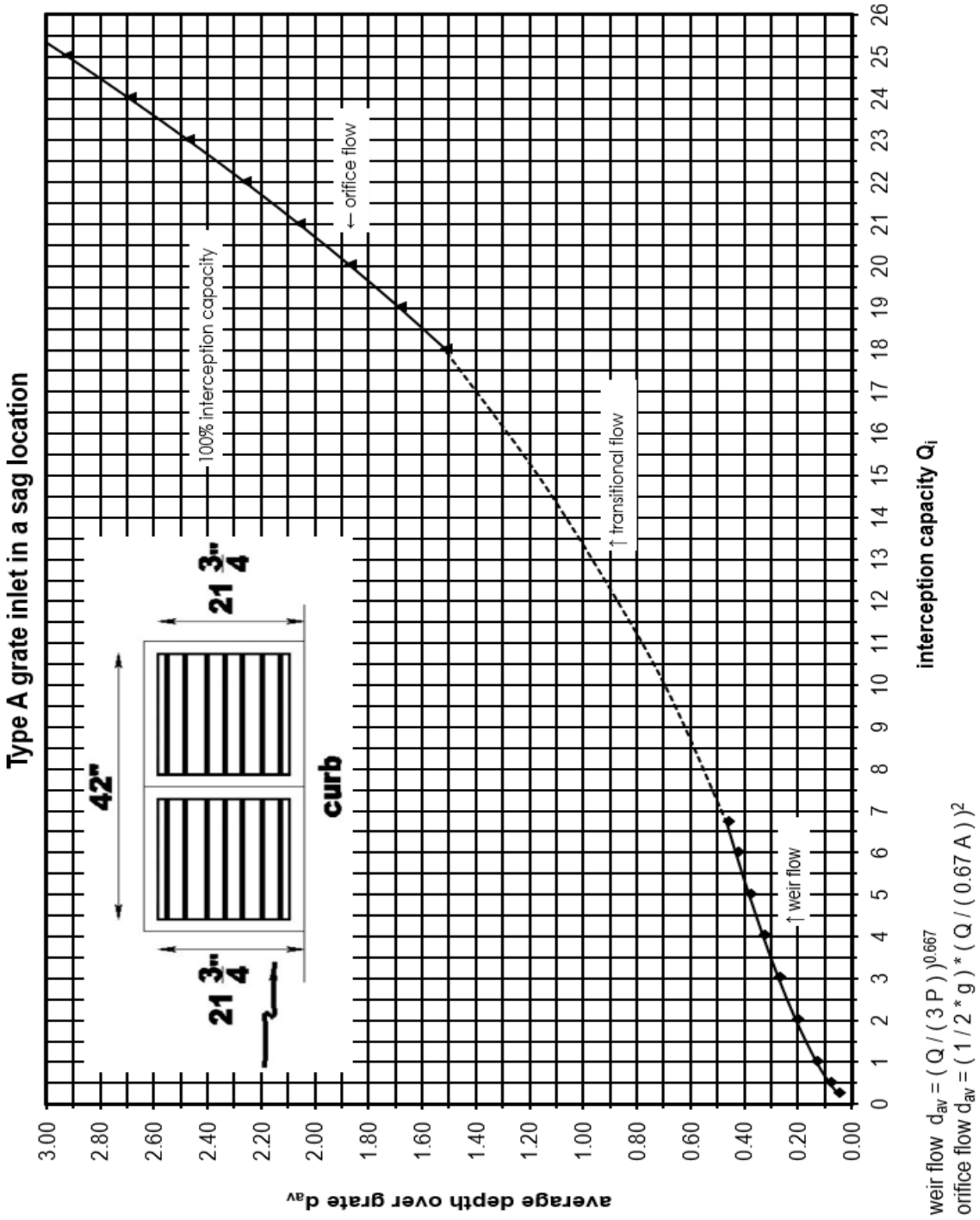
g = gravitational acceleration, 32.2 (ft/s^2)

d = average depth across the grate (ft)

Formulas for depths of flow adjacent to the road and adjacent to the curb for composite gutter sections can be found on Figure 5-2. Chart 5-19 through Chart 5-21 can be used to determine the grate inlet capacity of the WVDOH standard grate inlets in a sag location.

Chart 5-19

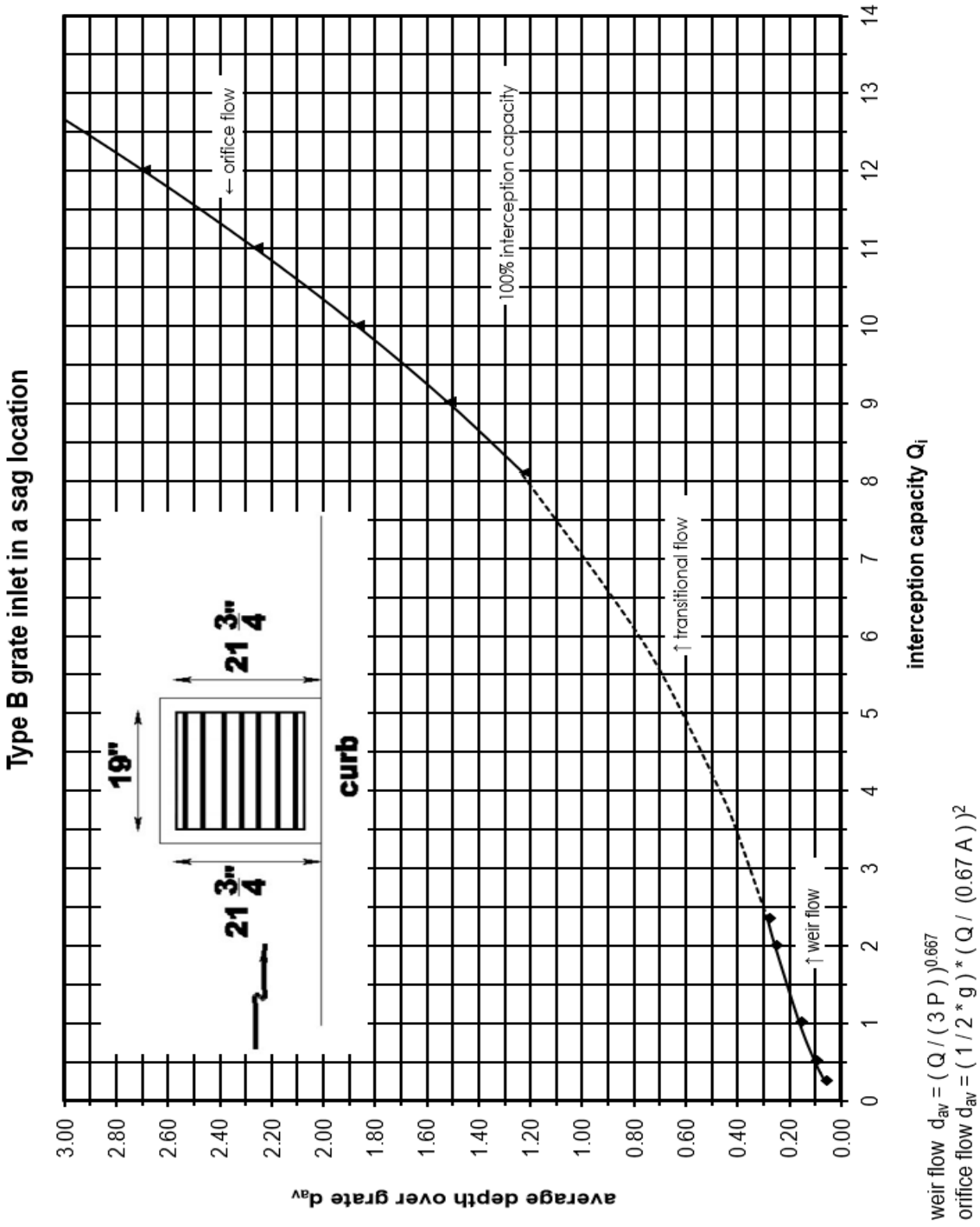
Type A Grate Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-20

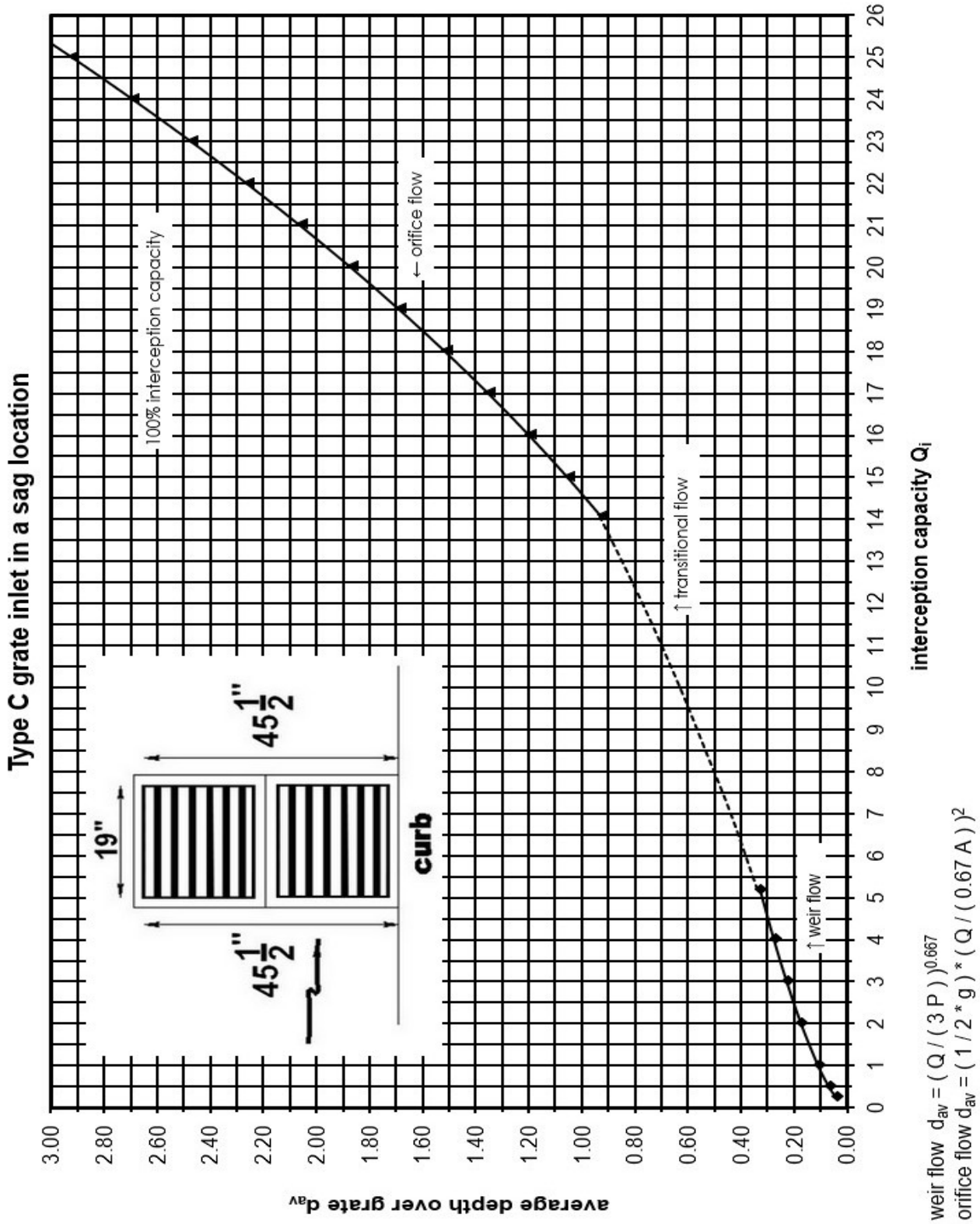
Type B Grate Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-21

Type C Grate Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Equations that approximate the transitional flow line are provided for the purpose of spreadsheet development by users of this manual. They are provided in Table 5-4 through Table 5-6.

Table 5-4

Transitional Flow Line Equations for Type A, B, C Inlets

Line	Weir flow limit depth	d_{AV} vs. Interception Capacity	Orifice flow limit depth
A 100% capacity	0.46	$d_{AV} = 0.0028Q^2 + 0.0252Q + 0.1702$	1.52
B 100% capacity	0.28	$d_{AV} = 0.0137Q^2 + 0.0230Q + 0.1546$	1.23
C 100% capacity	0.34	$d_{AV} = 0.0028Q^2 + 0.0149Q + 0.1755$	0.93

5.3.4.8 CURB-OPENING INLET CAPACITY IN A SAG LOCATION

The capacity of a curb-opening inlet in a sag location depends on the projected water depth at the curb opening, the curb opening length, and the height of the curb opening. The inlet operates as a weir to depths equal to the curb opening height and as an orifice at depths greater than 1.4 times the opening height. At depths between 1.0 and 1.4 times the opening height, flow is in a transitional stage. If the opening is depressed, the depth of the depression is not added to the opening height to determine the limits of weir and orifice flow.

The capacity of a depressed curb-opening inlet operating as a weir is:

$$Q_i = 2.3\left(L + 1.8\,W\right) d^{\,1.5}$$

L = length of curb opening (ft)

W = lateral width of depression (ft)

d = depth at the curb measured from the cross slope

(i.e. projected depth d = TS_x) (ft)

WVDOH standard curb-opening inlets have a 4 inch opening and are depressed 2 inches. The lateral width of depression is 1 foot. For curb-opening lengths greater than 12 feet, the weir equation becomes:

$$Q_i = 3\,L\,d^{\,1.5}$$

The capacity of a curb-opening inlet operating as an orifice is:

$$Q_i = 0.67\ h\ L \left[2\ g \left(d - \left(\frac{h}{2} \right) \sin\ \theta \right) \right]^{0.5}$$

h = orifice throat width (ft)

L = length of curb opening (ft)

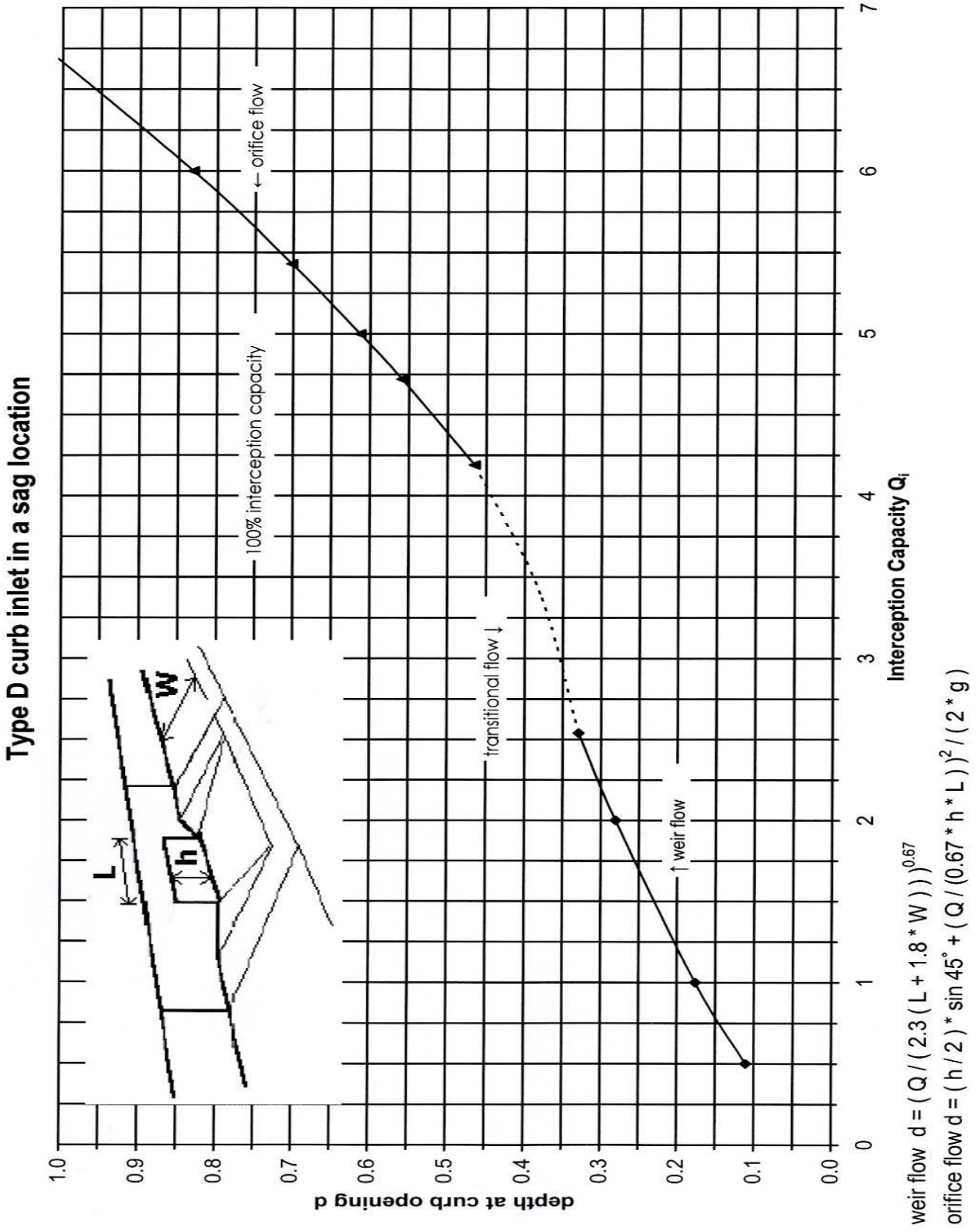
d = depth at the curb (ft)

Θ = angle of inclination for the inlet throat (degrees)

WVDOH standard curb-opening inlets have an inclined throat at an angle of 45˚ with a throat width of 4 inches. Chart 5-22 through Chart 5-26 can be used to determine the inlet capacity of the WVDOH standard curb opening inlets in a sag location. Based on the opening height, the depth limits for weir and orifice flow for the standard curb-opening inlets overlap; therefore, the transitional flow line was created using the same method as that of grate inlets.

Chart 5-22

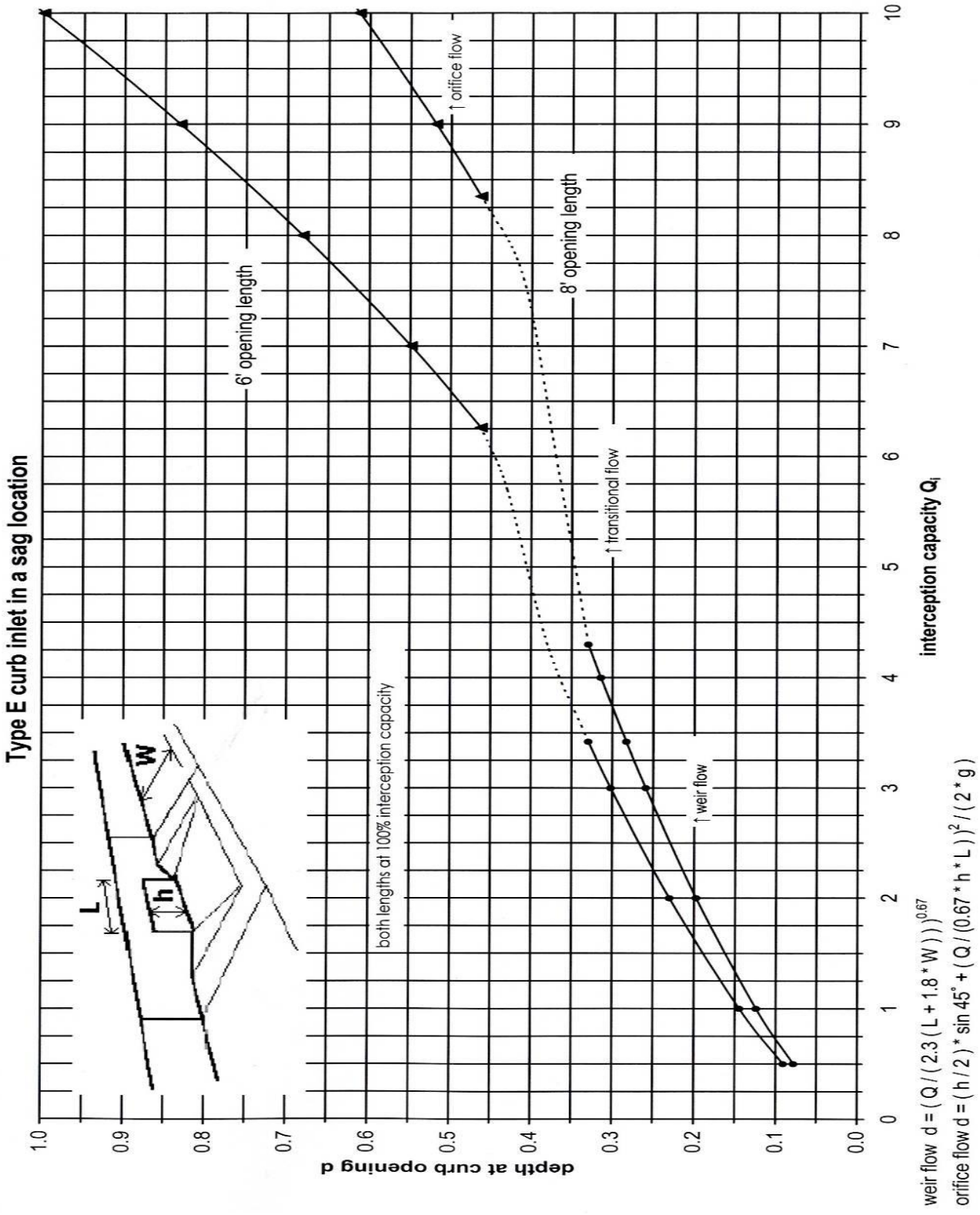
Type D Curb-Opening Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-23

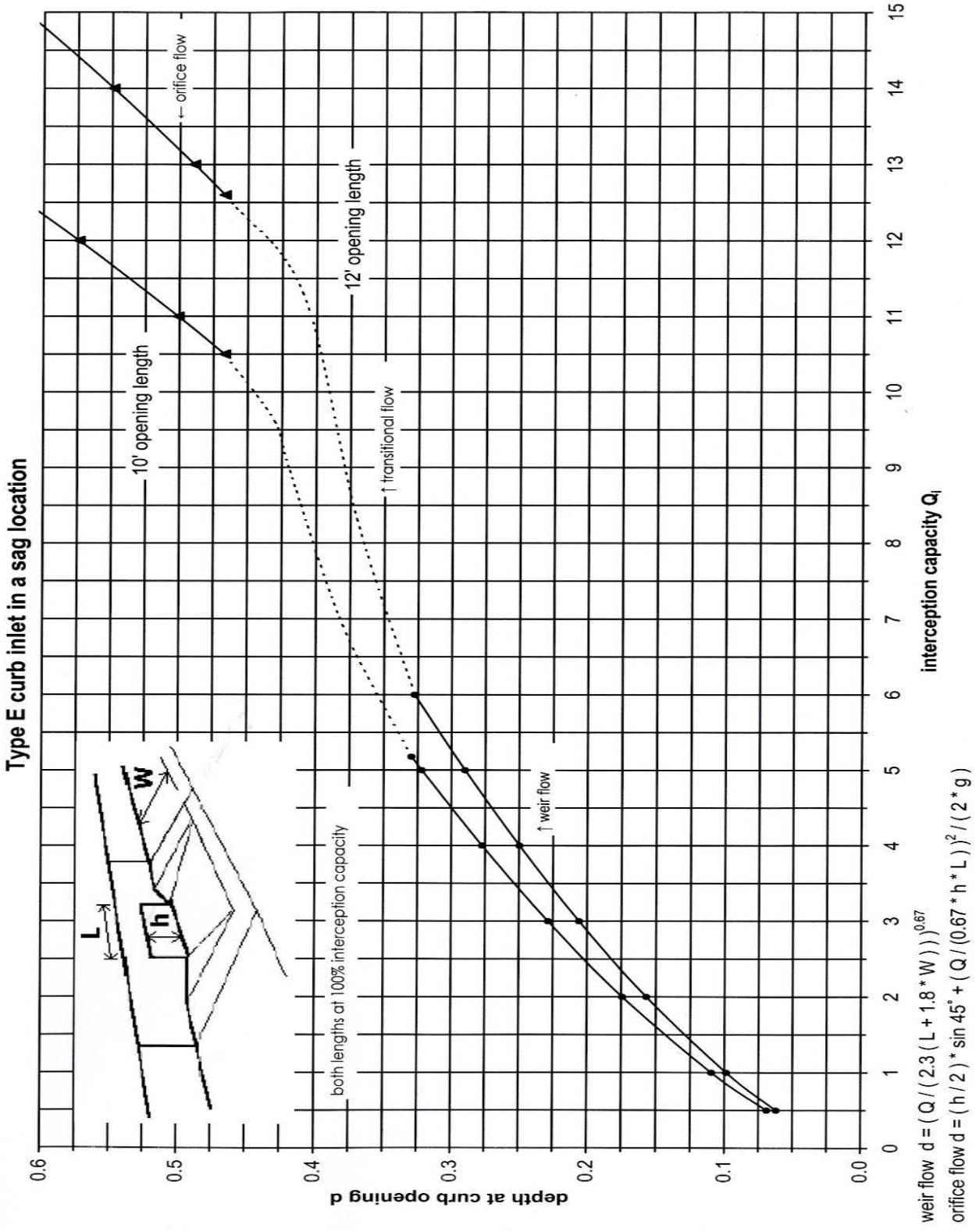
Type E (6', 8') Curb-Opening Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-24

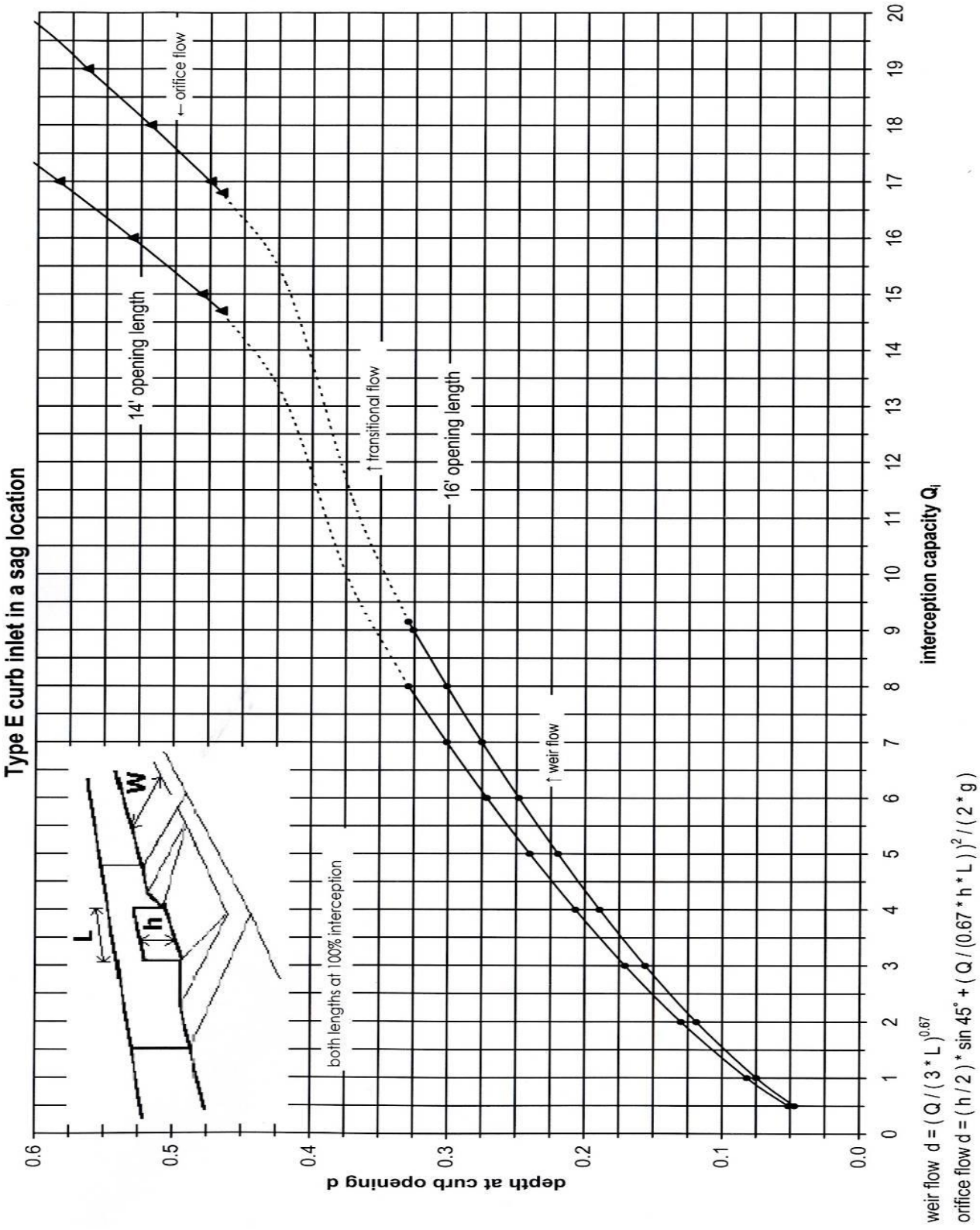
Type E (10', 12') Curb-Opening Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-25

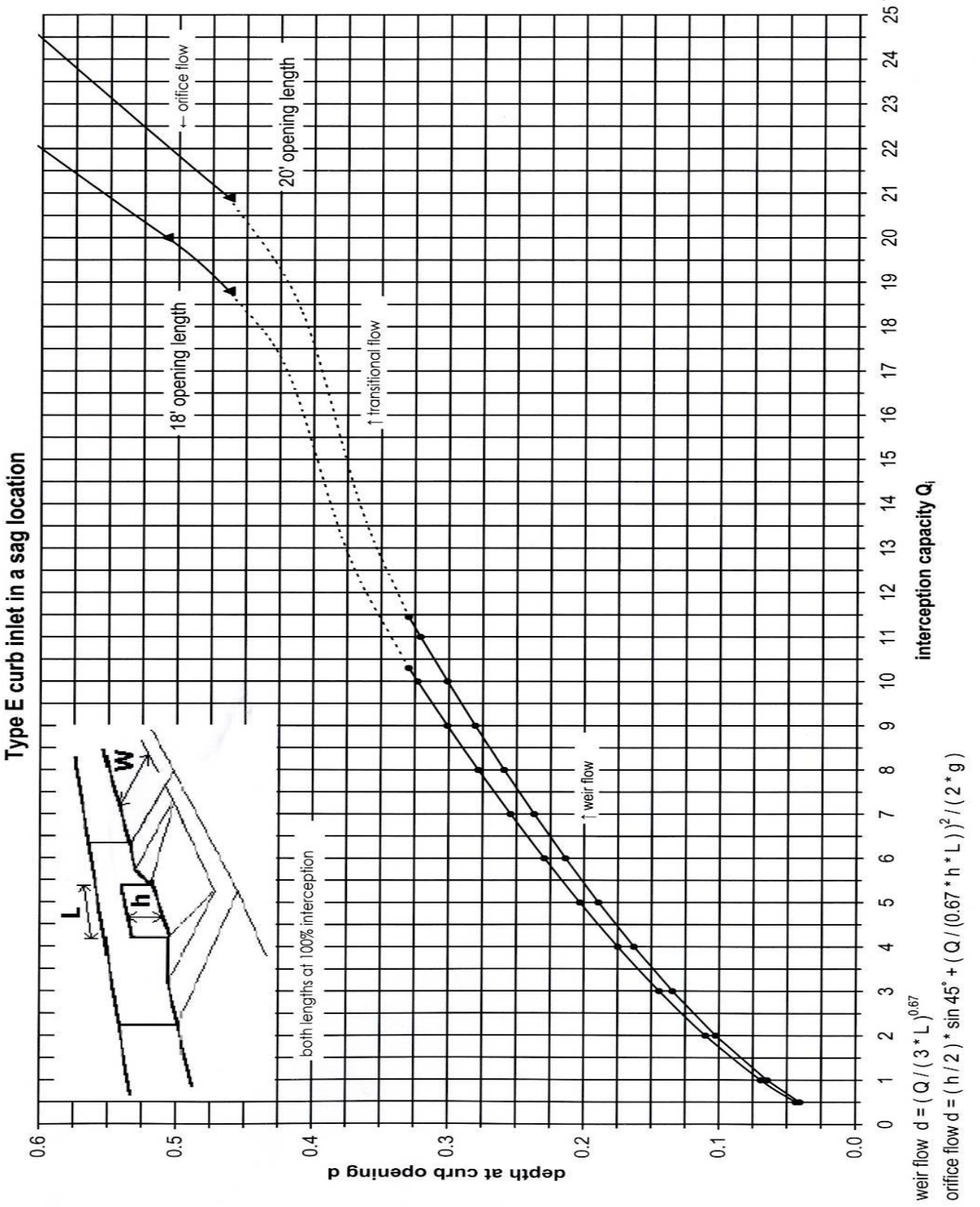
Type E (14', 16') Curb-Opening Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-26

Type E (18', 20') Curb-Opening Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Table 5-5

Transitional Flow Line Equations for Type D & E Inlets

Line 100% capacity	Weir flow limit depth	Depth at the curb vs. Interception Capacity	Orifice flow limit depth
D	0.33	$d = 0.0295Q^2 - 0.1160Q + 0.4335$	0.47
E 6' opening	0.33	$d = 0.0073Q^3 - 0.108Q^2 + 0.5621Q - 0.6228$	0.47
E 8' opening	0.33	$d = 0.0047Q^3 - 0.0831Q^2 + 0.5051Q - 0.6771$	0.47
E 10' opening	0.33	$d = 0.0014Q^3 - 0.0318Q^2 + 0.2643Q - 0.3742$	0.47
E 12' opening	0.33	$d = 0.0012Q^3 - 0.0321Q^2 + 0.2895Q - 0.516$	0.47
E 14' opening	0.33	$d = 0.0007Q^3 - 0.0238Q^2 + 0.2777Q - 0.7328$	0.47
E 16' opening	0.33	$d = 0.0005Q^3 - 0.0196Q^2 + 0.2556Q - 0.7672$	0.47
E 18' opening	0.33	$d = 0.0004Q^3 - 0.016Q^2 + 0.2369Q - 0.8229$	0.47
E 20' opening	0.33	$d = 0.0002Q^3 - 0.0111Q^2 + 0.1806Q - 0.6394$	0.47

5.3.4.9 COMBINATION INLET CAPACITY IN A SAG LOCATION

The interception capacity of the curb opening with grate combination is essentially equal to that of the grate alone in weir flow. In orifice flow, the capacity is equal to that of the grate plus that of the curb opening. For orifice flow, the capacity of the grate depends on the average depth over the grate and the capacity of the curb opening depends on the projected water depth at the curb. To graph depth vs. capacity the depth must be common to both types of flow. For this manual, the depth at the curb will be put in terms of the average depth over the grate. The use of this depth will require formulation of graphs for specific gutter widths and gutter slopes.

$$d_1 = d_2 + S_X\, W + a \qquad \text{(see Figure 5-2)}$$

d_1 = depth at the curb, ft

d_2 = depth at the break in cross slope, ft

$$a = S_W\, W - S_X\, W \quad \therefore \quad d_1 = d_2 + S_W\, W \quad or \quad d_2 = d_1 - S_W\, W$$

Therefore, the average depth over the grate (between d_1 and d_2) in terms of the depth at the curb (d_1) becomes:

$$d_{av} = d_1 - \frac{1}{2} S_W\, W \quad \therefore \quad d_1 = d_{av} + \frac{1}{2} S_W\, W$$

WVDOH standard combination inlets have a vertical throat with a throat width of 4 inches. Due to the vertical throat, the equation for orifice flow in a sag location for the curb-opening component does not depend on an angle of inclination. Substituting for the projected depth at the curb in the curb opening orifice flow equation gives the equation in terms of the average depth over the grate.

$$Q_i = 0.67\ h\ L \left(2\ g\ d_{av} + \frac{1}{2} S_W\ W \right)^{0.5}$$

h = height of curb opening (ft)

L = length of curb opening (ft)

g = gravitational acceleration, 32.2 (ft/s^2)

S_W = cross slope of gutter (ft/ft)

W = width of gutter (ft)

This results in the equation for orifice flow for WVDOH standard combination inlets in terms of the average depth over the grate as:

$$Q_i = 0.67\ A \left(2\ g\ d_{av}\ \right)^{0.5} + 0.67\ h\ L \left(2\ g\ d_{av} + \frac{1}{2} S_W\ W \right)^{0.5}$$

A = effective clear opening area of the grate (ft^2)

h = height of curb opening (ft)

L = length of curb opening (ft)

g = gravitational acceleration, 32.2 (ft/s^2)

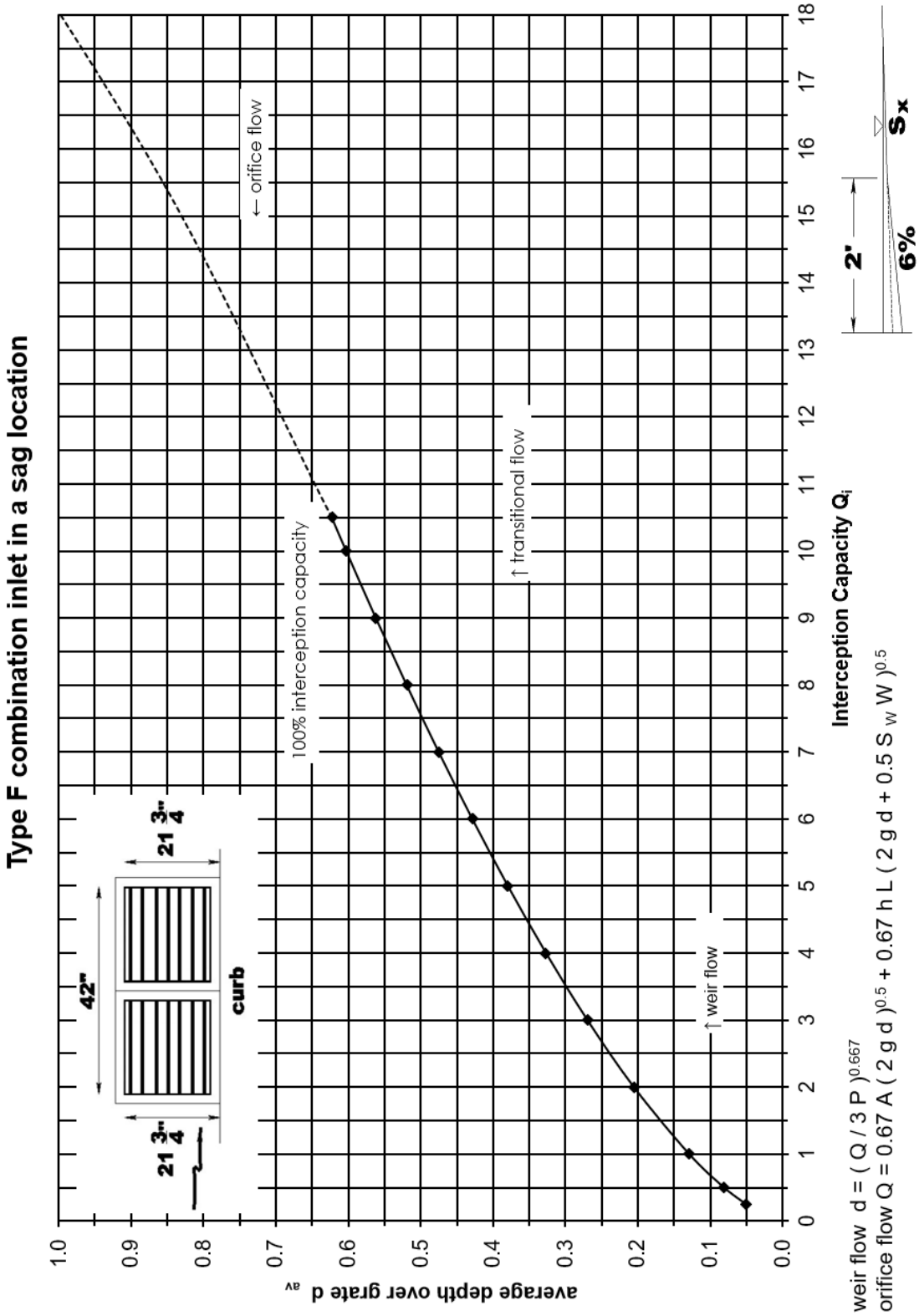
S_W = cross slope of gutter (ft/ft)

W = width of gutter (ft)

The limits for weir and orifice flow are determined in the same manner as that for the grate inlet capacity in a sag location (see Section 5.3.4.7). Chart 5-27 and Chart 5-28 can be used to determine the inlet capacity of standard WVDOH combination inlets in a sag location. Values for the capacity for other composite gutter sections may be obtained by using the equations.

Chart 5-27

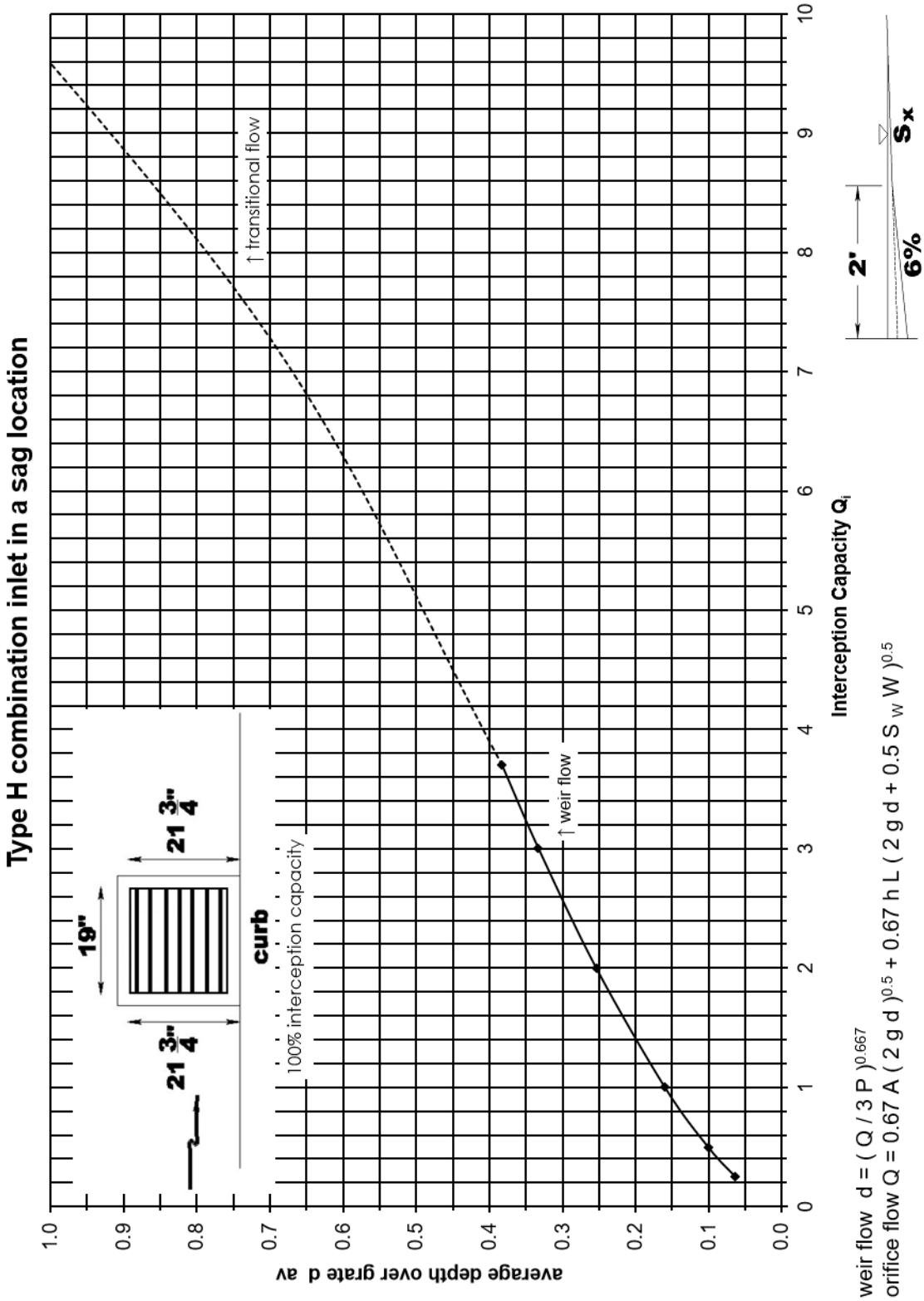
Type F (2' wide, 6% gutter) Combination Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Chart 5-28

Type H (2' wide, 6% gutter) Combination Inlet in a Sag Location



Created by the WVDOH Hydraulic and Drainage Unit

Table 5-6

Transitional Flow Line Equations for Type F & H Inlets

Line 100% capacity	Weir flow limit depth	Depth at the curb vs. Interception Capacity	Orifice flow limit depth
F 100% capacity	0.62	$d = 0.0012Q^2 + 0.0146Q + 0.335$	1.79
H 100% capacity	0.38	$d = 0.0044Q^2 + 0.0462Q + 0.1475$	1.59

5.3.4.10 FLANKING INLETS AT SAG LOCATION

To properly drain sag vertical curves where significant ponding may occur, flanking inlets should be placed on each side of the inlet located at the low point of the sag. This is important when there is no outlet from a depressed area except through the storm drain system. The flanking inlets should be located so that they will receive all the flow when the sag inlet is 100% clogged. They should do this without exceeding the design spread at the low point of the sag. Other inlets may be required between the flanking inlets and the sag inlet location. The flanking inlets are used as a safety factor and should not be included in the spacing design to intercept flow.

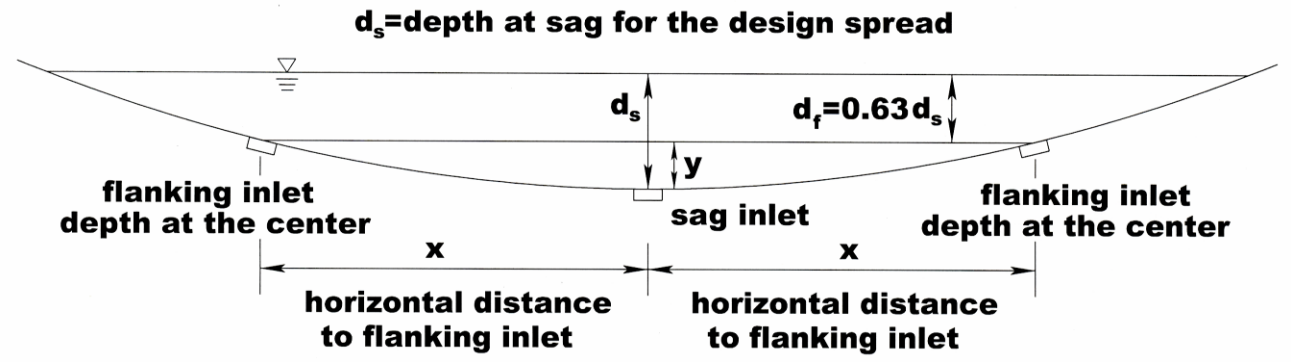
The design of a sag inlet begins by determining the depth for the allowable design spread. The allowable spread almost always results in weir flow into the inlets. It is important to define the depth common to the sag and the flanking inlets. In most cases this depth is the average depth over a grate since in weir flow the grate usually provides the flow capacity. The definition changes to the depth at the curb if a curb opening inlet is used as the sag or flanker inlet. If a mixture of a combination inlet at the sag and a curb opening inlet as a flanker is used the depth should be defined at the curb. This means the equation for the capacity of the combination inlet at the sag should be changed to use the depth at the curb instead of the average depth.

Once the capacity for the sag inlet is determined from the defined depth, half of this capacity is the amount the flanking inlet must accept. The depth over the flanking inlet for half of the sag inlet capacity is determined using the weir flow equation for the sag and flanking inlet. If the flanking inlets have the same effective perimeter as the sag inlet, the depth at the flanking inlet (d_f) is 0.63 times the depth as the sag inlet (d_s, see Figure 5-7). For example, this would be the case for the following sag and flanking inlet combinations:

- The same inlet type (and length for E's) at the sag and the flanking positions (A, B, C, D, E, F, H).
- Type F at the sag with Type A inlets at the flanking positions.
- Type H at the sag with Type B inlets at the flanking positions.

Figure 5-7

Flanking Inlets with Same Effective Perimeter as the Sag Inlet



The following illustrates how the factor is determined if the flanking inlets are the same as the sag inlet:

$$Q_i = 3\,P\,d^{\,1.5}$$

P = effective perimeter of grate (P_f – flanking, P_s – sag), ft

d = average depth across the grate, ft

$$Q_f = Q_s$$

$$3\,P_f\,d_f^{\,1.5} = \frac{1}{2} \times 3\,P_s\,d_s^{\,1.5}$$

$$d_f = \left(\frac{1}{2}\right)^{\frac{1}{1.5}} d_s$$

$$d_f = 0.63\,d_s$$

Once the depths over the sag and flanking inlets are known, the vertical distance from the low point in the sag vertical curve to the flanking inlet location (y) can be determined. The horizontal distance to the flanking inlet from the sag inlet is then calculated by the following equation:

$$x = \sqrt{200\;y\;K}$$

y = vertical distance from the lowest point in the sag to the flanking inlet

(d_s – d_f), ft

K = is the rate of vertical curvature, ft / %

If the units for K are defined as ft / ft/ft then the equation becomes:

$$x = \sqrt{2\ y\ K}$$

Table 5-7 shows the horizontal distance (x) to the flanking inlets if they have the same effective perimeter as the sag inlet. This distance is provided for various depths of ponding over the sag inlet (d_S) and various rates of vertical curvature (K) in ft/%.

AASHTO policy notes when considering the effects of drainage in a vertical curve design a minimum grade of 0.30 percent should be provided within 50 feet of the level point. This criterion corresponds to a K of 167 feet per percent change in grade.

Table 5-7

Flanking with the same Effective Perimeter as the Sag

Horizontal Distance (x) From the Low Point of a Sag Curve to Flanking Inlets Depth defined as the average depth or depth at the curb										
	K (ft/%)									
d_s (ft)	20	30	40	50	70	90	110	130	160	167
0.05	8.6	10.5	12.2	13.6	16.1	18.2	20.2	21.9	24.3	24.9
0.10	12.2	14.9	17.2	19.2	22.8	25.8	28.5	31.0	34.4	35.2
0.15	14.9	18.2	21.1	23.6	27.9	31.6	34.9	38.0	42.1	43.1
0.20	17.2	21.1	24.3	27.2	32.2	36.5	40.3	43.9	48.7	49.7
0.25	19.2	23.6	27.2	30.4	36.0	40.8	45.1	49.0	54.4	55.6
0.30	21.1	25.8	29.8	33.3	39.4	44.7	49.4	53.7	59.6	60.9
0.35	22.8	27.9	32.2	36.0	42.6	48.3	53.4	58.0	64.4	65.8
0.40	24.3	29.8	34.4	38.5	45.5	51.6	57.1	62.0	68.8	70.3
0.45	25.8	31.6	36.5	40.8	48.3	54.7	60.5	65.8	73.0	74.6
0.50	27.2	33.3	38.5	43.0	50.9	57.7	63.8	69.4	76.9	78.6

$$y = d_S - d_f \quad or \quad d_S - 0.63\ d_S$$

If the flanking inlets do not have the same effective perimeter as the sag inlet, another factor for the depth at the sag (d_s) is used to determine the depth at the flanking inlet (d_f). For example, this would be the case for the following sag and flanking inlet combinations:

- A type F or type A at the sag with type B's at the flanking positions.
- A type F or type A at the sag with type C's at the flanking positions.
- A type H at the sag with type C's at the flanking positions.

Table 5-8 and Table 5-9 are for inlets that do not have the same effective perimeter as the sag inlet. Horizontal distances for other combinations between the sag and flankers can be determined using the weir flow equation with the respective effective perimeters. The designer should be careful how the depth is defined when determining the distance between the sag and flanker inlets. This is especially true if curb opening inlets are used to flank a grate or

combination inlet at the sag as the weir perimeter is much different for the curb opening inlets. The depth at the flanking inlet is taken at the middle of its longitudinal dimension. In the case of a curb opening inlet as a flanker, it may have a much longer longitudinal dimension than the sag inlet.

Table 5-8

Type F or A Inlet in the Sag with Type B Flanking

Horizontal Distance (x) From the Low Point of a Sag Curve to Flanking Inlets Depth defined as the average depth										
	K (ft/%)									
d_s (ft)	20	30	40	50	70	90	110	130	160	167
0.05	6.6	8.1	9.4	10.5	12.4	14.1	15.6	16.9	18.8	19.2
0.10	9.4	11.5	13.3	14.8	17.5	19.9	22.0	23.9	26.5	27.1
0.15	11.5	14.1	16.2	18.2	21.5	24.4	26.9	29.3	32.5	33.2
0.20	13.3	16.2	18.8	21.0	24.8	28.1	31.1	33.8	37.5	38.3
0.25	14.8	18.2	21.0	23.5	27.7	31.5	34.8	37.8	42.0	42.9
0.30	16.2	19.9	23.0	25.7	30.4	34.5	38.1	41.4	46.0	47.0
0.35	17.5	21.5	24.8	27.7	32.8	37.2	41.2	44.7	49.6	50.7
0.40	18.8	23.0	26.5	29.7	35.1	39.8	44.0	47.8	53.1	54.2
0.45	19.9	24.4	28.1	31.5	37.2	42.2	46.7	50.7	56.3	57.5
0.50	21.0	25.7	29.7	33.2	39.2	44.5	49.2	53.5	59.3	60.6

$$y = d_S - d_f \quad or \quad d_S - 0.78\, d_S$$

Table 5-9

Type F or A Inlet in the Sag with Type C Flanking

Horizontal Distance (x) From the Low Point of a Sag Curve to Flanking Inlets Depth defined as the average depth										
	K (ft/%)									
d_s (ft)	20	30	40	50	70	90	110	130	160	167
0.05	9.7	11.9	13.7	15.3	18.1	20.6	22.7	24.7	27.4	28.0
0.10	13.7	16.8	19.4	21.7	25.7	29.1	32.2	35.0	38.8	39.6
0.15	16.8	20.6	23.7	26.6	31.4	35.6	39.4	42.8	47.5	48.5
0.20	19.4	23.7	27.4	30.7	36.3	41.1	45.5	49.4	54.8	56.0
0.25	21.7	26.6	30.7	34.3	40.6	46.0	50.8	55.3	61.3	62.6
0.30	23.7	29.1	33.6	37.5	44.4	50.4	55.7	60.5	67.2	68.6
0.35	25.7	31.4	36.3	40.6	48.0	54.4	60.2	65.4	72.6	74.1
0.40	27.4	33.6	38.8	43.4	51.3	58.2	64.3	69.9	77.6	79.2
0.45	29.1	35.6	41.1	46.0	54.4	61.7	68.2	74.2	82.3	84.0
0.50	30.7	37.5	43.4	48.5	57.4	65.0	71.9	78.2	86.7	88.6

$$y = d_S - d_f \quad or \quad d_S - 0.53\, d_S$$

5.3.5 ACCESS STRUCTURES / MANHOLES

Manholes are utilized to provide access to continuous underground storm drains for inspection and cleanout. Where feasible, grate inlets may be used for access in lieu of manholes for the benefit of additional storm-water interception at minimal additional cost. Typical locations where manholes should be specified are:

- where two or more storm drains converge
- at intermediate points along tangent sections
- at a change in pipe size
- where a change in alignment more than 10 degrees occurs
- where a change in grade more than 15 percent occurs

All measures should be taken to avoid the placement of manholes within traffic lanes. When it is impossible to avoid locating a manhole in a traffic lane, care should be taken to ensure it is not in the normal wheel path.

5.3.5.1 HEIGHT

Pre-cast manhole sections are available for installation of pipes up to 60 inches in diameter. Larger sizes are limited by the pre-cast segment height of 8 feet. Manholes with an installation of larger pipe sizes will require field construction (cast-in-place or masonry), tee structures or a special pre-cast design. Special details must be shown in the contract plans.

5.3.5.2 SPACING

The maximum spacing of access structures whether manholes or inlets should not be exceeded. See Section 5.2.7.

5.3.6 STORM DRAINS

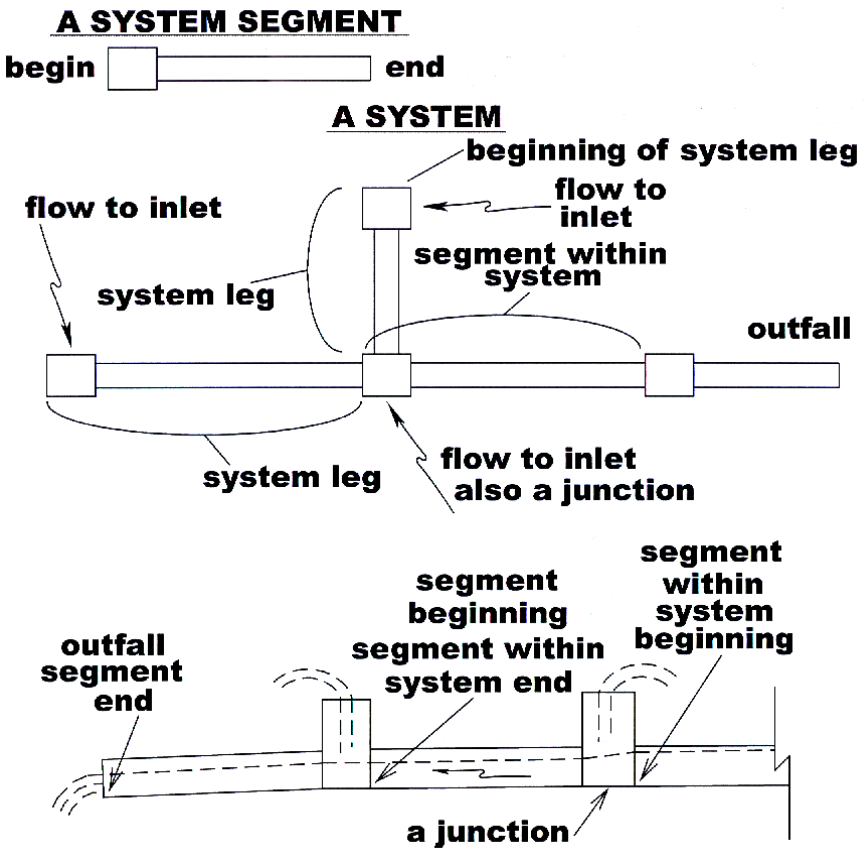
A storm drain is that portion of the highway drainage system which receives surface water through inlets and conveys the water through conduits to an outfall. A storm drain system generally discharges to a single outfall location. It may be a closed-conduit, open-conduit, or some combination of the two.

5.3.6.1 HYDRAULIC DESIGN

A chain of inlets connected by pipes is referred to as a system. Each segment in the system consists of an inlet and the pipe leaving that inlet. A leg in the system begins with an inlet and ends in a junction.

Figure 5-8

Hydraulic Design



After the preliminary locations of inlets, connecting pipes, and outfalls are placed, the size, slope, and amount of conveyed discharge is determined for each pipe in each segment of the system. This determination is made starting at the upstream segment proceeding downstream to the system outfall. The grade of the storm drain should approximate the roadway grade if the system parallels the roadway. When two segments or legs in a system converge at an inlet or access structure (junction) it is preferable to match the crown elevations of the inflow and outflow pipes. If the inflow and outflow inverts are the same and the accumulated inflow, or the reduction of slope for the outflow pipe should require an increase in the size of the outflow pipe then the flow entering the junction must increase in depth to fill the outflow pipe. The head loss in the junction may be more than the size increase for the outflow pipe because the inflow is slowed (loss of velocity head) to build up the required head for outflow. The result is a higher hydraulic grade line in the junction and possible siltation within the junction. Matching the crown elevations is more efficient because the design of the junction takes advantage of available head instead of the possibility of requiring additional head for the outflow. If an increase in the size of the outflow pipe is not necessary, the outflow pipe should be designed at least 0.1 feet lower than the lowest inflow pipe invert elevation to ensure flow through the junction after the construction of the system.

In most cases the Rational Method should be used to determine the conveyed discharge in each segment of the storm drain system. The rate of discharge at any point in the system is not equal to the sum of the flow rates of all the segments upstream of that point. For example, a fundamental rule of the Rational Method is that it assumes uniform rainfall intensity over the entire watershed. If the discharge rates were summed to the design point in a system and those rates were based on different time of concentrations, the rainfall intensities would be different for each rate. The flow path having the longest time of concentration to the design point will define the duration used to select the rainfall intensity value for the Rational Method. It is necessary to compute the incremental travel time through the system and accumulate this time as part of the flow path. Travel time through each segment of conduit is computed using the uniform flow velocity within the pipe of each segment. Refer to Section 4.4.2.5 to determine the rainfall intensity for the time of concentration.

In the case of a storm sewer system hydraulic design, the minimum T_c shall not apply. Since the travel time is summed as a design progresses through a system, applying the minimum of 5 minutes at the beginning artificially lowers the rainfall intensity when determining the overall time of concentration at the outlet.

Exceptions to the general application of the Rational Equation do exist. For example, a small relatively impervious area within a larger drainage area may have an independent discharge higher than that of the total area. This anomaly may occur because of a high runoff coefficient (C value) and high intensity resulting from a shorter time of concentration.

The design of a storm drain system should be based on open channel flow principles. The pipe should flow at a maximum depth equal to 0.8 times the pipe diameter or equivalent at the design discharge. In situations where a substantial advantage in economics or constructability can be achieved, pressure flow may be allowed at the discretion of the Engineer. The hydraulic grade line methodology described in Sections 5.3.6.4 should be used to analyze pressure flow in storm drains. Manning's Equation is recommended for determining the initial size or capacity of the conduit. Hydraulic grade line calculations are then made to check the effects of tailwater conditions and energy losses through the system.

Refer to Section 5.2.3 for the design frequency of storm drain conduits.

5.3.6.2 HYDRAULIC CAPACITY

Manning's Equation is expressed by the following equation:

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

In terms of discharge, the above formula becomes:

$$Q = VA = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

For storm drains flowing full, the above equations become:

$$V = \frac{0.059}{n} D^{2/3} S^{1/2} \qquad Q = \frac{0.463}{n} D^{8/3} S^{1/2}$$

V = Mean velocity of flow (ft/s)

S = Slope of the energy grade line (ft/ft)

R = Hydraulic radius (ft)

(flow area divided by the wetted perimeter (A/P)

N = Manning's roughness coefficient

P = Wetted perimeter (ft)

Q = Discharge (ft^3/s)

A = Cross-sectional area of flow (ft^2)

D = Diameter of pipe (ft)

Chart 5-30 can be used for determining the hydraulic capacity of storm drains flowing partially full. Chart 5-31 illustrates a sample calculation.

The Manning's Roughness coefficient for various pipe materials should be based on the recommendations in the latest version of Design Directive-503 (DD-503), Design of Alternate Pipe Materials, published by the West Virginia Division of Highways.

5.3.6.3 MINIMUM VELOCITY, MINIMUM GRADES

Minimum grades for storm drains should be such that the flow velocity is not less than 2 feet per second when the pipe is 15% full. For very flat grades the general practice is to design a system so that flow velocities will increase progressively throughout its length. The system should be checked to be sure there is sufficient velocity in all the segments to prevent settling of particles.

Slopes that result in uniform flow velocities more than 10 feet per second for the design storm should be avoided due to the potential for abrasion. Concrete pipes on slopes more than 10 percent are not preferred due to the need for anchor blocks. In steeper terrain, large elevation differences can be accommodated by using access structures.

5.3.6.4 HYDRAULIC GRADE LINE

The hydraulic grade line (HGL) aids the designer in determining the acceptability of the proposed system by establishing the elevations to which the water will rise when the system is operating at the design discharge.

For a storm drain conduit flowing partially full under open channel flow conditions, the HGL is a line coinciding with the level of flowing water at any point in the conduit. For a storm drain conduit flowing full under pressure, the HGL will be above the crown of the conduit. Storm drain systems can alternate between pressure and open channel flow conditions from one segment to another. Storm drains designed to operate under pressure flow conditions can cause surcharging and manhole lid displacement if the hydraulic grade line rises above the ground surface. A design should include a review with a storm event larger than the design storm which pressurizes the system. This larger storm is known as the check storm (see Chapter 4, Section 4.3.2) and it shall not be detrimental to nearby property. For example, surcharging due to pressurization from the check storm may exceed the allowable spread and close a roadway, but it should not overtop the curb and damage nearby property. Possible detrimental impacts to nearby property may require a more detailed design analysis and right of way take or easement acquisition.

Detailed HGL calculations usually begin with the tailwater elevations at the system outfall. If the proposed outfall is an existing storm drainage system, the HGL calculation must begin at the outlet end of the existing system.

5.3.6.5 TAILWATER

Evaluation of the hydraulic grade line begins at the system outfall with the tailwater elevation. If the pipe outfall is an existing stream or basin, the actual water surface elevation for the design storm should be determined as a first step. When estimating tailwater depth on the receiving stream, the designer should consider the joint or coincidental probability of two hydrologic events occurring at the same time. For the case of a tributary stream or a storm drain, its relative independence may be qualitatively evaluated by a comparison of its drainage area with that of the receiving or mainstream. A short duration storm, which causes peak discharges on a small watershed, may not be critical for a large watershed. Also, it may safely be assumed that if the same storm causes peak discharges on both watersheds, the peaks will be out of phase. Table 5-10 can be used as an aid to evaluate the coincidental occurrence and joint probability.

Table 5-10

Joint Probability Analysis

Drainage Area Ratio	Frequencies for Coincidental Occurrence			
	10-Year Design		100-Year Design	
	Main Stream	Tributary	Main Stream	Tributary
10,000 to 1	1 10	10 1	2 100	100 2
1,000 to 1	2 10	10 2	10 100	100 10
100 to 1	5 10	10 5	25 100	100 25
10 to 1	10 10	10 10	50 100	100 50
1 to 1	10 10	10 10	100 100	100 100

This table (source: Urban Drainage Design Manual, HEC-22, FHWA 2001) provides a comparison of discharge frequencies of coincidental occurrence for a 10-year and 100-year design storm. This table can be used to establish an appropriate design tailwater elevation for a storm drainage system based on the expected coincident storm frequency on the outfall channel. For example, if the receiving stream has a drainage area of 200 acres, and the storm drainage system has a drainage area of 2 acres, the ratio of the receiving area to the storm drainage area is 200 to 2, which equals 100 to 1. From Table 5-10, considering a 10-year design storm occurring over both areas, the flow rate in the receiving stream will be equal to that of the 5-year storm when the drainage system flow rate reaches its 10-year flow at the outfall. Conversely, when the flow rate in the receiving stream reaches its 10-year flow rate,

the flow rate from the storm drainage system will have fallen to the 5-year flow rate. This is because the drainage areas are different sizes, and the time to peak for each drainage area is different.

Once the flow rate is known for the receiving stream, the actual water surface elevation can be determined using Manning's equation if the receiving stream has steady, uniform flow. This water surface elevation is known as the normal depth. The tailwater is determined by comparing the observed or computed tailwater (from backwater or normal depth calculations) with the critical depth of flow at the outfall. Based on numerous calculations by the FHWA it was determined that for partly full flow at the outfall a downstream extension of the full-flow hydraulic grade line pierces the vertical plane of the pipe outlet at a point halfway between critical depth (dc) and the top of the barrel (pipe diameter, D). This means the change in the flow state occurs within the pipe and the tailwater elevation at the outlet is (dc+D)/2 above the outlet invert. This is the value used to set the beginning of the hydraulic grade line at the outfall. If the observed or computed tailwater elevation exceeds (dc+D)/2, then it is used to set the beginning of hydraulic grade line. For more information on the tailwater elevation see Section 8.4.10.

5.3.6.6 ENERGY LOSSES

Energy losses can be classified into major and minor losses within a system segment. These losses are subtracted from the elevation of the EGL to obtain the elevation of the HGL at the beginning of a system segment. Major head losses result from the energy required to overcome the friction in each segment pipe. Minor head losses are attributed to the energy required to overcome changes in momentum or turbulence at system outlets, inlet or access hole structures, transitions, and junctions.

Major head loss due to friction is a function of the pipe length and friction slope. Minor head losses are estimated as a function of the change in velocity or the velocity head. A transition is a location where the pipe or channel size changes; however, these should be avoided and replaced with access holes. A junction is the connection of a lateral pipe to a larger trunkline without the use of an access hole structure. A junction loss is estimated using a form of the momentum equation. Transition and Junction losses are not covered in detail in this manual. Refer to HEC-22 for details on calculating these losses.

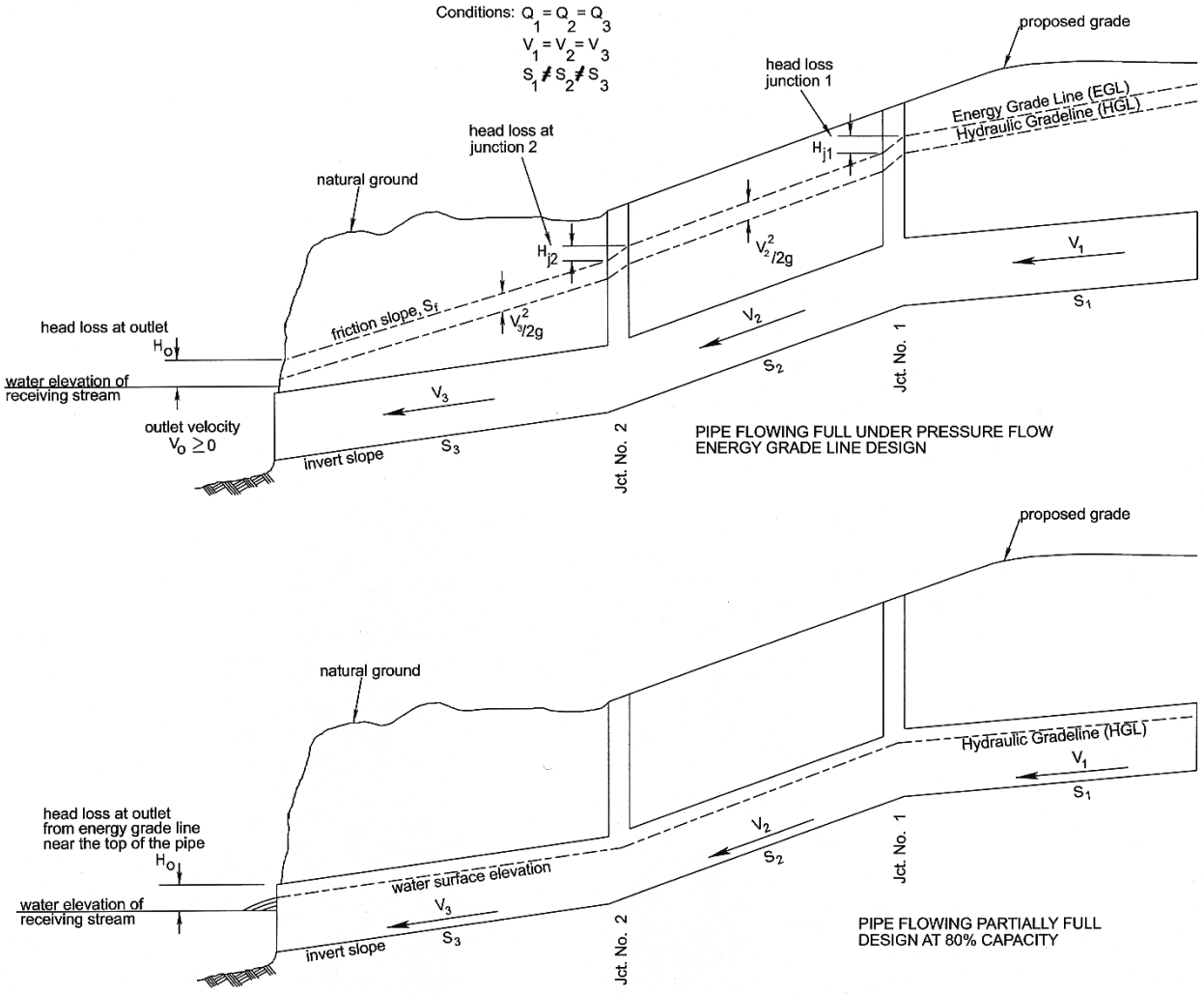
The design discharge and the effective pipe velocity should be used for computing the minor head losses. If the HGL is below the crown line of the conduit, partial-flow or normal velocity (based on the design discharge) should be used in computing the losses. If the HGL is above the crown line of the pipe, the full flow velocity (the design discharge divided by the cross-sectional area of the conduit) should be used in computing the losses. Since it is not known whether the HGL will fall above or below the crown line of the pipe, the designer should first calculate the HGL assuming partial-flow or normal velocity. If the computed HGL is below the

crown line, the assumption of normal velocity and the computed HGL is verified. If the computed HGL is above the crown line, then full flow velocity should be assumed and the HGL recalculated. Figure 5-9 illustrates energy losses and the hydraulic grade line in a storm drain system under pressure flow and in a system at an 80% design capacity.

A chain of inlets connected by pipes will be referred to as a system (see Figure 5-8). Each segment in the system consists of an inlet (segment beginning opposite of pipe connection) and the pipe leaving that inlet (segment end opposite of inlet connection). A location where more than one segment connects will be referred to as a junction. For the hydraulic design of a storm sewer, a leg in the system begins at an inlet and ends at a junction. For the determination of the hydraulic grade line in a storm sewer, a leg in the system begins at a junction and ends with an inlet. Refer to Section 5.4 and the step-by-step instructions for more detail.

Figure 5-9

Energy Losses in a Storm Drain System



5.3.6.7 MAJOR LOSSES

The major loss in a storm drainage system is the friction or boundary shear loss. The head loss due to friction in a pipe is computed as follows:

$$H_f = S_f L$$

H_f = Friction loss (ft)

S_f = Friction slope (ft/ft)

L = Length of pipe (ft)

The friction slope is also the slope of the hydraulic gradient for a particular pipe run. Since this design procedure assumes steady uniform flow in an open channel, the friction slope will match the pipe slope for part full flow. Pipe friction losses for full flow are computed as follows:

$$S_f = \frac{H_f}{L} = \left(\frac{Q\,n}{0.46\,D^{2.67}} \right)^2$$

Q = Rate of flow (ft^3/s)

D = Storm drain diameter (ft)

n = Manning's coefficient

5.3.6.8 MINOR LOSSES

Head loss due to flow entering and/or passing through an inlet or access hole structure is based on many factors. The method presented here for calculating minor losses is based on laboratory research by the FHWA. This method does not apply when the inflow pipe invert is above the water level (HGL) in the structure.

For the case where an inflow pipe invert is above the water level (HGL) within the structure, or the minor losses are being calculated for the first inlet in a leg of a system the outflow pipe shall be designed as a culvert. For a culvert, if this outflow pipe is flowing full or partly full under outlet control, the minor loss can be computed using the entrance loss coefficients in Chapter 8, Table 8-4. Adding this minor loss to the friction loss through the outlet pipe, the water surface elevation is obtained within the structure. For a culvert, if the outflow pipe is flowing under inlet control, the water depth in the structure should be computed using the inlet control equations or nomographs. Check the water surface elevation in the structure for both inlet and outlet control and use the higher of the two. Consult Chapter 8, Section 8.4.5 for guidance.

For cases where the inflow pipe invert is below the water level (HGL) in the access hole, the head loss is represented as being proportional to the velocity head of the segment pipe. Using K to represent the constant of proportionality, the total minor loss is approximated by the following equation:

$$H_m = K\left(\frac{V_S^2}{2\,g}\right) \qquad K = K_o\,C_d\,C_D\,C_Q\,C_P\,C_B$$

H_m= Minor loss (ft)

K= Overall minor loss coefficient

K_O= Initial head loss coefficient

C_d= Factor for flow depth (free surface flow only)

C_D= Factor for pipe diameter change (pressure flow only)

C_Q= Factor for relative flow

C_P= Plunging flow factor

C_B= Benching factor

V_S= Flow velocity in the segment pipe (ft/s)

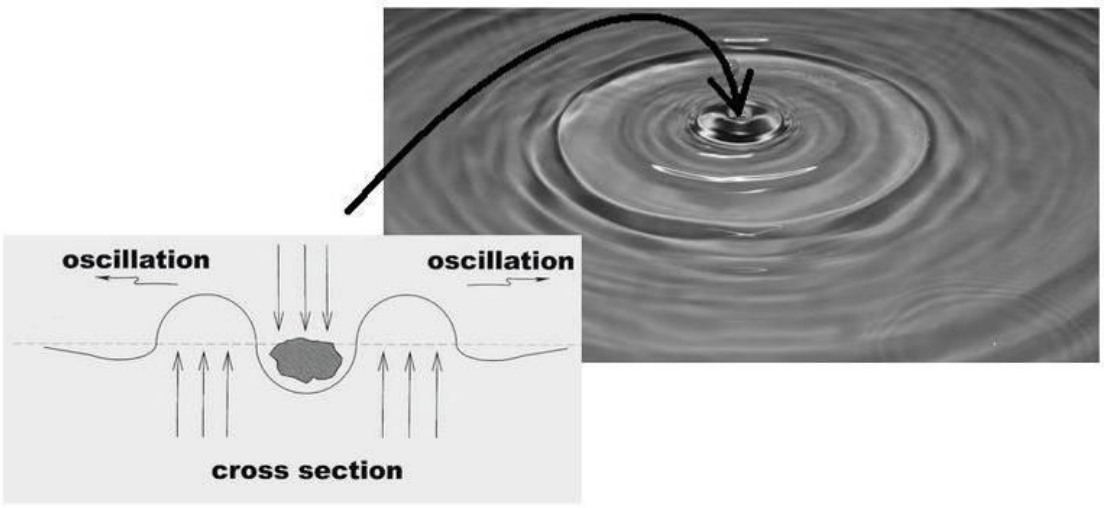
See Section 5.4 for definitions, equations, and illustrations for each of these minor loss factors.

5.3.6.9 THE STATE OF FLOW

The effect that gravity has on the state of flow is represented by a dimensionless ratio of the inertial forces to the gravitational forces. This ratio results in a number known as the Froude number (named for William Froude in 1868). This ratio may also be physically interpreted as the ratio between the average flow velocity to the speed of an elementary gravity wave (celerity) traveling over the water surface. A good example of a gravity wave is what results from throwing a rock into a lake with still water. When the surface water is displaced by the rock, gravity restores the surface toward equilibrium resulting in an oscillation about the equilibrium state. This oscillation causes waves that radiate in all directions.

Figure 5-10

Elementary Gravity Wave



Flow can exist as a subcritical state, a supercritical state, or a critical state in an open channel flow regime. Subcritical or tranquil flow occurs on mild slopes where flow is deep with a low velocity. The control section is always at the downstream end of the flow reach in this state. Supercritical flow occurs on steep slopes where the flow is shallow with a high velocity. In this state the control section is always at the upstream end of the flow reach.

The equation for the Froude number is as follows:

$$\frac{V}{\sqrt{g\ d_{md}}} \qquad d_{md} = \frac{A}{T}$$

V = average velocity (ft/s)

g = acceleration due to gravity (ft/s^2)

d_{md} = hydraulic mean depth (ft see section 8.4.5.1)

A = open channel flow area (ft^2)

T = top width of flow (ft)

$\sqrt{g\ d_{md}}$ = gravity wave celerity (ft/s)

If this number is less than 1, gravitational forces are dominant and the flow is in a subcritical state. If this number is greater than 1, inertial forces are dominant and the flow is in a supercritical state. When this number is equal to one the flow is at the critical state and the hydraulic mean depth is termed the critical depth.

Major and minor head losses are not accounted for upstream in a storm sewer system when the flow is in a supercritical state. Neglecting the losses occur because the effect of a disturbance in the flow cannot be transmitted upstream. For example: if the creek flowing into the lake has a velocity that is less than the wave celerity, the waves from the rock can travel upstream into the creek channel. This means the velocity of flow in the creek is in a subcritical state or the Froude number is less than one. If the creek velocity is greater than the wave celerity the waves from the rock cannot travel upstream into the channel and the creek is in a supercritical state or the Froude number is greater than one. For flow in a critical state the surface disturbances remain stationary in the flow. Another analogy would be running up an escalator moving in the downward direction. If the running person represents the gravity wave (or a disturbance in the flow), and the speed of the escalator is moving faster than the person can run, that person will not make it up the escalator.

In the case of neglecting the minor head losses in a structure, the flow must be in a supercritical state on both the inflow and outflow sides of the inlet or access hole. Comparing the pipe flow depth to the critical depth will reveal the state of flow for each pipe. Depths less than the critical depth are in a supercritical state and depths greater than the critical depth are in a subcritical state. The minor head losses should be determined within the structure where they occur for evaluation of whether they are neglected or not.

It is important to mention that this principle applies at the system outfall. The beginning of the HGL calculations will not start at the outfall if the flow state is supercritical. This is because the control section is upstream of the outfall. In this case, the HGL calculations start in the segment where subcritical flow begins and the elevation to begin with, is the critical depth.

5.3.6.10 TOTAL HEAD LOSSES

Total head loss is computed by adding the major loss due to friction to the minor losses due to each inlet or access hole structure.

$$H = H_f + H_m$$

5.3.6.11 MATERIALS AND ALTERNATES

Refer to DD-502, "Maximum Fill Height Tables," to determine appropriate pipe material, thickness and corrugation based on the depth of cover over the pipe.

See DD-503, "Design of Alternate Pipe Materials", for Manning's "n" values, and allowable pipe materials based on roadway classification, structural requirements, and corrosion and abrasion potential.

5.3.7 ECONOMIC CONSIDERATIONS

The designer should consider the following factors to get the maximum cost efficiency from the storm drain system:

- Location of utilities (under pavement or behind curb)
- Gutter widths
- Type and spacing of inlets.
- Storm drain sizes and locations
- Type of curb or median
- Cross pipes from other inlets (size and depth)
- Culverts (size and depth)
- Debris

Where there are other means of maintenance access to storm drains or culverts, inlets should not be unreasonably large or deep to accommodate large pipes. Saddles and pipe stubs can be used to connect inlets to large or deep pipes at lower costs in such cases.

The cost of drainage is neither incidental nor minor on most roads. Careful attention to requirements for adequate drainage and protection of the highway from stormwater in all

phases of location and design will prove to be effective in reducing costs in both construction and maintenance. Unless drainage is properly accommodated, maintenance costs will be unduly high.

5.3.8 STORM DRAINAGE IN KARST AREAS

The designer should be mindful of the outlet of flow from a storm sewer in karst areas. Outlet structures should be designed in such a way as to dissipate the flow over the largest area possible, thus creating an overland type of flow. Every attempt should be made to avoid the concentration and ponding of outlet flow in a karst area.

5.3.9 ENVIRONMENTAL CONCERNS

Environmental concerns for storm drainage design projects generally pertain to erosion and sedimentation problems, which can be particularly visible on urban highway projects. Permanent and temporary erosion control features should be carefully designed, installed, and maintained in sensitive surroundings.

Hazardous spills can be transported long distances in an enclosed storm drain system. Leaking pipe joints may also allow the spill to exfiltrate into strata containing precious groundwater supplies. The point of spill may not be a sensitive area, but the point of outfall such as a lake or river, may be sensitive. A 404 nationwide permit and a 401 water quality certification may be required if the point of outfall empties into waters of the U.S. Capture of the first inch of rainfall in Municipal Separate Storm Sewer System (MS4) areas may be required at the outfall.

5.3.9.1 SAFETY

Safety of the public is always of paramount importance and is the basis for the design of all elements of a storm drainage system. Inlet design (type, location, and spacing), pavement drainage design (cross-slope, spread, curb and gutter), and storm drain design, are all predicated on safely discharging storm water to the outlet.

5.3.9.2 ADA CONSIDERATIONS

State governments are required to comply with the Americans with Disabilities Act (ADA) for the design of public facilities. Inlet type, location, and spacing should be considered regarding the safety of pedestrians and disabled persons. Drainage inlets should be placed sufficiently away from pedestrian crosswalks so that people with disabilities do not encounter excessive water for the design event when traversing such locations.

5.3.9.3 BICYCLE SAFETY

Inlet type, location, and spacing should be considered regarding the safety of bicyclists. Inlets should generally not be located within bicycle lanes. Water should not be allowed to spread into designated bicycle lanes. Pavement depressions to accommodate grate and curb inlets should preferably be located outside bicycle lanes to prevent bicyclists from swerving to avoid them. Grate inlets should be bicycle safe unless located on highways where bicycles are not permitted.

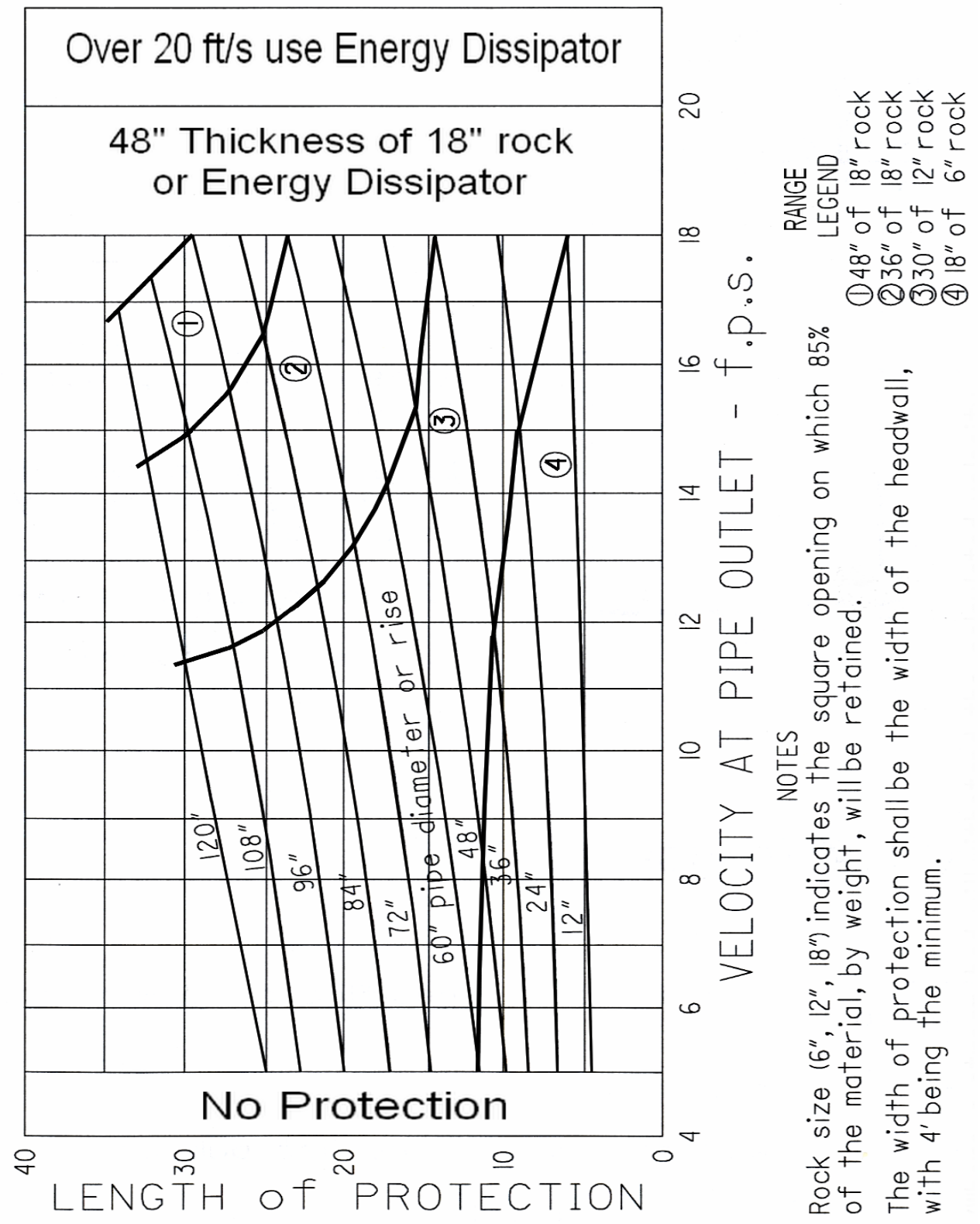
5.3.10 OUTLET PROTECTION

The three most common forms of rock lined outlet protection are dumped rock gutter, select embankment, and a rock lined scour basin. Rock lining is designated as “Dumped Rock Gutter” if the bottom width of the outlet bed is less than 8 feet. If the bottom width of the outlet bed is 8 feet or more, the rock lined protection is designated as “Select Embankment”. Both dumped rock gutter and select embankment shall not be placed within a stream with a defined bed, bank, and ordinary high-water markings. These linings are for protecting the outlet of a storm sewer system or culvert that drains surface runoff which does not create a defined channel. Dumped rock gutter and select embankment should be used as shown in the Standard Details Book, Volume I, Sheet DR8, Sheet 2 of 4. The length of blanket needed for dumped rock gutter or select embankment protection can be determined by the method outlined in the FHWA Hydraulic Engineering Circular 14 or the following chart provided by the Ohio Department of Transportation. This chart was formulated from an ODOT funded study through the University of Cincinnati called Design Criteria for Erosion Protection at the Outlet of Culverts by L.M. Laushey.

It is important to note that this specification for rock type differs from the WVDOH specification for dump rock gutter. The 85% requirement for the rock diameter should be explained on the general notes sheet.

Chart 5-29

Length of Blanket for Outlet Protection



Source: ODOT Location and Design Manual Vol. 2, Drainage Design, January 2007

The allowable velocities for the outlet bed material are listed in Table 5-11 (AASHTO Model Drainage Manual, 1991 Edition). V_o is the storm sewer system or culvert outlet velocity in feet/second.

- If V_o < allowable outlet bed material velocity, no protection is needed
- If V_o > allowable outlet bed material velocity, use dumped rock gutter or select embankment
- If V_o > 20 fps, use rock lined basin or energy dissipator (see HEC-14)

Table 5-11

Allowable Velocities of Streambed Material

SOIL TEXTURE	ALLOWABLE VELOCITIES (ft/s)
Fine sand and sandy loam (A-3)	2.5
Silt soils (A-4, A-5, A-6)	3.0
Silt or clayey gravel and sand (A-2)	3.5
Clayey soils (A-6, A-7)	4.0
Clay, fine gravel	5.0
Cobbles	5.5
Shale	6.0

5.4 INSTRUCTIONS, DESIGN FORMS, AND PROGRAMS

This section contains step by step procedures and computation forms for the designer's use. Nomographs, charts, computation forms, step-by-step procedures, and example problems pertaining to all aspects of storm drain system design can also be found in HEC-22. The Federal Highway Administration has developed the HYDRAIN computer program package that includes the computer program HYDRA, which can be used to check the design adequacy and analyze the performance of a storm drain system under inflow conditions. The FHWA HY-22 computer program can be used to compute gutter and inlet capacities and determine the spacing of inlets. Other programs may be used with approval from the engineer.

A Step By Step Guide to Form 5-1 INLET SPACING

STEP 1: Mark the location of inlets which are necessary without considering any specific drainage area such as the locations described in Section 5.2.5.

STEP 2: Start at a high point in the vertical alignment at one end (if possible) and work towards the sag curve or low point. Begin at the next high point and work backwards toward the same sag or low point. An inlet design for the sag curve or low point with flanking inlets will be required.

STEP 3, DRAINAGE AREA: The purpose of this step is to estimate the drainage area that will create an amount of runoff to cause the design spread to occur in the gutter, thus requiring the placement of an inlet. Since the width of the drainage area is known (typically the roadway from the curb to the centerline), the length is the parameter to determine. The closer the estimate is to the length that creates the design spread, the less iteration needed to achieve it. A good first trial length is between 300 and 500 feet. If there is a possibility of any runoff that will overtop the curb and run onto the roadway be sure to take this area into account, thus shortening your length estimate. Where practical, runoff from areas beyond the curb should be intercepted before it reaches it. Record the drainage area in column 3.

STEP 4, INLET ID: Record the location of the inlet by number and station in columns 1 and 2. Identify the curb and gutter type in the remark's column. A sketch of the gutter cross section should also be presented in the margin. If the system will be small the next line could be used for the sketch.

STEP 5, TIME OF CONCENTRATION: Compute the total time of concentration by calculating the sheet flow and shallow concentrated flow segments. See Chapter 4 Section 4.4.2.5 for guidance on determining T_c. Record this information in columns four, five and six. The minimum time of concentration is 5 minutes.

STEP 6, RAINFALL INTENSITY: Using the time of concentration, determine the rainfall intensity from the Intensity-Duration-Frequency curve obtained from the Precipitation Frequency Data Server website or by selecting the appropriate rainfall intensity zone for West Virginia. This will be the intensity for a 10-year return period or recurrence interval. Section 4.4.2.7 for guidance. Record this information in column seven.

STEP 7, RUNOFF COEFFICIENT: Determine the runoff coefficient C, which represents the drainage area for the inlet. See Table 4-4 of Chapter 4 and record this value in column eight.

Step 8, FLOW: Determine the flow in the gutter using the Rational Method and record this information in column nine. See Section 4.4.2 for guidance.

STEP 9, GUTTER SECTION PROPERTIES: Record the gutter section properties in columns ten through fifteen. The longitudinal gutter slope should consider any superelevation. If your

gutter section is not a composite one, enter the same value for columns eleven and twelve. The inlet type should be noted according to those shown in the Standard Details Book Volume 1 (type A, B, C, D, E, F, or H).

STEP 10: For the first inlet in a series, enter 0 into column sixteen and the same value from column 9 into column 17 as there will not be any bypass flow.

STEP 11, GUTTER DISCHARGE: Determine the flow spread by Chart 5-4, Chart 5-5, Chart 5-6 or the equations in Figure 5-2 and enter the value into column eighteen. Determine the depth of flow at the curb by Chart 5-4, Chart 5-5, Chart 5-6 or the equations in Figure 5-2 and enter the value into column 19. Compare the calculated spread with the allowable spread (see Section 5.3.3) and the calculated depth of flow with the curb height. If the calculated spread is near the allowable spread and the depth at the curb is less than the curb height, continue to Step 12. Else, expand or contract the drainage area up to the inlet to increase or decrease the spread. Repeat Steps 3 through 11 until appropriate spread and depth at the curb values are obtained.

STEP 12A, INLET CAPACITY: Calculate the inlet capacity or intercepted flow by the inlet (Q_i) and enter the value into column 20. For grate and combination inlets on grade use Chart 5-4, Chart 5-5, Chart 5-6 or the equations in Section 5.3.4.4 to determine the frontal flow / total gutter flow ratio E_o, and the side flow / total gutter flow ratio Q_s/Q. The inlet efficiency E is determined using the frontal flow intercepted / total frontal flow ratio R_f, and the side flow intercepted / total side flow ratio R_s. These values are taken from Chart 5-7and Chart 5-8, respectively. For curb opening and slotted inlets on grade Chart 5-9, Chart 5-10, and the equations in Section 5.3.4.5 will provide the inlet efficiency. The interception flow Q_i is then equal to the efficiency E times the flow in the gutter Q for the inlet type.

STEP 12B: Determine the inlet bypass flow (Q_B) by subtracting the intercepted flow from the total gutter flow (column 17 - column 20) and enter this value into column 21. Record this value into column 16 for the next inlet location down the grade.

STEP 13 CONTINUE: Proceed with the design for the next inlet down the grade by repeating steps 3–13 (skipping step 10). Determine the total gutter flow for the next inlet by adding the bypass from the previous inlet to the flow in the gutter and record this value in column 17. Continue for each subsequent inlet down the grade to the low point.

Form 5-1

Inlet Spacing Design Form

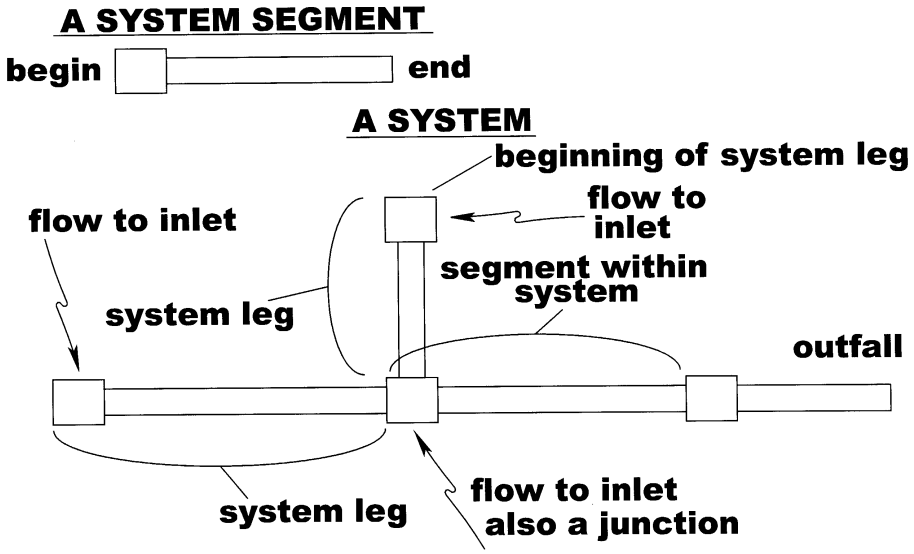
DRAINAGE COMPUTATION FORM 5-1
INLET SPACING

PROJECT NAME _____ PROJECT # _____ SHEET _____ OF _____

INLET ID.																										
			FLOW IN THE GUTTER								GUTTER SECTION PROPERTIES						GUTTER DISCHARGE						INLET CAPACITY		REMARKS
INLET NUMBER	STATION	DRAINAGE AREA	TIME OF CONCENTRATION			RAINFALL INTENSITY	RUNOFF COEFFICIENT	Q_{10} = C I A	LONGITUDINAL GUTTER SLOPE	GUTTER CROSS SLOPE	ROADWAY CROSS SLOPE	GUTTER WIDTH	INLET TYPE	INLET DIMENSIONS	PREV IOUS INLET BYPASS FLOW	TOTAL GUTTER FLOW $Q_{10} + Q_B$	GUTTER FLOW SPREAD	GUTTER FLOW DEPTH	INTERCEPTED FLOW	INLET BY PASS FLOW					
			SHEET FLOW	SHALLOW CONCEN. FLOW	TOTAL																				
		A	t_t	t_t	T_c	i	C	Q_{10}	S_L	S_W	S_X	W			Q_B	Q	T	d	Q_i	Q_B					
		acres	min	min	min	in/hr		cfs	ft/ft	ft/ft	ft/ft	feet		feet x feet	cfs	cfs	feet	feet	cfs	cfs					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21					

A Step by Step Guide to Form 5-2 STORM SEWER, HYDRAULIC DESIGN

A chain of inlets connected by pipes will be referred to as a system. Each segment in the system consists of an inlet and the pipe leaving that inlet. Each line on Form 5-2 represents one segment. The FROM POINT in column 1 represents the invert of the inlet (beginning of segment) and the TO POINT in column 2 represents the invert at the end of the pipe leaving the inlet (end of segment). A leg in the system begins with an inlet and ends in a junction. The first segment in a leg in the system (no segment preceding it) should have a blank line above it on Form 5-2 (excluding the use of line 1). A separate form shall be used for each system. When laying out a system the design should stay as close to the surface as possible while considering the minimum cover for each pipe. If an increase in the size of the outflow pipe is not necessary, the outflow pipe should be designed at least 0.1 feet lower than the lowest inflow pipe invert elevation to ensure flow through the junction after the construction of the system. See Section 5.3.6.1 for guidance.



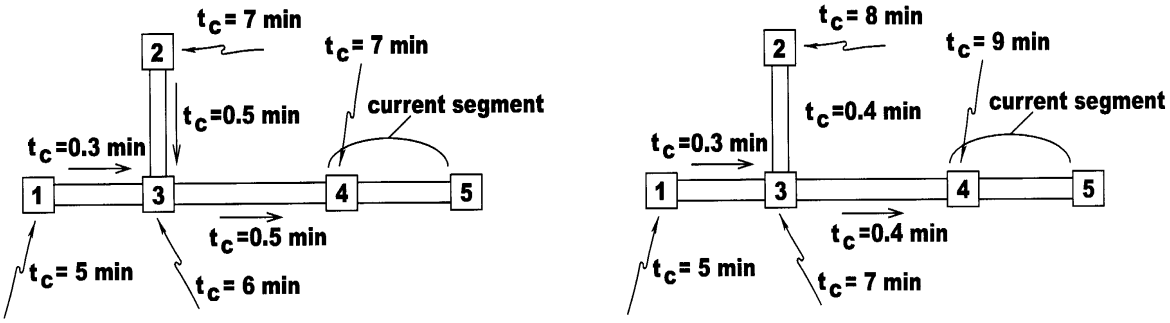
STEP 1, PIPE ID: Start at the beginning of a system leg on line 1. Fill in column 1 (FROM POINT) with the inlet label from the plan sheet. Fill in column 2 (TO POINT) with the proceeding inlet label from the plan sheet. All legs attached to the next segment shall be designed before continuing to a segment within the system (legs 2-3 and 1-3 in the diagram on the next page).

STEP 2A, PIPE FLOW: Calculate the pipe flow at the invert of the inlet (FROM POINT) using the Rational Method. Fill in the amount of drainage area (in acres) that contributes flow to the inlet opening in column 3. Fill in the weighted runoff coefficient (C) for that drainage area in column 4. Multiply the drainage area and the weighted runoff coefficient and place this value in column 5. This represents the increment CA value at the current segment. Sum the increment

CA values for the preceding segments and the current segment and place this value in column 6. This value represents the accumulated product of the drainage area and runoff coefficient for the system up to the current segment.

STEP 2B: Calculate the flow time of concentration at the beginning of the segment and fill in column 7. For a segment at the start of a leg in the system, this value is the time of concentration to the inlet opening. For a segment within the system or within a leg, this value is the larger of the longest overall time of concentration for the system from the previous segment (column 21 from the previous line) vs. the time of concentration of flow to the inlet opening. The purpose of this comparison is to obtain the longest flow time of concentration to the current segment. In the case of a storm sewer system hydraulic design, the minimum T_c value of 5 minutes shall not apply. Since the travel time is summed as a design progresses through a system, applying the minimum of 5 minutes at the beginning artificially lowers the rainfall intensity when determining the overall time of concentration at the system outlet.

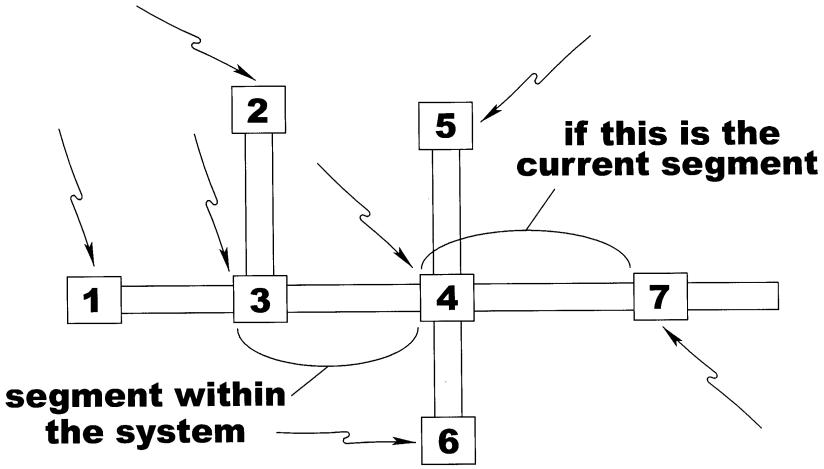
The following diagrams illustrate a couple of examples:



For the example on the left, the longest overall time of concentration for the system at the current segment would be 8 minutes (segment 2-3-4) and the time of concentration of flow to the inlet opening would be 7 minutes (in 4), therefore the answer is 8 minutes. For the example on the right, the longest overall time of concentration for the system at the current segment would be 8.8 minutes (segment 2-3-4) and the time of concentration of flow to the inlet opening would be 9 minutes (in 4), therefore the answer is 9 minutes.

For a situation where the current segment is preceded by a segment within the system and one or more system legs, compare the longest overall time of concentration for the system from the previous segment within the system vs. each of the legs vs. the time to the inlet opening and record the longest value.

The following diagram illustrates this comparison:



Compare the column 21 values for segment 3-4, segment 5-4, and segment 6-4 to the time of concentration into inlet 4 and record the largest value in column7 for the current segment.

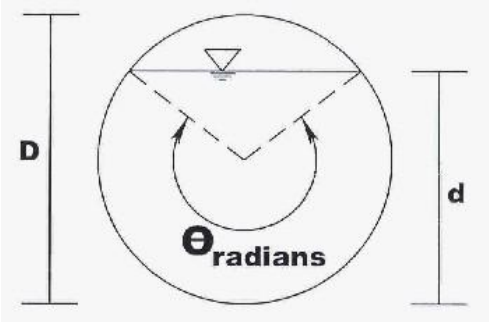
STEP 2C: Determine the rainfall intensity for a 10-year return period for the time of concentration in column 7 from Chart 4-2, 4-3, or 4-4 and place this value in column 8. Calculate the pipe flow at the invert of the inlet (FROM POINT) for a 10-year return period by multiplying the values in column 6 and column 8 and place the answer in column 9.

STEP 3, PIPE PROPERTIES: Record the pipe properties for the segment by filling in columns 10 through 15 with the appropriate data. As stated in Section 5.3.6.1 the pipe should flow at a depth no greater than 0.8 times the pipe diameter or equivalent at the design discharge, thus column 15 is provided for a check against the calculated flow depth.

STEP 4A, PIPE FLOW PROPERTIES: Calculate the pipe flow normal depth using Manning's equation and fill in column 16. If you re-arrange Manning's equation with a constant on one side, you can iteratively solve for the depth of flow if the slope, roughness, and flow are known. You can also solve for a pipe diameter if you set the flow depth at 0.8 times the diameter (0.8D) with the slope, roughness, and flow as known parameters.

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}} \qquad 0.6730 = \frac{1}{Q n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

Here are some useful formulas for the iteration:



$$\theta_{Radians} = 2\, ar\cos\left(1 - 2\frac{d}{D}\right)$$

$$WettedPerimeter = 0.5\, D\, \theta_{radians}$$

$$Flow\ Area = \frac{D^2}{8}\left(\theta_{radians} - \sin\theta_{radians}\right)$$

STEP 4B: Calculate the pipe flow average velocity and critical depth and fill in columns 17 and 18. Average velocity is simply the flow in the pipe divided by the flow area in the pipe. Critical depth describes the flow depth that minimizes the specific energy (head) for the open channel flow within the pipe (see section 8.4.5.1). It is important to examine the open channel flow regime as it can exist in a state of subcritical or supercritical flow based on the effect of gravity. This is important because the flow state determines the effect of head loss on a storm sewer system. The effect of gravity on the state of flow is represented by a dimensionless ratio of the inertial flow forces to the gravitational forces which is known as the Froude Number.

$$\frac{V}{\sqrt{g\, d_{md}}} \qquad d_{md} = \frac{A}{T}$$

V = average velocity (ft/s)

g = acceleration due to gravity (32.2 ft/s^2)

d_{md} = hydraulic mean depth (ft)

A = open channel flow area (ft^2)

T = top width of flow (ft)

If this number is less than 1 the gravitational forces are dominant and the flow is in a subcritical state, characterized by deep slow flow. If this number is greater than 1 the inertial forces are dominant and the flow is in a supercritical state, characterized by shallow fast flow. The hydraulic mean depth that causes the Froude Number to be equal to 1 is the critical depth of flow. Major (pipe friction) and minor (access hole or inlet) head losses do not apply when the flow is in a supercritical state. In the case of the minor losses the flow must be supercritical on both the inflow and outflow sides of the inlet. Comparing the calculated pipe flow normal depth to the critical depth will reveal the state of flow. Normal depths less than the critical depth are in a supercritical state and normal depths greater than the critical depth are in a subcritical

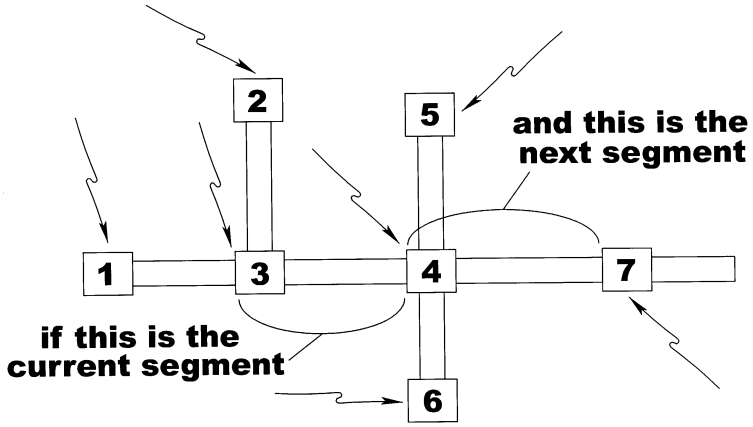
state. See section 8.4.5.1 and 5.3.6.9 for more information. Fill in column 19 with the state of flow.

STEP 5, SYSTEM FLOW TIME: Calculate the system flow time up to the end of the current segment and fill in columns 20 and 21. The pipe flow time is simply the length of the pipe (column 13) divided by the velocity of flow through the pipe (column 17). The longest overall time of concentration is the time of concentration at the beginning of the segment (column 7) plus the pipe flow time (column 20). This number will be compared to the time of concentration of flow to the inlet opening for the next segment within the system.

STEP 6, SELF CLEANING: Calculate the minimum velocity needed for self-cleaning of the pipe and fill in columns 22 and 23. This velocity should not be less than 2 feet per second when the pipe is flowing 15% full. If this number is less than 2 feet per second, make the required changes and re-design the segment on the next line of Form DR-5A (do not skip a line).

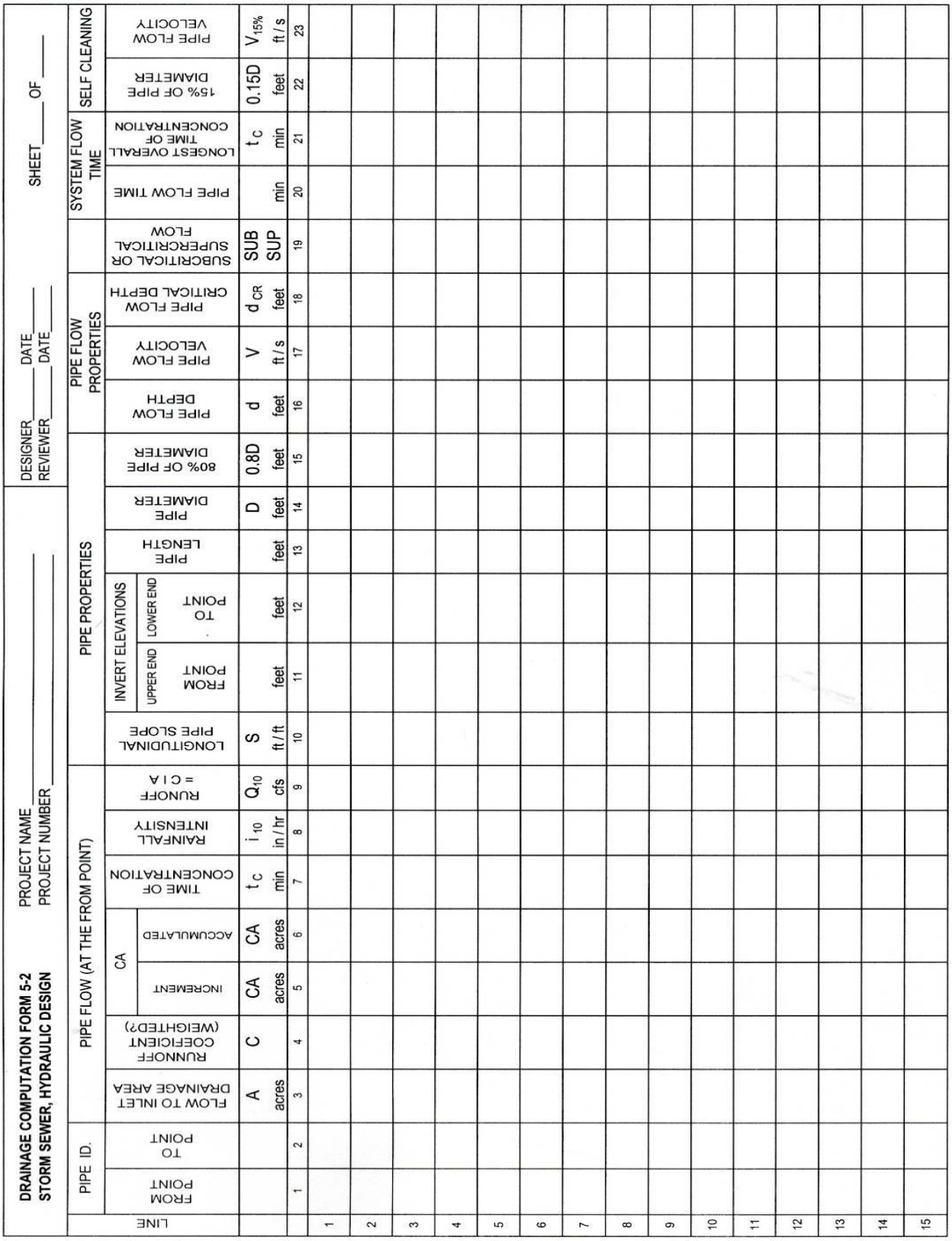
STEP 7 CONTINUE: Continue to the next segment. If there is more than one leg attached to the next segment, then the following line(s) on the form (blank line preceding each) shall be the other legs attached to the next segment. Once all the attached legs are designed continue to the next segment within the system. In the diagram to the right, legs 5-4 and 6-4 shall precede the next segment.

Fill in column 1 with the inlet label from the plan sheet. Fill in column 2 with the proceeding inlet label from the plan sheet for the next segment. Repeat steps 2 through 8 until the system outfall is reached.



Form 5-2

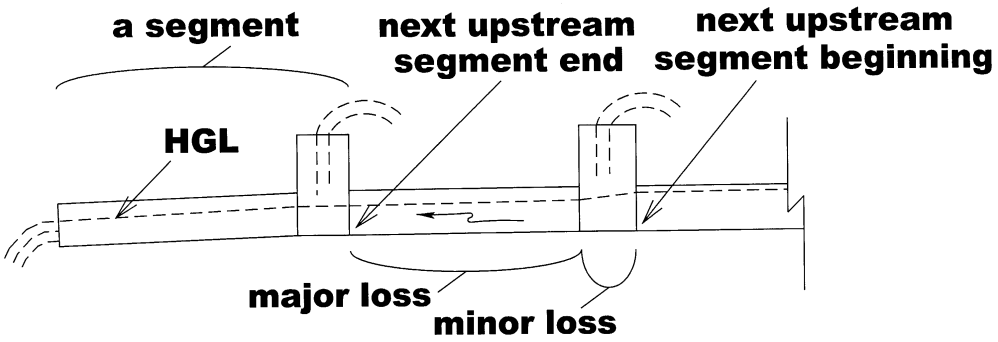
Storm Sewer, Hydraulic Design Form



A Step-by-Step Guide to Form 5-3 and Form 5-4

STORM SEWER, HYDRAULIC GRADE LINE

A chain of inlets connected by pipes will be referred to as a system. Each segment in the system consists of an inlet and the pipe leaving that inlet and each line on Form 5-3 represents one segment. A location where more than one segment connects will be referred to as a junction. For this process, a leg in the system begins at a junction and ends with an inlet (backwards from hydraulic design process). The diagram on the next page illustrates the terminology used in this process. Each segment at a leg in the system (one with no segment preceding it) should have a blank line below it on Form 5-3. A separate form should be used for each system.



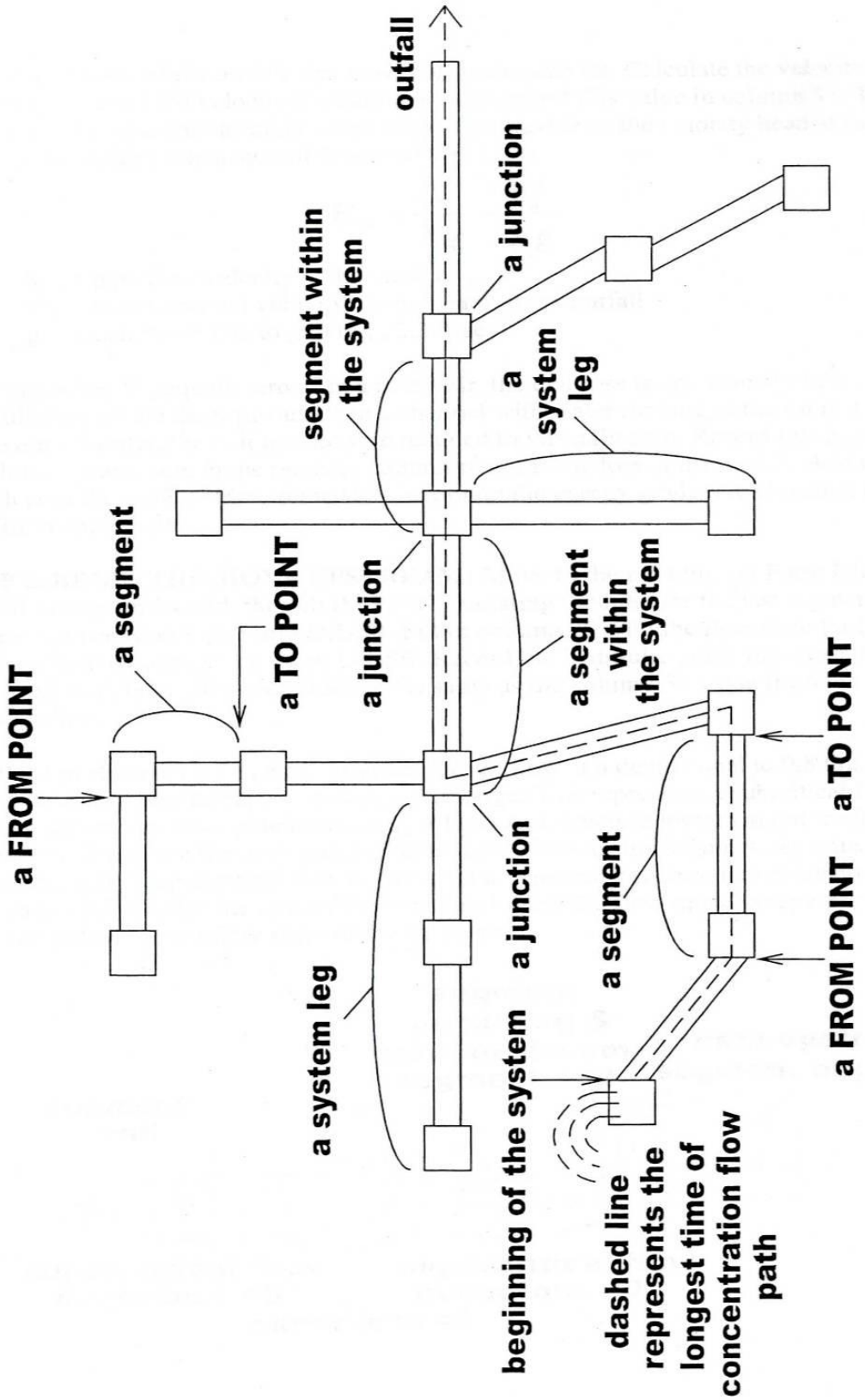
Hydraulic grade line computations begin at the outfall of the system and are calculated upstream taking each junction into consideration.

Energy losses in a system are classified as major (flow friction loss) and minor (access hole or inlet loss). Each segment is referred to by its respective inlet and the total loss is calculated up to the inflow side of the inlet.

STEP 1, SYSTEM OUTFALL: Start at the system outfall and fill in column 24 with a label notating the end of the pipe. You want to start with the same label for the TO POINT from the last segment of the system from Form 5-2. This process will work the connected segments backwards to a system leg or the beginning of the system through a junction. Fill in column 32 with the velocity of the flow at the outfall. This is the flow velocity at the end of the last segment of the system in column 17 on Form 5-2. A storm sewer is assumed to be under outlet control when determining the hydraulic grade line (HGL) for the system. The starting HGL elevation for the outfall is placed in column 37 and it is determined in the same manner as the tailwater elevation for a culvert design in an outlet control situation (see Section 8.4.10).

Figure 5-11

A System Illustration



In the case of the outfall pipe outlet being submerged, the tailwater or HGL is the observed or known water surface elevation at the outfall. In the case of the outfall pipe flowing partly full or unsubmerged, the tailwater or HGL is determined by comparing the observed or normal depth in the outlet channel and the average of the critical depth and the pipe diameter. The larger of these two values is the tailwater or HGL at the outfall. Record this value in column 37.

Record the crown of the outfall pipe elevation in column 38. Calculate the velocity head for the outlet using the velocity in column 32 and record this value in column 33. The exit loss from a storm drain outfall is a function of the change in the velocity head at the outlet. For a sudden expansion of flow, the exit loss is:

$$H_o = \frac{V_O^2}{2g} - \frac{V_d^2}{2g}$$

V_o = pipe flow velocity at the outfall (ft/s)

V_d = outlet channel velocity downstream of the outfall (ft/s)

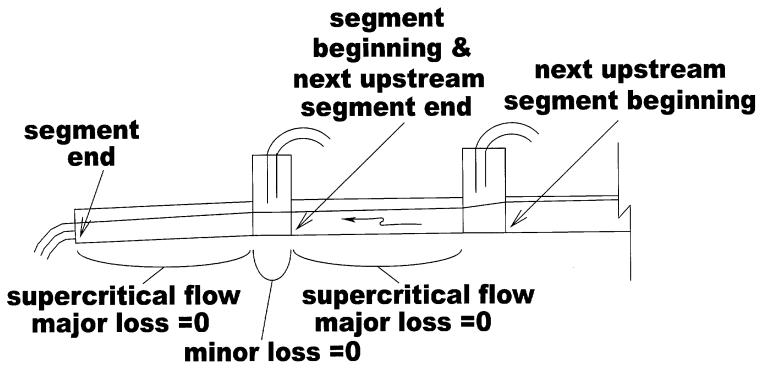
g = acceleration due to gravity (32.2 ft/s^2)

Note that when V_d equals zero as in a reservoir, the exit loss is one velocity head. For part full flow where the pipe outlets in a channel with water moving in the same direction as the outfall water, the exit loss may be reduced to virtually zero. Record this head loss in column 36 and note in the remarks column that it is the loss at the outfall. Add this head loss at the outfall value to the HGL to obtain the energy grade line elevation (EGL) and fill in column 39.

STEP 2, BEGIN THE MOVE UPSTREAM: Move to the next line on Form 5-3 and fill in column 24 with the TO POINT notating the same outfall end of the last segment in the system from column 2 on Form 5-2. Fill in column 25 with the flow state for the segment from column 19 on Form 5-2. Record the hydraulic grade line elevation for the outfall in column 26 which shall be the same as the column 37 value from the previous line.

As stated in Section 5.3.6.1, a storm sewer should flow at a depth equal to 0.8 times the pipe diameter or equivalent at the design discharge. This represents a subcritical flow state. In subcritical flow, pipe losses (major loss) and structure losses (minor loss) are summed to determine the upstream hydraulic grade line for the segment. As stated in Section 5.3.6.9 if supercritical flow is present, the pipe and structure losses are not carried upstream. However, for the case of the structure losses, the flow must be supercritical on both the inflow and outflow sides of the structure.

Therefore, if supercritical flow exists within the current segment pipe, the major loss is zero and column 31 shall be zero. If supercritical flow exists within the preceding segment pipe, the major loss for the preceding segment is zero and the minor loss for the structure in-between them shall also be zero.



STEP 3, MAJOR LOSSES: Record the diameter, flow, and length for the segment in columns 27, 28, and 29 from the information on Form 5-2. If column 25 denotes SUB calculate the friction loss H_f and fill in column 31. Since this design procedure assumes steady uniform flow in open channel flow, the friction slope S_f will match the pipe slope for partly full flow. In this case, the pipe slope from column 10 on Form 5-2 will be the same as column 30 on Form 5-3. The major loss is calculated by this equation:

$$H_f = S_f * pipe\ \ length$$

Major losses for full pipe flow result in a different friction slope thus they are calculated by this equation:

$$H_f = S_f * length = \left(\frac{Q\,n}{0.46\,D^{2.67}} \right)^2 * length$$

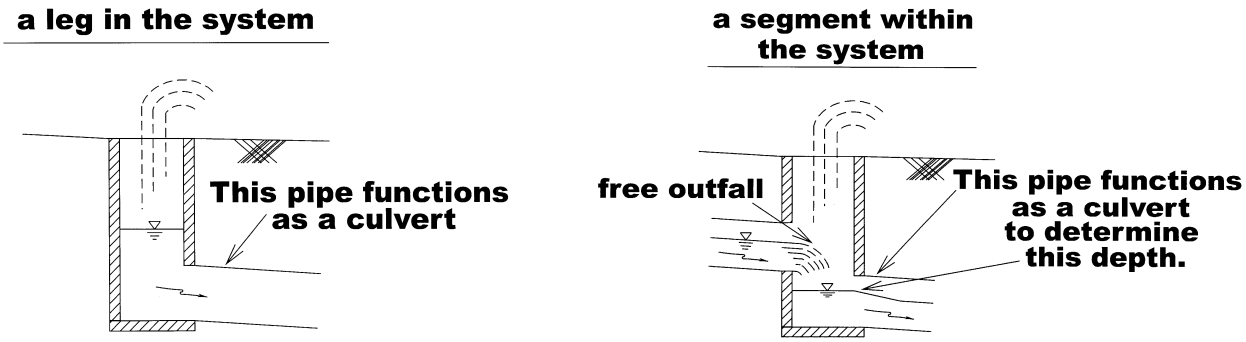
Q = pipe flow (ft^3/s)

n = Manning's roughness coefficient

D = pipe diameter (ft)

If the flow state in column 25 denotes SUP (supercritical) record a zero in column 31.

STEP 4, MINOR LOSSES: The energy loss equation for flow through an access hole or inlet structure is based on laboratory research. The equation will not apply when the invert of the inflow pipe is above the water level in the structure or if there is no inflow pipe present and the inlet opening is the only source of the inflow (as occurs in a leg of the system).



In both situations the outflow pipe or the current segment pipe will function as a culvert. In the case of the invert of the inflow being above the water level, the hydraulic and energy grade line calculations will start over, thus treating it as a system outfall.

For a culvert design, if the segment pipe is flowing full or partly full under outlet control, the minor loss in the structure can be calculated by setting K equal to K_e in the equation below (see Table 8-4, Section 8.4.5). If the segment pipe is flowing under inlet control, the minor loss in the structure shall be computed using the inlet control equations (see Section 8.4.5) or Charts 8-1 or 8-4 from Chapter 8. The higher water depth in the structure due to either inlet or outlet control will govern.

The energy loss that occurs as flow moves through a structure is represented as being proportional to the velocity head of the outlet pipe from the structure. Therefore, the velocity head for the segment pipe being analyzed will be multiplied by a coefficient to represent the minor loss. Record the velocity for the segment from column 17 on Form 5-2 into column 32 on Form 5-3 and calculate and record the velocity head in column 33. The equation for the minor loss through the structure is as follows:

$$H_{aho} = K\left(\frac{V_S^2}{2g}\right)$$

H_{aho} = minor loss for the access hole or inlet (ft)

V_S = velocity for the segment pipe (ft/s)

K = minor loss coefficient

g = acceleration due to gravity (32.2 ft/s^2)

Determination of the K value is based on experimental study which resulted in a six-term equation. Each term represents a different scenario that the flow may experience as it moves through the structure.

$$K = K_o \; C_d \; C_D \; C_Q \; C_P \; C_B$$

K_o = initial head loss coefficient

C_d = factor for flow depth (free surface flow only)

C_D = factor for pipe diameter change (pressure flow only)

C_Q = factor for relative flow

C_P = plunging flow factor

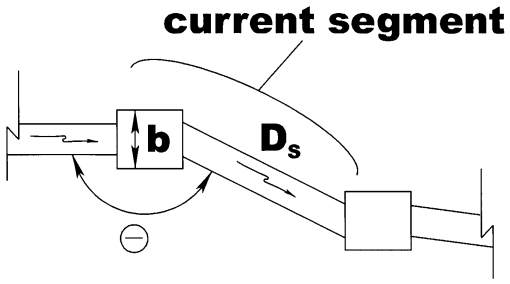
C_B = benching factor (energy gain)

The minor loss coefficient will be calculated in the following steps using Form 5-4. Fill in column 40 with the same TO POINT from column 24 on Form 5-3. **Fill in column 41 with the NEXT UPSTREAM SEGMENT flow state from column 19 on Form 5-2.** Remember, the flow must be supercritical on BOTH the inflow and outflow sides of the structure to neglect the minor losses through it. If column 25 and column 41 denote SUP then record a ZERO in column 57 and columns 34 & 35 for the current segment.

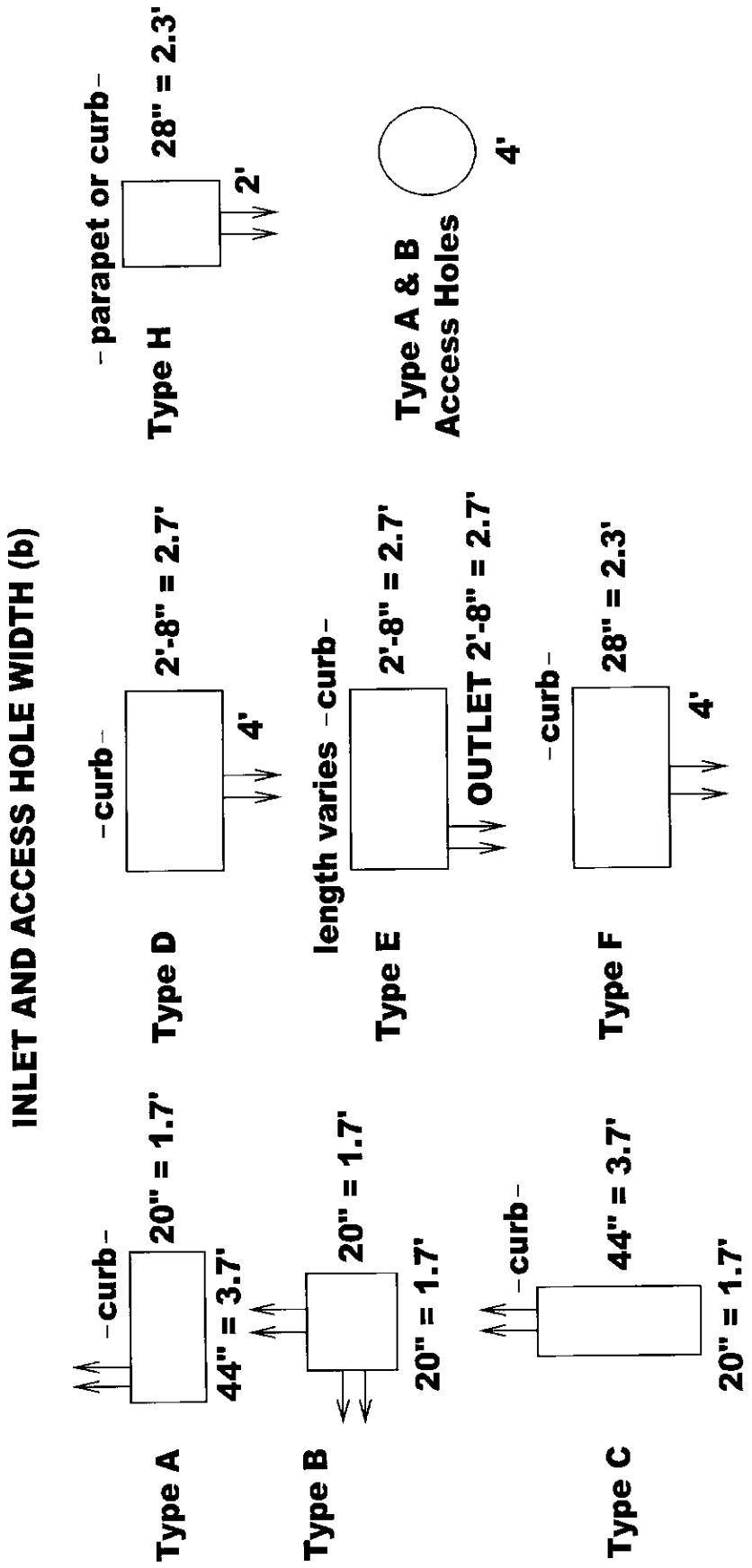
STEP 4A, INITIAL HEAD LOSS: The initial head loss coefficient is estimated as a function of the relative structure size and the angle of deflection between the next upstream segment pipe and the current segment pipe (in degrees).

$$K_o = 0.1\left(\frac{b}{D_S}\right)\left(1-\sin\theta\right)+1.4\left(\frac{b}{D_S}\right)^{0.15}\sin\theta$$

Record the inlet width or access hole diameter in column 42 (see next page), the change in flow angle between the current segment and the next upstream segment in column 43, and the current segment pipe diameter in column 44. Calculate and record the initial head loss coefficient in column 45.

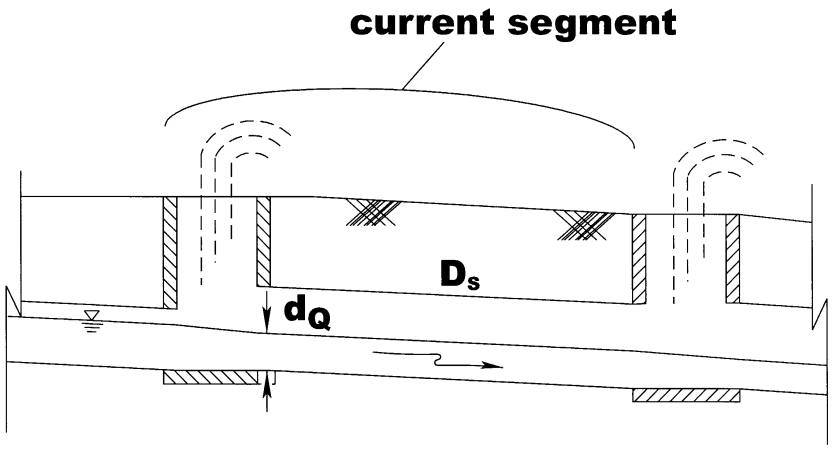


b - inlet width or access hole diameter
⊖ - change in flow angle
D_s- segment pipe diameter


INLET AND ACCESS HOLE WIDTH (b)
– parapet or curb –
28" = 2.3'
2'
Type H
Type A & B
Access Holes
4'
– curb –
2'-8" = 2.7'
4'
Type D
length varies – curb –
2'-8" = 2.7'
OUTLET 2'-8" = 2.7'
Type E
– curb –
28" = 2.3'
4'
Type F
– curb –
20" = 1.7'
44" = 3.7'
Type A
20" = 1.7'
20" = 1.7'
Type B
– curb –
44" = 3.7'
20" = 1.7'
Type C

STEP 4B, FACTOR FOR FLOW DEPTH: This factor is significant only in cases of free surface flow or low pressures when the water depth in the structure is less than or equal to 3.2 times the segment pipe diameter. In cases where the water depth is greater, this factor is set equal to 1. To determine the applicability of this factor, the water depth is approximated as the level of the hydraulic grade line at the upstream end of the segment pipe.

$$C_d = 0.5\left(\frac{d_Q}{D_S}\right)^{0.6}$$



d_Q- water depth in inlet or access hole

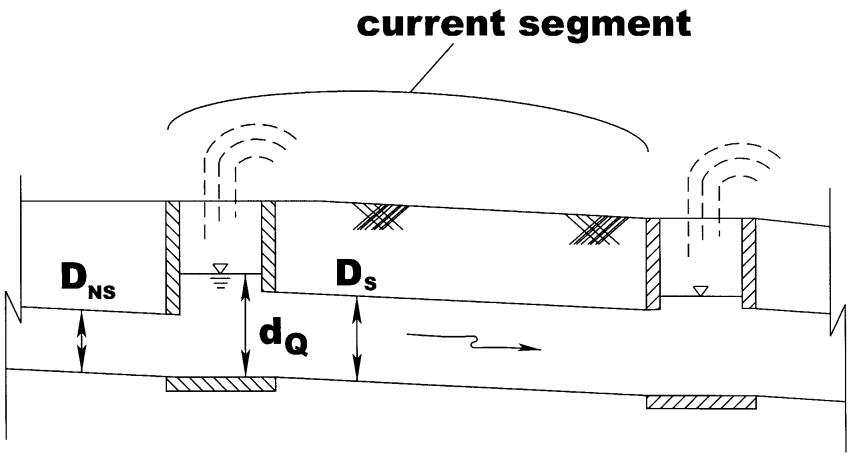
D_s- segment pipe diameter

$d_Q \leq 3.2\ D_s$

Record water depth or flow depth in the inlet or access hole in column 46. Calculate and record the free surface factor for flow depth in column 47.

STEP 4C, FACTOR FOR A PIPE DIAMETER CHANGE: A change in head loss due to differences in segment pipe diameters is only significant in pressure flow situations when the water depth in the structure is greater than or equal to 3.2 times the segment pipe diameter. In cases where the water depth is less, this factor is set equal to 1.

$$C_D = \left(\frac{D_S}{D_{NS}}\right)^3$$



d_Q- water depth in inlet or access hole

D_s- segment pipe diameter

D_{NS}- next upstream segment pipe diameter

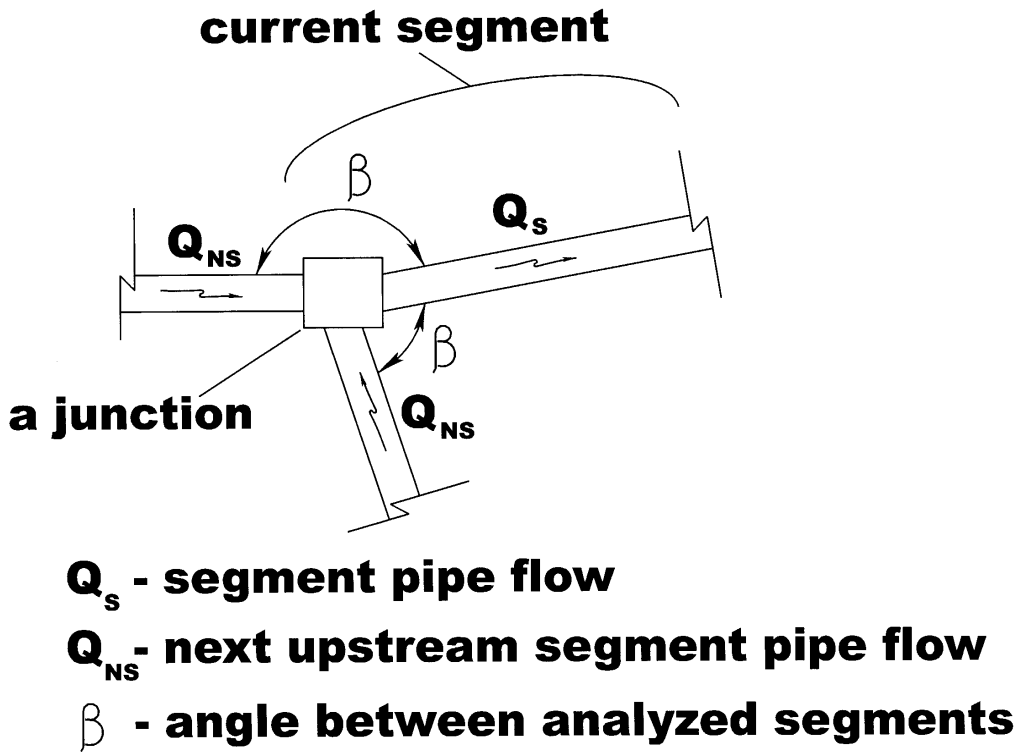
$$d_Q \geq 3.2\ D_s$$

Record the next upstream segment pipe diameter in column 48. Calculate and record the pressure flow factor for a pipe diameter change in column 49. Assume that the d_Q requirement is met and determine the minor loss for column 49. Go back and check this d_Q requirement once the water surface elevation (HGL) has been determined for column 37. If this d_Q requirement is not met, then change this factor to 1 prompting a new water surface elevation (HGL) calculation for column 37.

STEP 4D, FACTOR FOR RELATIVE FLOW: This factor is a function of the angle of the incoming flow as well as the percentage of flow entering the structure from the next upstream segment in the analysis path. This factor is only applied to a junction where there are 3 or more pipes connected to the structure at approximately the same elevation. Engineering judgment will have to be used to determine the meaning of the word approximately. This judgment should be based on the vertical geometry of the entire proposed system. For example, if only one junction in the system exhibits a noticeable difference between inflowing pipes then that junction should not have a relative flow loss factor.

$$C_Q = (1 - 2\sin\beta)\left(1 - \frac{Q_{NS}}{Q_S}\right)^{0.75} + 1$$

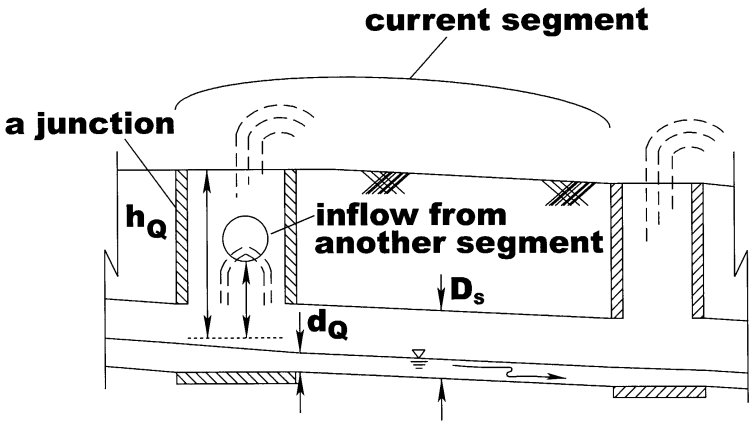
Record the current segment pipe flow in column 50, the next upstream segment pipe flow in column 51 (also from column 9 on Form 5-2), and the angle between the analyzed segments in column 52 (in degrees). Calculate and record the factor for relative flow in column 53.



STEP 4E, PLUNGING FLOW FACTOR: This factor is applied only when a higher flow plunges into a structure that has an inflow and outflow in the bottom of the structure. The higher flow must fall a distance that is greater than the water depth in the inlet or access hole. The source of the higher flow could be from the next upstream segment along another analysis path at a junction, or from a curb and/or grate opening from above. The distance of fall is the vertical length from:

- The invert of the next upstream segment along another analysis path at a junction to the center of the current segment pipe.
- The structures' curb and/or grate opening to the center of the current segment pipe.
- Two important facts to note in determining this loss are:
- The water depth in the inlet or access hole is approximated as the level of the hydraulic grade line at the upstream end of the segment pipe.
- If both sources of plunging flow are present in the same structure, they will both add to the turbulence and head losses. In this case the average plunging height between the two shall be used to determine the factor.

$$C_P = 1 + 0.2\left(\frac{h_Q}{D_S}\right)\left(\frac{h_Q - d_Q}{D_S}\right)$$



d_Q- water depth in inlet or access hole
D_s- segment pipe diameter
h_Q- vertical distance of plunging flow

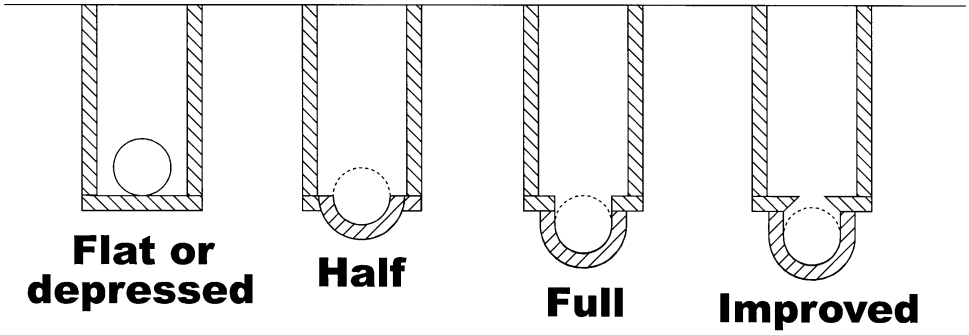
Record the vertical distance of plunging flow in column 54. Calculate and record the plunging flow factor in column 55.

STEP 4F, STRUCTURE BENCHING FACTOR: Benching provides an improvement for the transmission of flow through a structure. It tends to direct flow through the inlet or access hole, resulting in a reduction of head loss. The factor is obtained from the following table for flow depths within the structure respective to the segment pipe diameter. Refer to the diagram for the plunging flow factor for an illustration of d_Q and D_s. If the d_Q requirement is not met, then this factor is equal to one.

Bench Type	Submerged (pressure flow)	Unsubmerged (free surface flow)
Flat or Depressed Floor	1.00	1.00
Half Bench	0.95	0.15
Full Bench	0.75	0.07
Improved Bench	0.40	0.02

Record the benching factor in column 56 from the table above.

Types of structure benching



for pressure flow $d_Q \geq 3.2\ D_s$

for free surface flow $d_Q \leq D_s$

STEP 4G, MINOR LOSS COEFFICIENT: Multiply the values in columns 45, 47 (if applicable), 49 (if applicable), 53, 55, & 56 to obtain the minor loss coefficient K and record it in columns 57 on Form 5-4 and 34 on Form 5-3. Determine the access hole or inlet loss for the current segment by multiplying columns 34 and 33 and record this value in column 35.

STEP 5, TOTAL HEAD LOSS: The total loss is simply the addition of the major and minor losses for the current segment. Add the values in columns 31 and 35 and record this value in column 36. This energy loss will determine the hydraulic grade line elevation from the outlet end of the pipe (TO POINT) to where flow enters the structure (FROM POINT) for the current segment.

STEP 6, WATER SURFACE ELEVATION (HGL): Add the head or energy loss from column 36 to the pipe outlet water surface elevation from column 26 and record this value in column 37. This represents the hydraulic grade line elevation for the beginning of the current segment.

STEP 7, STRUCTURE TOP ELEVATION: Record the top cover elevation for the access hole or the top of grate elevation for the inlet in column 38. This step provides the check for a flow surcharge from the system. If column 37 is higher in elevation than column 38, water is purging from the system for the design storm.

STEP 8, ENERGY GRADE LINE: The energy grade line (EGL) is an imaginary line that represents the total energy along a channel or conduit that carries water. Total energy includes elevation head, velocity head and pressure head. The energy equation states that the energy head at any cross section within the system must equal that in any other downstream section plus the intervening losses. The EGL for the beginning of the current segment is the HGL plus the velocity head at the end of the next upstream segment. Therefore, once column 33 is

determined for the next line on Form 5-3 (or the next upstream segment) you can return to column 39 and add that value to column 37 and record the EGL.

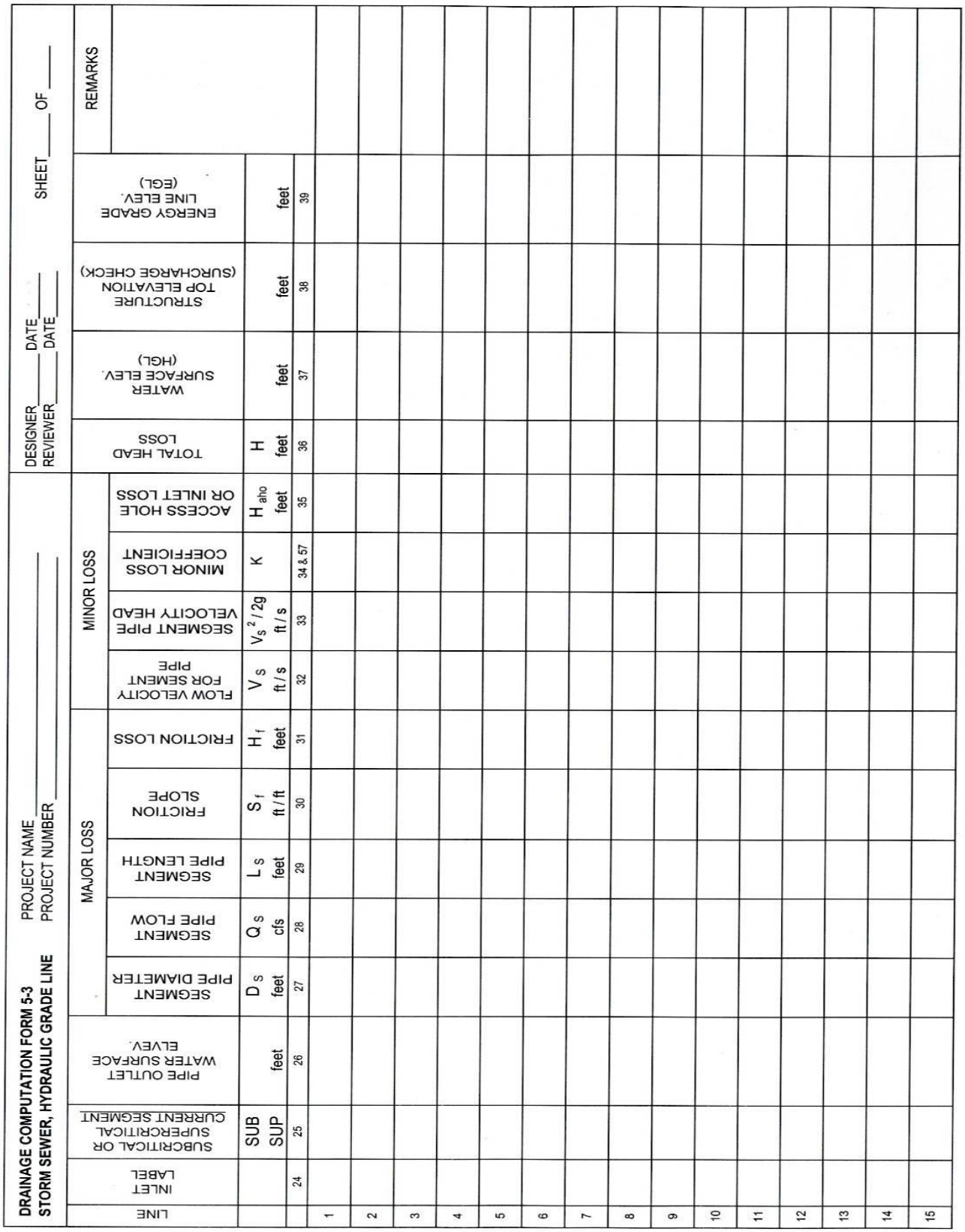
STEP 9, REPEAT AND CONTINUE TO MOVE UPSTREAM: Move to the next line on Form 5-3 and fill in column 24 with the TO POINT for the next upstream segment. Fill in column 25 with the flow state for the segment from column 19 on Form 5-2. Record the hydraulic grade line elevation for the outfall in column 26 which shall be the same as the column 37 value from the previous line.

Return to STEP 3 and STEP 4 and determine the losses in the segment.

Continue through STEP 5 to STEP 8 and repeat STEP 9 until you reach the end of a leg in the system or the beginning of the system. It is important to note that the segment at the start of a leg is called the beginning of the system when the time of concentration from this leg to the outfall is the longest for any path in the system.

Form 5-3

Storm Sewer, Hydraulic Grade Line Form



Form 5-4

Storm Sewer, Minor Losses Form

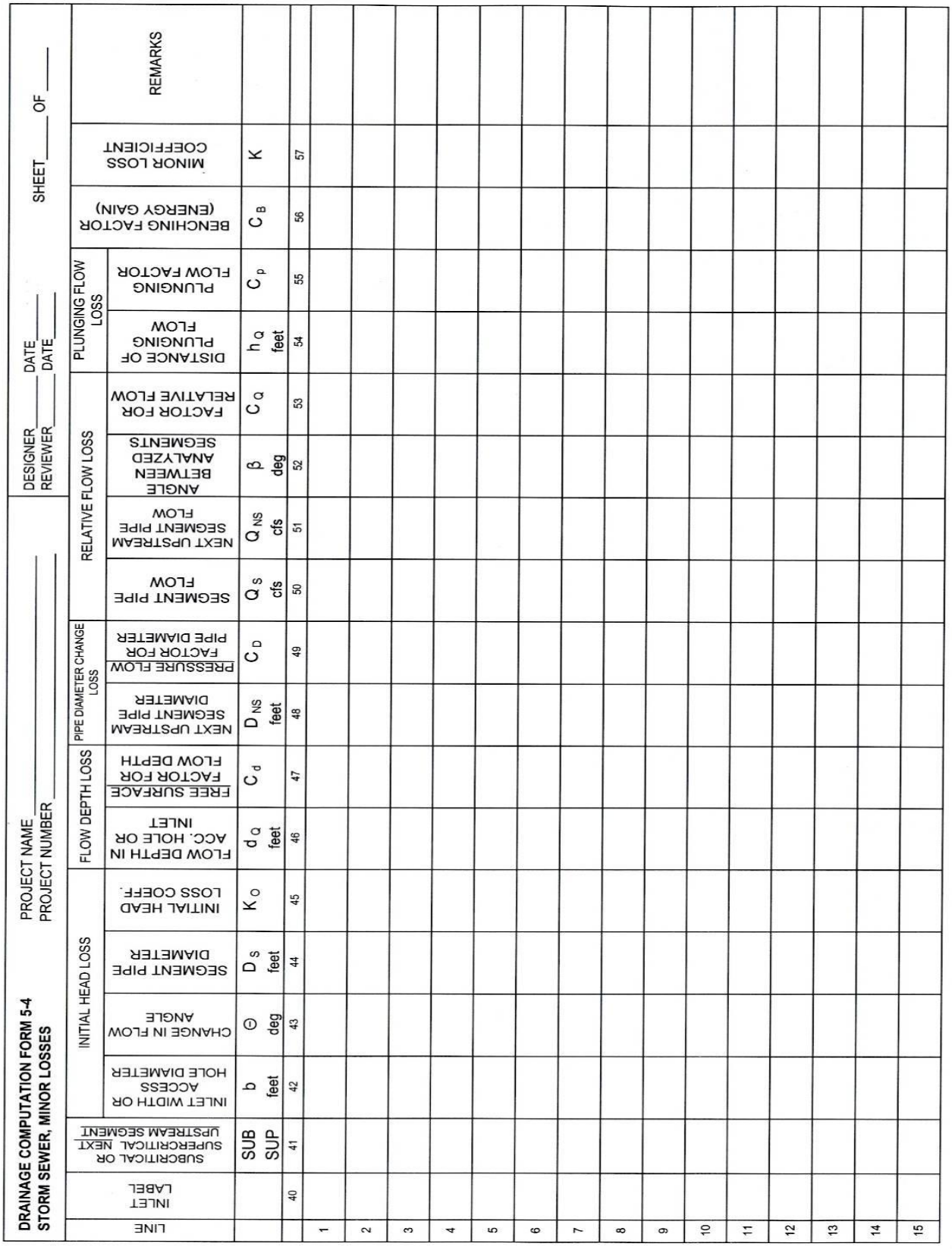
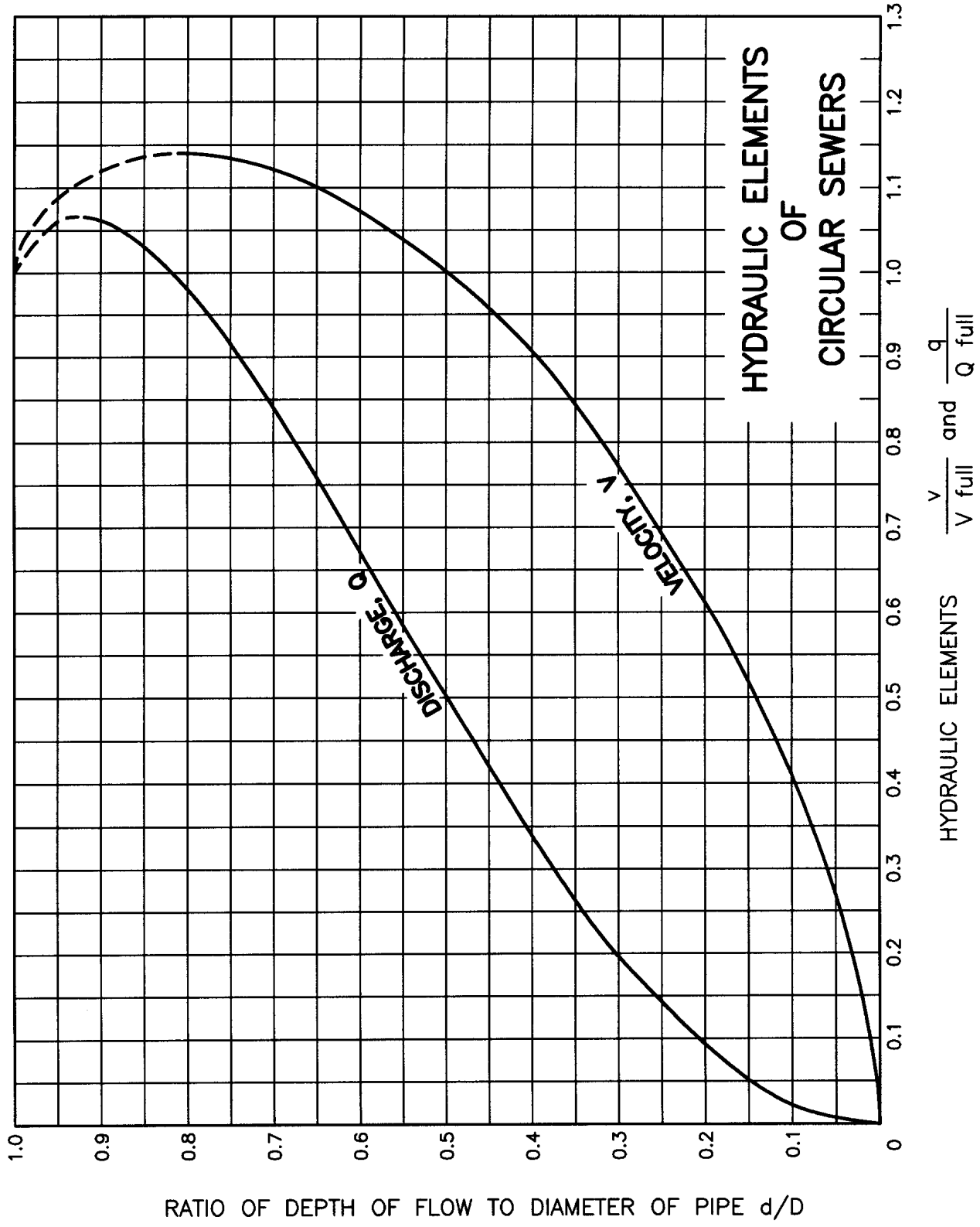


Chart 5-30

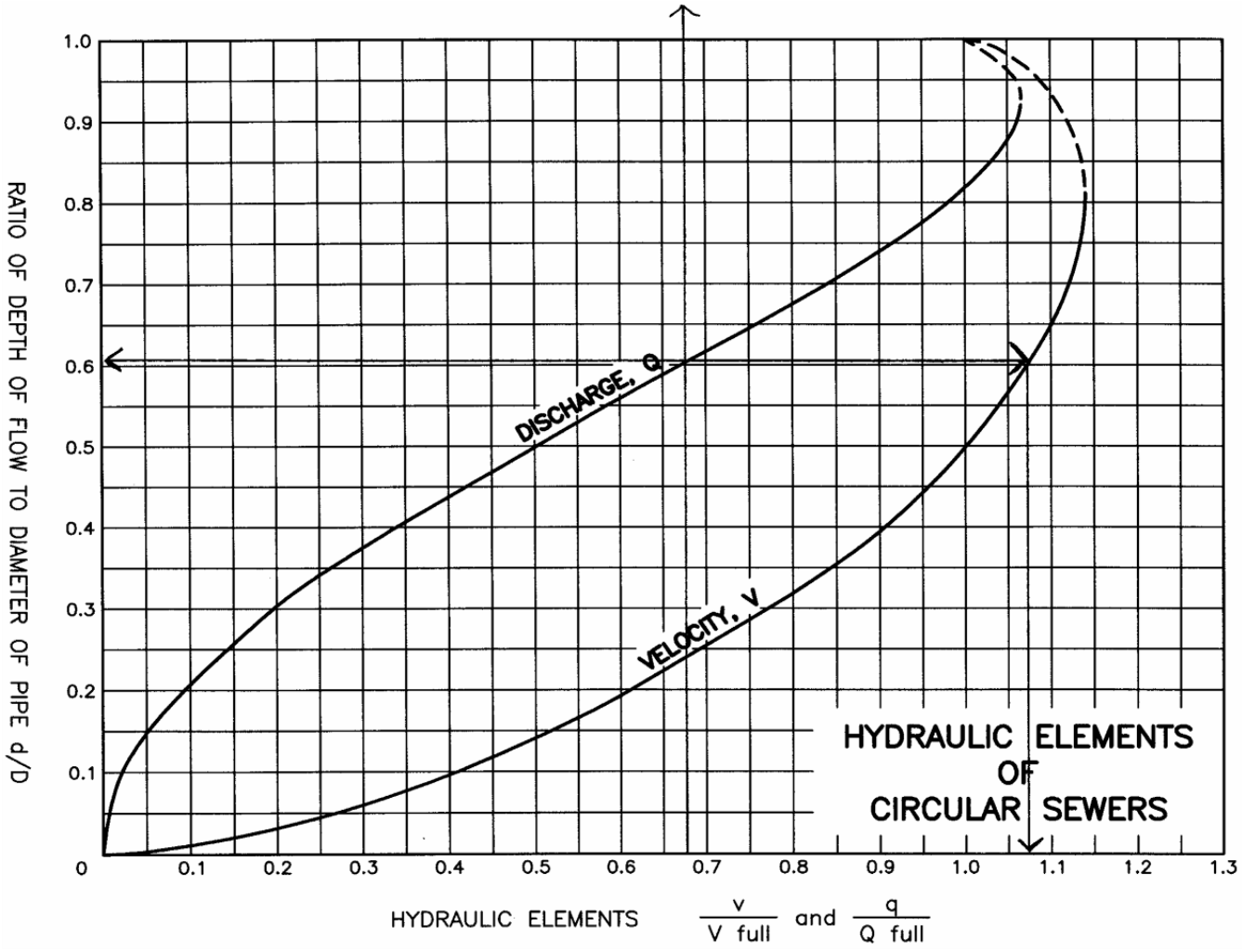
Hydraulic Elements for Partially Full Circular Storm Drains



Source: Louisville & Jefferson County M.S.D. Design Manual, January 2001

Chart 5-31

Hydraulic Elements: Example



Given: D_{full} = 18 in, Q = 7 cfs (the design flow - i.e., what the actual flow will be under design conditions), V_{full} = 5.96 fps (what the velocity would be at full flow), Q_{full} = 10.5 cfs (what Q will be when the pipe is flowing full)

Required: (a) depth, d, when Q = 7 cfs (i.e., when the sewer is partially full) and (b) velocity, v, when Q = 7 cfs (i.e., when the sewer is partially full)

Solution: $Q / Q_{full} = 7 / 10.5 = 0.67$

From figure related to hydraulic elements, $d / d_{full} = 0.61$

$d = (d_{full})(0.61) = 11$ in

From figure related to hydraulic elements, $V / V_{full} = 1.08$

$V = (V_{full})(1.08) = 6.4$ ft / sec

Source: Louisville & Jefferson County M.S.D. Design Manual, January 2001

5.5 REFERENCES

(1) Design of Bridge Deck Drainage, Hydraulic Engineering Circular-21 (HEC-21), Federal Highway Administration, May 1993

(2) Highway Drainage Guidelines, American Association of State Highway and Transportation Officials, 1999

(3) AASHTO Drainage Manual, American Association of State Highway Transportation Officials (AASHTO), 2014

(4) Urban Drainage Design Manual, Hydraulic Engineering Circular-22 (HEC-22), Second Edition, Federal Highway Administration, August 2001

(5) Neenah Inlet Grate Capacities, Neenah Foundry company, 1987

Chapter 10 Bridges

West Virginia
Department of Transportation
Division of Highways
Drainage Manual

TABLE OF CONTENTS

10.1 INTRODUCTION AND CONCEPTS....1
10.1.1 DEFINITION....1
10.1.2 HYDRAULIC DESIGN CONSIDERATIONS....1
10.1.3 COMMON NFIP ACRONYMS....2
10.1.4 BRIDGE SCOUR AND STREAM STABILITY CONSIDERATIONS....8
10.2 DESIGN POLICY....8
10.3 DESIGN CRITERIA....9
10.3.1 BACKWATER INCREASES AND NFIP REQUIREMENTS....10
10.3.2 FREEBOARD....11
10.3.3 FLOATING DEBRIS CONSIDERATIONS....11
10.3.4 BRIDGE SCOUR....12
10.3.5 HYDRAULIC ANALYSIS METHODS....12
10.3.6 STREAMBANK PROTECTION....12
10.4 HYDRAULIC DESIGN PROCEDURE....13
10.4.1 REQUIRED DATA....13
10.4.2 STREAM SURVEYS....13
10.4.3 HYDROLOGIC ANALYSIS....14
10.4.4 HYDRAULIC ANALYSIS....15
10.4.5 BRIDGE SCOUR....16
10.4.6 DOCUMENTATION....17
10.5 HYDRAULIC DESIGN OF TEMPORARY CONSTRUCTION....17
10.5.1 BACKGROUND....17
10.5.2 TEMPORARY BRIDGE CROSSINGS (DETOUR)....17
10.5.3 TEMPORARY CONSTRUCTION ACCESS....18
10.5.4 NORMAL FLOW....19
10.6 BRIDGE DECK DRAINAGE....19
10.6.1 PURPOSE....19
10.6.2 GENERAL POLICY....19
10.6.3 DESIGN APPROACH....20
10.7 BRIDGE ABUTMENT PROTECTION....45
10.8 REFERENCES....45

LIST OF FIGURES

FIGURE 10-1 EXAMPLE FHBM: BERKELEY COUNTY, WV 3
FIGURE 10-2 EXAMPLE FIRM: JEFFERSON COUNTY, WV 4
FIGURE 10-3 EXAMPLE FBFM: JEFFERSON COUNTY, WV 6
FIGURE 10-4 FEMA REGULATORY FLOODWAY CONCEPT 7
FIGURE 10-5 SPILL-THROUGH ABUTMENT 45

LIST OF FORMS

FORM 10-1 BRIDGE DECK DRAINAGE CALCULATIONS CONSTANT GRADE & FLAT BRIDGES 28
FORM 10-2 BRIDGE DECK DRAINAGE CALCULATIONS VERTICAL CURVE BRIDGES ... 29

LIST OF CHARTS

CHART 10-1 LOGIC FOR DRAIN OR SCUPPER SPACING ON CONSTANT GRADE 30
CHART 10-2 OVERLAND TIME OF CONCENTRATION 31
CHART 10-3 GUTTER TIME OF CONCENTRATION 32
CHART 10-4 FLOW IN TRIANGULAR GUTTER SECTIONS 33
CHART 10-5 CONSTANT DISTANCE BETWEEN DRAINS OR SCUPPERS ON CONSTANT GRADE 34
CHART 10-6 EFFICIENCY CURVES FOR CIRCULAR SCUPPERS 35
CHART 10-7 RATIO FRONTAL FLOW TO TOTAL GUTTER FLOW 36
CHART 10-8 TYPICAL BAR GRATE DETAILS 37
CHART 10-9 VELOCITY IN TRIANGULAR GUTTER SECTIONS 38
CHART 10-10 FRONTAL FLOW INTERCEPTION EFFICIENCY FOR TYPICAL BAR GRATES 39
CHART 10-11 LOGIC FOR DRAIN OR SCUPPER SPACING ON A FLAT GRADE 40
CHART 10-12 CONSTANT DISTANCE BETWEEN DRAINS OR SCUPPERS ON A FLAT BRIDGE 41
CHART 10-13 EFFECTIVE DRAIN OR SCUPPER PERIMETER ON A FLAT BRIDGE 42
CHART 10-14 LOGIC FOR DRAIN OR SCUPPER SPACING ON VERTICAL CURVE BRIDGES 43
CHART 10-15 INTERCEPTION COEFFICIENT K FOR VERTICAL BRIDGES 44

CHAPTER 10 BRIDGES

10.1 INTRODUCTION AND CONCEPTS

This chapter pertains to the hydraulic analysis and design procedures for bridges over waterways. The information presented here should be used to design waterway openings and to analyze backwater conditions.

10.1.1 DEFINITION

Bridges are defined as:

- Structures that transport traffic over waterways or other obstructions.
- A 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. For this chapter, all structures designed hydraulically as a bridge should be treated as such regardless of its length.

10.1.2 HYDRAULIC DESIGN CONSIDERATIONS

Proper hydraulic analysis and design is as vital as the structural design. A bridge carrying a highway over a watercourse must as a minimum, pass the design storm without overtopping the roadway or causing damage to the structure. This is to assure that frequent overtopping does not interrupt roadway service. The frequency of allowable overtopping is a function of the roadway classification and the availability of alternative routes in the event the roadway is overtopped.

Serviceability of the bridge and roadway must be balanced against flooding concerns. In certain situations, it may be more feasible to size replacement drainage structures to carry less than the design discharge. In such cases, replacement structures or the approach roadway will be inundated to convey expected discharges. A replacement structure where approach work is limited by physical or monetary restraints should not increase the backwater elevation than the existing structure.

Careful consideration must be given to the effects of increased frequency and depth of flooding on residential, commercial, industrial, agricultural, and recreational property. While it would be preferable not to cause any adverse impacts from backwater for a range of storms including the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storms, this is not always possible or economical. Minor increases in flood levels may be acceptable for some properties. However, significant increases in the frequency or depth of flooding will not.

For example, a property that is subject to flooding once every 50 years on average before the project may be able to sustain a minor increase in the 50-year flood level without major economic

hardship if the frequency of flooding has not increased significantly (such as unused adjacent floodplain). In contrast, considerable economic hardship would occur for a property that was flooding once every 25 years on average before the project is now flooded once every 2 years on average because of the project, regardless of the increase in the 25-year flood level.

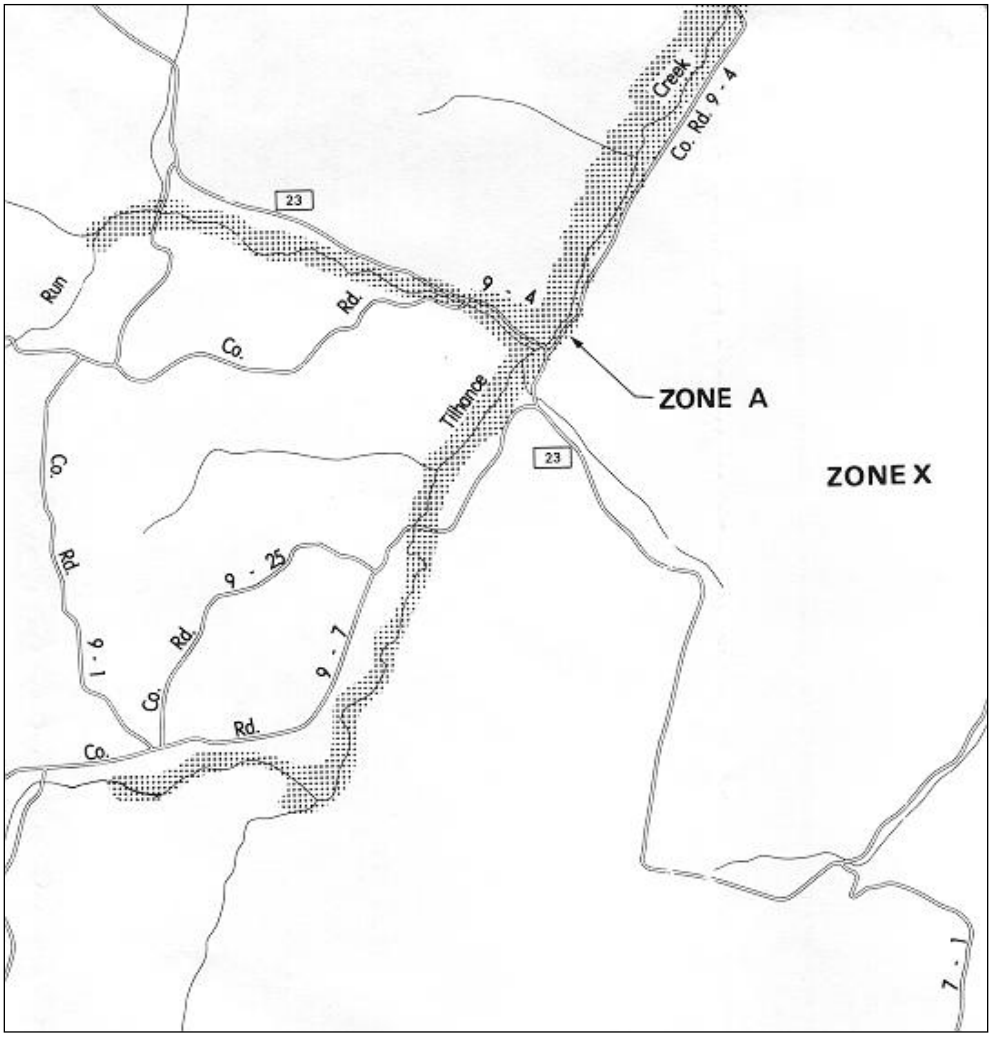
Bridges should be designed to minimize cost subject to the design criteria for the desired level of hydraulic performance in accordance with acceptable risk.

10.1.3 COMMON NFIP ACRONYMS

The designer should be familiar with the following common acronyms of the National Flood Insurance Program (NFIP) administered by the Federal Emergency Management Agency (FEMA):

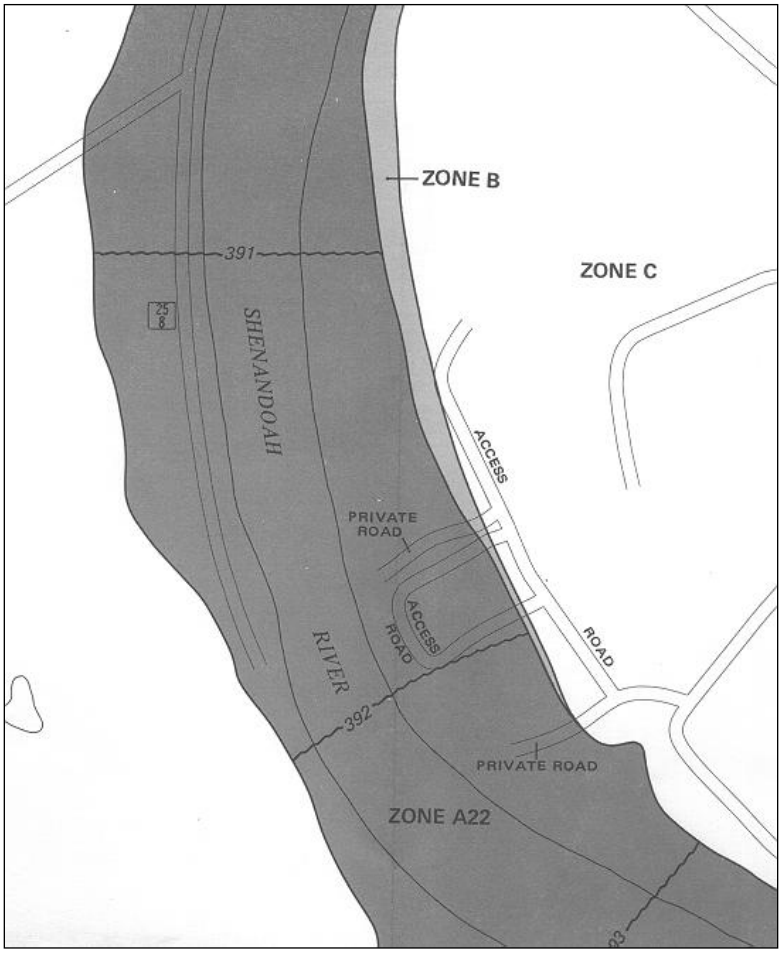
1. *Special Flood Hazard Area (SFHA)*: An area of land that would be inundated by the base flood shown on Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs).
2. *Flood Insurance Study (FIS) Report:* A report that describes the detailed methodologies and procedures used in developing the flood risk information shown on the FIRM and FBFM. Detailed methodologies include hydrology, hydraulics, and floodplain mapping. The FIS report usually contains the profiles for the 10-, 50-, 100-, and 500-year floods.
3. *Base Flood*: A flood having a 1-percent chance of being equaled or exceeded in any given year. Commonly referred to as the 100-year flood.
4. *Base Flood Elevation (BFE):* The water surface elevation associated with the 100-year flood profile, usually referenced to either the National Geodetic Vertical Datum of 1929 (NGVD 29) or the North American Vertical Datum of 1988 (NAVD 88).
5. *Design Discharge:* Discharge that must be safely conveyed through a bridge or culvert without overtopping the road. The design discharge is described by a return interval (e.g., 50-year flood) and is a function of the highway classification. (See Chapter 4, Section 4.3.1)
6. *Flood Hazard Boundary Map (FHBM):* The initial flood map issued by FEMA that identifies, based on approximate analysis, the areas of 100-year flood hazard in a community. The FHBM shows floodplain boundaries, but no BFE's or floodways (Figure 10-1).

Figure 10-1
Example FHBM: Berkeley County, WV



7. *Flood Insurance Rate Map (FIRM):* A map produced by the Federal Emergency Management Agency (FEMA) which depicts flood risk information including the 100-year floodplain along with other flood risk zones and the base flood elevations (BFEs). Versions of this map published later than 1986 combined information from both the FIRM and FBFM. The base (100-year) floodplains on pre-1986 FIRMs were designated by dark-shaded areas (Zones A, A1-A30, A99, AO, AH, AR, V, V1-V30) as shown in Figure 10-2. The 500-year floodplains were designated by lighter-shaded areas (Zone B). Post-1986 FIRMs show simplified flood insurance zone designations. The previous Zones A1-A30 and V1-V30 were replaced by the designations AE and VE; and Zones B and C were replaced by Zone X. The 500-year floodplain is still shown as “shaded” portions of Zone X. Base Flood Elevations (BFEs) are shown as wavy lines across the base floodplain.

Figure 10-2
Example FIRM: Jefferson County, WV



8. *Flood Insurance Rate Map Zones:*

Zone A: The 100-year or base floodplain. There are six types of A Zones:

A The base floodplain mapped by approximate methods; BFEs are not determined. This is often called unnumbered A Zone or an approximate A Zone.

A1-30 These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).

AE The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of the A1-A30 Zones.

AO The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.

AH Shallow flooding base floodplain. BFEs are provided.

A99 Area to be protected from base flood by levees or Federal Flood Protection Systems under construction. BFEs are not determined.

AR The base floodplain that results from the decertification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.

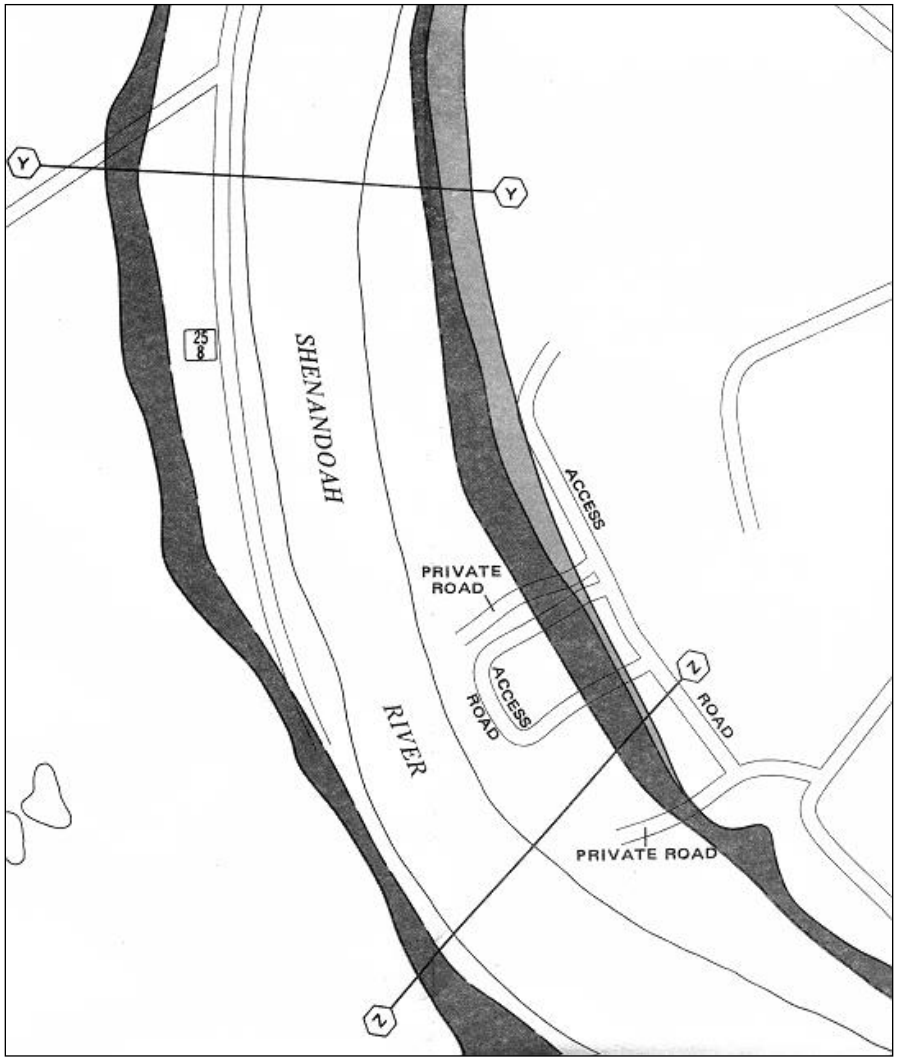
Zone B and Zone X (shaded): Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, shallow flooding areas with average depths of less than one foot, or drainage areas less than 1 square mile.

Zone C and Zone X (unshaded): Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X (unshaded) is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

Zone D: Area of undetermined but possible flood hazards.

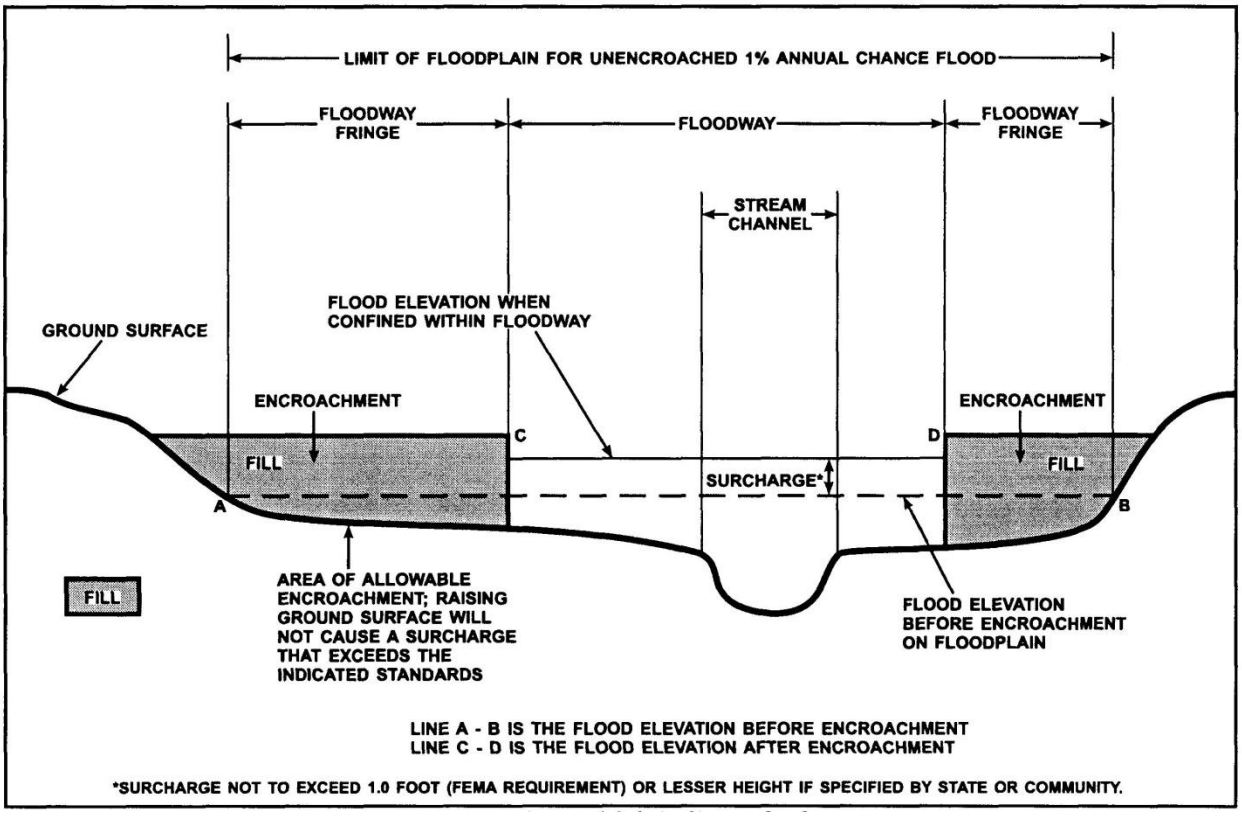
9. *Flood Boundary and Floodway Map (FBFM):* A map issued by FEMA that depicts the boundaries of the 100-year floodplain and the regulatory floodway based on detailed analysis (see Figure 10-3). This map also shows the location of the cross-sections used in the hydraulic analysis that were used to establish the BFEs. FBFMs were published prior to 1986. Since 1986, the information on the FBFM is published on FIRMs.

Figure 10-3
Example FBFM: Jefferson County, WV



10. *Floodway:* A regulatory floodway adopted into a community's floodplain management ordinance that includes the stream channel plus that portion of the overbanks that must be kept free from encroachments to discharge the base flood without increasing flood levels more than 1.0-foot (see Figure 10-4).

Figure 10-4
FEMA Regulatory Floodway Concept



11. *Floodway Fringe:* The portion of the floodplain between the floodway boundary and the base flood boundary.

12. *Conditional Letter of Map Revision (CLOMR):* A CLOMR is FEMA's formal review comment whether a proposed project if constructed would comply with the minimum NFIP floodplain management criteria and warrant a revision to the FIRM.

13. *Letter of Map Revision (LOMR)*: A LOMR is an official revision to the currently effective FEMA map. It consists of a letter with an attached copy of the FIRM, annotated to show changes to the BFEs, floodplain boundary, or regulatory floodway based on revised conditions.

14. *Physical Map Revision (PMR):* An official republication of a community's NFIP map to effect changes to the BFEs, floodplain boundaries, regulatory floodways, or planimetric features. These changes typically occur because of structural works or improvements, annexations resulting in additional flood hazard areas, or corrections to the BFEs or SFHAs.

10.1.4 BRIDGE SCOUR AND STREAM STABILITY CONSIDERATIONS

Reasonable and prudent hydraulic analysis of a bridge design requires that an assessment be made of the proposed bridge's vulnerability to undermining due to potential scour. FHWA issued a Technical Advisory (TA 5140.23) in October 1991 requiring a scour evaluation for existing and proposed bridges over waterways. Nearly all design situations in West Virginia allow access to a stable underlying layer of rock for the bridge foundations. This fact usually negates the concern of scour at a bridge crossing, however the amount of scour shall be determined and documented as part of the design process. The hydraulics engineer must always be aware of and use the most current scour forecasting technology.

Less hazardous perhaps, are problems associated with aggradation. Aggradation is sometimes referred to as negative scour. Where freeboard is limited, problems associated with increased flood hazards to upstream property or to the traveling public due to more frequent overtopping may occur. Where aggradation is expected, it may be necessary to evaluate these consequences.

The inherent complexities of stream stability, further complicated by highway stream crossings, requires a multi-level solution procedure. The evaluation and design of a highway stream crossing or encroachment should begin with a qualitative assessment of stream stability. This involves application of geomorphic concepts to identify potential problems and alternative solutions. This analysis should be followed with a quantitative analysis using basic hydrologic, hydraulic, and sediment transport engineering concepts. Such analyses could include evaluation of flood history, channel hydraulic conditions, (up to and including, for example, water surface profile analysis) and basic sediment transport analyses (e.g., evaluation of watershed sediment yield, incipient motion analysis, and scour calculations). This analysis can be considered adequate for many locations if the problems are resolved and the relationships between different factors affecting stability are adequately explained. If not, a more complex quantitative analysis, based on detailed mathematical modeling and/or physical hydraulic models, should be considered. This multi-level approach is presented in HEC 20.

10.2 DESIGN POLICY

This section presents policies that are unique to the hydraulic design of bridges. For new and replacement bridges, 0.00 backwater increase is always the goal. Measures to limit any increase in the risk of flood damage to property and structures must be balanced with other competing interests.

- Minimizing social, economic, and environmental impacts.
- Compliance with the requirements of the NFIP administered by FEMA.

- As far as practicable, bridges in floodplains shall be designed to avoid significant encroachments that could result in the interruption or termination of the highway facility that serves as the only evacuation route during an emergency.
- The hydraulic design of bridge waterway openings, road grade, bridge scour estimates, and abutment protection shall consider the potential risks to traffic, adjacent property, and the environment.
- The design discharge is normally one or more of the customarily documented events (2, 5, 10, 25, 50, 100, & 500-year floods) that will pass under the bridge superstructure at its lowest elevation with the minimum freeboard, provided that level of protection is acceptable to the bridge designer.
- The discharges obtained from the effective FIS for the community shall be utilized for hydraulic design provided they are representative of current site conditions. The selected design discharges shall reflect consideration of traffic service level, environmental impact, property damage, hazard to human life, and floodplain management criteria.
- Bridges that exceed the maximum backwater increases allowed by FEMA for waterways mapped under the NFIP due to special circumstances shall require approval by the Division Director.
- Bridge pier placement, pier spacing, pier orientation, and the abutments shall be designed to minimize flow disruption and potential scour. Pier placement within the floodway should be avoided.
- Bridges should be designed to operate with a minimum freeboard for the passage of the design discharges and floating debris to account for the risk associated with the hydraulic computations.
- The bridge foundations shall be positioned below the total estimated scour depth to prevent bridge failure by scour. The total scour estimate shall consist of long-term degradation or aggradation of the riverbed, local scour at the piers, and local scour at the abutment (according to the most current scour forecasting method, this includes the contraction scour).
- Evaluation of various bridge alternatives shall be accomplished by using an approved backwater program such as the Army Corps of Engineers' HEC-RAS.

10.3 DESIGN CRITERIA

The proceeding design criteria in the following sections shall apply to the hydraulic design of bridges.

10.3.1 BACKWATER INCREASES AND NFIP REQUIREMENTS

Due to economic reasons, bridges usually encroach upon the floodplain with the roadway embankment and span the stream channel and a portion of the over-banks. This is true for both new bridges and bridge replacement projects.

Bridges shall be designed such that they do not cause increases in backwater that would have adverse impacts on the surrounding community. Small increases are sometimes unavoidable. 0.00 backwater increase is always the goal. Always evaluate increased risk of flood damage to property and structures. If the water surface elevation will be increased, consider the need for buying permanent drainage easements.

Designers shall conform to FEMA's National Flood Insurance Program (NFIP) regulations for sites located in the Special Flood Hazard Areas (SFHA) shown on the Flood Insurance Rate Maps (FIRMs) for the community. FEMA regulations and sound engineering practice require coordination with the community's floodplain administrator on all projects that may potentially affect the BFEs on a stream. FEMA requirements depend on the level of study that has been performed for a given stream.

Streams with BFE and Regulatory Floodway

The NFIP regulations do not permit any increase in the BFE (i.e., 0.00 foot or zero) for construction within the regulatory floodway. Exceptions to this requirement must be processed through a CLOMR request to FEMA. All impacts must be evaluated and affected property owners must be notified.

Construction in the floodway fringe may be allowed to cause up to 1-foot of cumulative increase in the BFE, also known as the floodway surcharge. The surcharge is defined as the cumulative effect of the proposed bridge combined with all other existing and anticipated development since the original NFIP study was completed. The published floodway surcharge shown in the FIS may be less than 1-foot in many places due to that development since the original study. Therefore, some, or all, of the allowable 1-foot surcharge may already be used by previous developments in the floodway fringe. The designer is cautioned that previous development may or may not be properly documented.

Streams with BFE but without Regulatory Floodway

A hydraulic analysis is required to demonstrate that the proposed bridge causes no more than 1-foot of cumulative increase in the BFE. BFE increases greater than 1-foot must be approved through the CLOMR process.

Streams without BFE Studied by Approximate Methods

BFE shall be developed for streams studied by approximate methods (i.e., the discharges and water surface elevations have not been published in the FIS) to ensure that the proposed bridge

causes no more than 1-foot of cumulative increase in the BFE including the effect of the proposed bridge. BFE increases greater than 1-foot must be approved through the CLOMR process.

Unstudied Streams

A hydraulic analysis shall be performed to ensure that increased water surface elevations will not adversely affect nearby property. A CLOMR is not required.

Conditional Letter of Map Revision (CLOMR)

Bridge encroachments may be allowed to cause BFE increases beyond the NFIP allowances if a CLOMR request is submitted for a BFE and/or floodway revision, and the following provisions of 44 CFR 65.12 are satisfied:

- An evaluation demonstrating why other alternatives, which would not result in allowable BFE increases, are not feasible.
- Documentation of individual legal notice to all impacted property owners.
- Concurrence of the Chief Executive Officers of the affected communities.
- Certification that no structures are affected by the BFE increases.

CLOMR requests should be prepared and submitted using FEMA's MT-2 Forms, which can be downloaded from FEMA's website.

Coordination with the community's floodplain manager is required in all cases with a FEMA designated floodplain. It should be noted that FEMA approval does not absolve the Highway Department's responsibility for any increased flooding. Therefore, **zero increase is the goal**.

10.3.2 FREEBOARD

Where practical and reasonable, a minimum freeboard of two feet should be provided between the design storm water surface elevation and the lowest portion of the superstructure for the design discharge. Where this is not practical and reasonable, the bridge designer should establish the freeboard based on the desired level of protection.

10.3.3 FLOATING DEBRIS CONSIDERATIONS

Floating debris that becomes trapped on a bridge can cause substantial damage through increased flooding and scour. If piers or abutments will be placed in the active channel or floodplain, then the potential for floating debris should be evaluated. Streams with steep soil banks generally have a greater likelihood of receiving floating debris. Piers in the active channel should be avoided.

10.3.4 BRIDGE SCOUR

Scour calculations shall be based on the 1% annual chance flood (100-year), the 0.2% annual chance flood (500-year), and the bridge overtopping flood. Form DS-34 shall be completed after the amount of scour is determined. This form is available in the Bridge Design Manual, Appendix C-3. Scour depth estimates are based upon the guidance provided in the following publications. The most current scour forecasting method for contraction and abutment scour is within the NCHRP report.

- *Evaluating Scour at Bridges, Hydraulic Engineering Circular No. 18, (FHWA, HEC 18)*
- *Stream Stability at Highway Structures, Hydraulic Engineering Circular No. 20 (FHWA, HEC-20)*
- *Estimation of Scour Depth at Bridge Abutments, National Cooperative Highway Research Program (NCHRP, 24-20)*

The FHWA Program Hydraulic Toolbox (latest version is 5.5) provides the calculation processes from the above publications. It is recommended for use in determining the required values of scour stated in the policy of Section 10.2.

Whenever necessary, adequate details shall be incorporated into the design plans to minimize the effects of scour. Spread footings shall be embedded at least one foot into non-scourable rock. For pile foundations, the bottom of the pile cap shall be below the scour depth. Drilled shaft foundations shall be analyzed to ensure stability without soil support. Whether rock is considered scourable is currently determined by the rock quality designation (RQD). If the RQD is greater than 50%, then the rock is considered non-scourable. The engineer and the geologist should also consider the type of rock.

10.3.5 HYDRAULIC ANALYSIS METHODS

A one-dimensional step-backwater computer program is usually acceptable to perform the hydraulic analysis for most situations. Any computer program currently approved by FEMA may be used but the Division prefers that the latest version of the Army Corps of Engineers' HEC-RAS computer program be used. Two-dimensional hydraulic modeling shall be considered for complex flow situations. If you believe a 1-dimensional model is inadequate for your project, consult the Hydrology and Hydraulics Design Unit for guidance.

10.3.6 STREAMBANK PROTECTION

Bridges that cross streams and highways along streams are at great risk if the streambanks are unstable. Maintaining a stable dimension, pattern, and profile for the stream is sometimes beyond control. Streambank protection is often required. Bridges shall be designed to be stable

even if the streambanks are not, but the banks should be protected to prevent damage to the highway system and the environment.

Rock has typically been used for slope protection at bridges and along highways adjacent to streams. Design procedures for rock slope protection are given in FHWA's HEC-23 Bridge Scour and Stream Instability Countermeasures, Volume 1, and Volume 2. Design Guideline 4 -Riprap Revetment is applicable for rock slope protection. Design Guideline 16 – Filter Design should also be used with Riprap Revetment design to prevent undermining of the revetment. The designer should become familiar with all 19 Design Guidelines contained in Volume 2 of HEC-23. The Hydrologic and Hydraulic Design Unit does not recommend using gabion baskets in active streams. Methods that require the placement of green concrete in the stream may be difficult to construct, and regulatory agencies may also oppose these methods.

10.4 HYDRAULIC DESIGN PROCEDURE

10.4.1 REQUIRED DATA

The data necessary to perform a hydraulic analysis typically includes topographic maps, aerial photographs, roadway plans and profiles, and typical sections to cover the width of the floodplain in the vicinity of the crossing. The designer should download FIS's and flood maps from FEMA's Map Service Center (MSC).

10.4.2 STREAM SURVEYS

Cross-section surveys should include shots at breaks in the grade, edge of water, streambed, thalweg (deepest part of the channel) and the top of bank. Surveyors trained to identify "Ordinary High Water" (OHW) and "bankfull" indicators should include them in the survey.

Cross sections should be taken at the following locations:

- Immediately upstream and downstream of the existing bridge approach fills.
- If the alignment is expected to change, immediately upstream and downstream of the proposed bridge approach fills.
- Underneath the existing and proposed bridge structures.
- One bridge length or channel width (whichever is less) upstream and downstream of the bridge.

If an existing hydraulics model will be used, the cross sections adjacent to the bridge must be field verified to account for differences in survey datum and aggradation or degradation of the stream. In this case, a total of six cross sections will be surveyed. See section 7.4.3.5 to determine the necessary downstream reach length.

If an existing hydraulic model is not available or will not be used, then additional cross sections will be required. A total of eight to twelve cross sections should suffice.

- Include two additional cross sections upstream and downstream, spaced at one channel width apart.
- If the stream has pools and riffles, cut sections at each pool and at the head of each riffle to include at least two riffles upstream and downstream of the proposed and existing bridge.
- Include a section at each significant constriction or obstruction to the channel or floodplain. This may be several hundred feet from the bridge.
- Include nearby bridges.

All cross sections do not need to cross the entire flood prone area if it is approximately uniform. If the flood prone area is approximately uniform, then just three of the sections across the entire flood prone area might be sufficient. All other surveyed cross sections would extend just beyond the top of the stream bank. Flood prone area limits and elevations for intermediate cross sections can be interpolated. For very wide floodplains, the extent of the flood prone area may be determined from a USGS map.

A profile of the thalweg (the deepest part of the channel) must be surveyed from the most downstream section to the most upstream section. Include shots at each break in the profile grade and at regular intervals.

See Chapter 7 Section 7.4.3 for guidance on boundary conditions and cross section locations.

10.4.3 HYDROLOGIC ANALYSIS

Discharges should be developed using the methods outlined in Chapter 4 (Hydrology). High flow (10-year, 50-year, 100-year, and 500-year discharges) as well as low flow (normal depth, ordinary high water (OHW), 2-year, 5-year) discharges shall be used for the analysis. OHW should be identified in the field survey. The representative flow for OHW and the normal depth shall be calibrated in the model to the field elevation.

Most drainage areas to bridges will qualify for the use of the USGS method. As stated in Section 4.4.4.2, these equations are appropriate for areas greater than 10 square miles. If the area is below are just above this value, TR-55 shall be used to determine the discharges.

If available, the FEMA FIS discharges should be considered. Read the study to determine when and by what means the discharges were formulated. If they were calculated recently by an acceptable method and compare well to the appropriate method of Chapter 4, they should be used for the analysis. Otherwise use the methods of Chapter 4 to determine the discharges for the analysis and include the FIS base flood discharge for information.

10.4.4 HYDRAULIC ANALYSIS

A detailed hydraulic analysis should be performed for all new or replacement bridges and structures involving significant lateral encroachments due to placement of highway fill within a floodplain. An analysis is required for all bridged waterways regardless of whether it is within a FEMA or other officially delineated floodplain. These analyses are commonly performed using a one-dimensional step backwater computer program. The use of a two-dimensional numerical model should be approved by the Engineering Division.

The designer should refer to Chapter 7 for modeling guidance regarding study limits, boundary conditions, cross-section layout and spacing, Manning's Roughness values, and calibration.

Major culvert installations where the backwater may affect insurable structures, developable property, or that are located within a FEMA designated flood zone may require a backwater analysis with the Engineering Division's approval.

The Division prefers the following representations of data for performing the hydraulic analysis:

Duplicate Effective Model

A duplicate reproduction of the baseline hydraulic model (such as the effective FEMA flood insurance study model) using a step-backwater computer program. It is not necessary to use the same program that was used to develop the Effective Model provided the output differences can be explained. This hydraulic model will be referred to as the Duplicate Effective Model. The designer should consider the use of a model from FEMA however one may not be available from the FEMA library for the project site.

Corrected Effective Model

The Corrected Effective Model would represent the use of additional data to the Duplicate Effective Model; however, it should not reflect any man-made changes since the date of the Effective Model. Examples would be more detailed topographic information at a cross section or additional cross sections at locations required to accurately model the proposed bridge. Any corrections to the data should also be made at this stage (which may include deletion of cross sections). If gaged flows or observed highwater marks are available, the Corrected Effective Model may be calibrated by adjusting the Manning's roughness values. Any changes to the Corrected Effective Model are primarily for the purpose of establishing the Existing Conditions model.

Existing Conditions Model

The Duplicate Effective Model or the Corrected Effective Model should be modified to produce the Existing Conditions Model. This representation will reflect any modifications that may have occurred within the floodplain since the date of the Effective Model but prior to the construction of the bridge project (such as beneficial survey data within the channel). If no modification has

occurred, then this model would be identical to the Corrected Effective Model or Duplicate Effective Model. The Existing Conditions Model may be required to support conclusions about the actual impacts of the proposed construction. Thus, it becomes the basis for measurement of any increase or decrease in water surface elevation due to the proposed construction.

Proposed Conditions Model

The Proposed Conditions Model(s) should include two separate versions. The Proposed Permanent Conditions and the Proposed Temporary Conditions models. The Existing Conditions Model with temporary works should be evaluated against the Proposed Temporary Conditions model with the higher water surface elevation of the two considered. Multiple additional models may also be required for a phased proposed construction. The Proposed Conditions Model(s) are compared to the Corrected Effective or Existing Conditions model to determine the permanent and temporary effects on the water surface elevation due to the proposed construction.

10.4.5 BRIDGE SCOUR

The hydraulics engineer must always be aware of and use the most current scour forecasting technology. NCHRP 24-20 equations for scour calculations which apply to local scour at the abutments (Section 8.6.3, page 8.8 of HEC-18). The seven specific steps are recommended in HEC-18 for estimating scour at bridges:

Step 1: Determine scour analysis variables.

Step 2: Evaluate long-term bed elevation change.

Step 3: Compute the magnitude of contraction scour.

Step 4: Compute other general scour depths.

Step 5: Compute the magnitude of local scour at piers.

Step 6: Determine abutment foundation type, protection, and elevation. Computation of local scour depths may be used to aid in this determination.

Step 7: Plot and evaluate the total scour depths.

The engineer should evaluate how reasonable the individual estimates of general scour (contraction or other) and local scour depths are in Steps 3, 4, and 5 and evaluate the reasonableness of the total scour in Step 7.

Perform the bridge foundation analysis on the basis that all streambed material in the scour prism above the total scour line has been removed and is not available for bearing or lateral support.

Finally repeat the procedure and calculate the scour for a superflood. It is recommended that this superflood (or check flood) be on the order of a 500-year event. However, flows greater or less than these suggested floods may be appropriate depending upon hydrologic considerations and the consequences of damage to the bridge. An overtopping flood less than the 500-year flood may produce the worst-case situation for checking the foundation design. The foundation design should be reevaluated for the superflood condition and design modifications made where required.

10.4.6 DOCUMENTATION

The designer should refer to the Division's recommended Hydrology and Hydraulics Report format in Chapter 3. Preliminary reports are generally only submitted on significant bridge projects that have a drawn Span Arrangement, Type, Size, and Location (TS&L). For most bridges, one submission is generally adequate.

10.5 HYDRAULIC DESIGN OF TEMPORARY CONSTRUCTION

10.5.1 BACKGROUND

The designer shall evaluate the risk of flood damage to property and structures for the temporary construction condition. Temporary construction features such as temporary bridge crossings (detour), causeways, and cofferdams are needed to provide construction access and to facilitate bridge construction. Impacts caused by construction features should be analyzed due to their effect on both low and high stream flow rates.

10.5.2 TEMPORARY BRIDGE CROSSINGS (DETOUR)

Flow Criteria

A temporary bridge or detour should be constructed to span the highest 10-year water surface elevation (present stream or the nearby confluence stream considering the coincident peak flow) to remain serviceable. If this elevation is below the bank elevation of the present stream, then the low chord of the temporary bridge should run from bank to bank of the present stream. In the case of a high ADT roadway, a less frequent flow criterion for serviceability may be considered.

Risk Criteria

A temporary bridge shall be designed such that it does not cause an increase in the water surface elevation that would have an adverse impact on nearby property. Increases in water surface elevation due to the presence of a temporary bridge with the existing bridge and/or proposed bridge in place are usually unavoidable. The criterion for allowable elevation increase is to be determined by the designer through an examination of the surrounding area. Risk criterion will be set based on the land use and the elevation of nearby structures. Thus, the

effects of flooding the surrounding area for the serviceable flow of the temporary condition set the risk criterion.

For example, if the presence of the temporary detour with the existing structure in place floods a nearby meadow or pasture field at the 10% (10-year) storm, the risk of adverse impacts is low. Moreover, if the same design situation floods a nearby outbuilding or garage for the 10% (10-year) storm, the risk of adverse impacts is high. In the second case the higher risk of adverse impacts shall warrant a modification to the design of the temporary structure to reduce the water surface elevation upstream.

The designer should be mindful of the local floodplain managers' possible knowledge and familiarity of the surrounding area. The local floodplain manager may require consultation for the determination of the risk criterion.

10.5.3 TEMPORARY CONSTRUCTION ACCESS

The objective of a temporary construction access design is to provide a design that is reasonably convenient, economical, and logistically feasible for the contractor to build, maintain, and remove.

Temporary fills placed in or near watercourses shall be constructed in a manner to withstand expected high flows and shall consist of clean and course non-erodible materials. The causeway's influence on flood flow elevations should also be checked for a range of flows from the OHW flow up to the 0.2% (500-year) storm.

The hydraulic analysis should consider in-stream obstructions such as piers or islands that could direct high velocity flows at points along the causeway.

The causeway shall be designed so that it will not significantly:

- Increase the water surface elevation for flows that could damage property.
- Increase the velocity of flow through the causeway opening(s).
- Alter the usual flow distribution.
- Direct flow at the piers and foundations which would subject them to forces for which they were not designed.

Temporary structures and fill placed in the active stream channel are at great risk to damage by high flows. Designers and builders are encouraged to consider more robust materials and methods of providing construction access in streams. For example, consider using a higher elevation temporary bridge or concrete box culverts instead of the traditional pipes and riprap. The following guidance may be used if the traditional causeway is found to be appropriate. The top of the causeway should typically be set about 1 foot above the OHW level. If a causeway will completely cross the channel, then the largest possible pipe diameter should

be placed through the causeway spaced at 0.5 times the diameter. Pipe size will vary with the depth of the stream.

10.5.4 NORMAL FLOW

USACE Nationwide 404 Permit states: "Appropriate measures must be taken to maintain near normal downstream flows and to minimize flooding." To ensure compliance with the normal flow requirement, an analysis of normal flow must be done when a construction project will have temporary works within the active channel.

Normal flow is the water flow prevailing during the greater part of the year. Statistically, this is most closely represented by the "mode", which is the value occurring most frequently in a series of observations or statistical data. However, for the purpose of meeting the 404 permit requirements, statistical analysis will not be required to determine normal flow. On regulated rivers, such as the Ohio, normal flow and/or stage can be obtained from the USACE. On unregulated rivers or streams, estimate the normal stage from field observations then determine the corresponding normal flow through calibration by using HEC-RAS.

10.6 BRIDGE DECK DRAINAGE

10.6.1 PURPOSE

The primary objective of bridge deck drainage is to remove runoff before it collects in the gutter to a point which exceeds the allowable design spread. Proper drainage on a bridge deck will help reduce the risk of hydroplaning during and after a storm event.

10.6.2 GENERAL POLICY

The allowable spread for a bridge deck follows the same guidelines listed for Storm Drainage Systems in Chapter 5, Table 5-1, page 5-14. For most bridges, the spread will be limited to the shoulder width for a 10-year storm event. Where speeds are lower than 40 MPH, an additional 3 foot of spread is allowed beyond the shoulder. Wider shoulders are advised to help limit the number of deck drains or scuppers.

The minimum value of five minutes usually represents the time of concentration. For exceptionally long bridges or where the preceding roadway drainage contributes to the deck drainage the following time of concentration calculations should be used. This is an iterative procedure which is dependent on the flow length and the rainfall intensity of the 10-year storm.

Bridge end collectors should be placed at the upstream end of the bridge to prevent the preceding roadway runoff from flowing onto the deck. They should also be placed at the downstream end of the bridge to outlet the gutter flow in a stable manner. Flow leaving the end of the deck shall be managed to prevent damage to the adjacent roadway fill and to private

property (see Chapter 6, Section 6.4.2). It shall not present a hazard to motorists, pedestrians, or cyclists.

Long bridges in urban or environmentally sensitive areas may require runoff to be collected and piped to a specified outlet location. Design of these collection systems will be addressed individually and shall be approved by the Engineer.

Bridge deck drains or scuppers should meet the design guidelines of HEC-21 and may follow the procedure outlined below. Structural and aesthetic constraints may also be considered when selecting the final size and location of deck drains or scuppers.

10.6.3 DESIGN APPROACH

General Assumptions

- This procedure assumes the roadway runoff is collected before reaching the bridge deck. If an upstream inlet is not used the roadway drainage area shall be included in the area to the first deck drain or scupper.
- The time of concentration is usually five minutes.
- The deck drainage area presents a constant or uniform cross slope (see Chart 5-1 and 5-2).

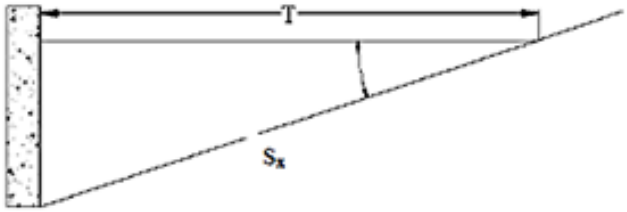


Figure 2-1 Uniform Cross Slope Section (Johnson and Chang 1984)

- The shallow concentrated flow part of the overland flow segment is not present (see Section 4.4.2.5).
- The bridge deck gutter width is defined by the spread of flow from the adjacent curb or parapet. This width is not defined by the shoulder and may include a portion of the travel lane.

This procedure simplifies the one provided in Chapter 5 for roadway inlet spacing. In the case of a bridge the roadway cross slope is usually constant for the entire length and the gutter cross slope is usually the same as the adjacent pavement. These equalities simplify the design equations and allow the hydrology determination of the Rational Method to be included within them.

Constant Grade Bridges

Step 1: Determine the Tc and corresponding rainfall intensity i which create the design spread T.

There are two components to the time of concentration calculation for bridge decks. The sheet flow (part of the overland flow) segment resides from the deck high point to the gutter and the channel segment lies along the gutter. The presented process assumes the sheet flow travels directly across the deck. If the deck has a sufficient longitudinal surface slope to cause an angled overland flow length to the gutter, l_o should be used in place of W_p. If this is the case, then the following iteration will require two assumptions to converge ($T_{t\ sheet\ flow}$ and l_o). For a bridge deck with a normal crown, half of the deck width contributes to the gutter flow. For a bridge deck with superelevation, the entire deck width contributes to the gutter flow. The most accepted method for estimating T_c for the overland sheet flow segment is the kinematic wave equation (Ragan, 1971, see Section 4.4.2.5).

$$T_{t\ \text{sheet flow}} = \frac{0.93}{Ci^{0.4}} \left(\frac{nW_p}{\sqrt{S}}\right)^{0.6}$$

$T_{t\ sheet\ flow}$ = sheet flow component of overland flow (min)

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity for the storm return period (in/hr)

n = roughness coefficient, usually 0.016 for asphalt 0.013 or concrete

W_p = width of pavement contributing runoff or l_o angled flow length (ft)

S = slope of the surface (ft/ft)

$$T_{t\ \text{channel flow}} = 484\ \frac{S_x T^2}{CiW_p}$$

$T_{t\ channel\ flow}$ = gutter flow (min)

S_x = uniform cross slope of the gutter and deck (ft/ft)

T = design spread, ft (occurs causing the need for the first drain or scupper)

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity for the storm return period (in/hr)

W_p = width of pavement contributing runoff (ft)

The calculation of the total T_c ($T_{t\ sheet\ flow}$ + $T_{t\ channel\ flow}$) is an iterative process. A trial selection of Tc is chosen and used to read the intensity value i from the IDF curve (Charts 4-2 through 4-4). This value of i is then used to calculate Tc. The calculated Tc value is then compared to the trial value chosen. If required, the computed Tc value is then used, and the process continues until the iteration converges. This usually occurs after two attempts. This iterative process determines the drainage area which creates the design spread due to rainfall runoff of a uniform intensity for the bridge location. If the Tc value is less than 5 minutes, use the rainfall intensity corresponding to a minimum of 5 minutes.

For the remaining steps we will determine the uniform longitudinal spacing of the drain or scupper. This spacing shall include the efficiency of the drain or scupper in interception of the design flow.

Step 2: Compute the flow based on the design spread T (see Chart 5-2). In a triangular channel the hydraulic radius does not adequately describe the gutter cross section. The Manning equation is integrated for an increment width across the channel (Izzard, 1946).

$$Q = \left(\frac{0.56}{n}\right) {S_x}^{1.67} S^{0.5}\, T^{2.67}$$

Q = flow rate (ft^3/s)

n = roughness coefficient, usually 0.016 for asphalt 0.013 or concrete

S_x = uniform cross slope of the gutter and deck (ft/ft)

S = longitudinal slope (ft/ft)

T = design spread (ft)

Step 3: Beginning from the upslope end of the bridge, calculate the required distance to the first drain or scupper for the design spread.

$$L_0 = \frac{43560Q}{CiW_p}$$

L_o = distance to the first drain or scupper (ft)

Q = flow rate (ft^3/s)

C = Runoff coefficient, 0.9 for the pavement of the deck

i = rainfall intensity from step 1 (in/hr)

W_p = width of pavement contributing runoff (ft)

If L_o is greater than the total bridge length, drains or scuppers are not needed. The designer must consider any ponding or erosion concerns that may occur at the end of the bridge. Bridge end collectors should be placed to outlet the gutter flow in a stable manner. Water may flow into open finger expansion joints and should be intercepted by a transverse trough to deny access to structural components. Any type of end collector should be designed and placed to intercept all the approach flow, except that required to flush the trough beneath the expansion joints. If a vertical sag curve exists downslope of the bridge, the end collector should be designed as a sag inlet as described in Section 5.3.4.7. If L_o is less than the bridge length, drains or scuppers are required thus proceed to Step 4.

Step 4: Determine the drain or scupper efficiency at intercepting the approaching gutter flow.

For a drain or scupper which uses a grate determine the ratio of frontal flow to total gutter flow (see Section 5.3.4.4, Chart 5-3, and Figure 5-3) for the deck drain or scupper.

$$E_0 = 1 - \left(1 - \frac{W}{T}\right)^{2.67}$$

E_o = ratio frontal flow to total gutter flow

W = width of the deck drain or scupper (ft)

T = flow spread (ft)

Use the equation below or Chart 9 to compute the gutter velocity approaching the drain or scupper.

$$V = \frac{0.56}{n} S^{0.5} {S_x}^{0.67} T^{0.67}$$

V = gutter flow velocity (ft/s)

n = roughness coefficient, usually 0.016 for asphalt 0.013 or concrete

S = longitudinal slope (ft/ft)

S_x = uniform cross slope of the gutter and deck (ft/ft)

T = flow spread (ft)

The ratio of frontal flow intercepted to total frontal flow (Johnson and Chang, 1984) is:

$$R_f = 1 - 0.09(V - V_0)$$

R_f = ratio frontal flow to intercepted frontal flow

V = gutter flow velocity (ft/s)

V_o = grate splash-over velocity (ft/s) (see notes on Chart 5-7)

For grate types that are not listed, the splash-over velocity can be determined by using the percent difference in open area. For additional information see Section 5.3.4.4. Side flow interception efficiency is assumed as zero.

The drain or scupper efficiency E that uses a grate is:

$$E = R_f E_0$$

E = interception efficiency

R_f = ratio frontal flow to intercepted frontal flow

E_o = ratio frontal flow to total gutter flow

The efficiency for open circular scuppers can be found using chart 6. To use the figure, calculate the ratio of inlet diameter D to the gutter spread T and enter the graph at the appropriate value along the x-axis.

Bypass should be nearly zero at the last drain or scupper at the downstream end of the bridge.

Step 5: Compute a constant distance between the remainder of the deck drain or scuppers.

$$L_c = \frac{43560Q}{CiW_p}E$$

L_c = constant distance between drains or scuppers (ft)

Q = flow rate (ft^3/s) (step 2)

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity from step 1 (in/hr)

W_p = width of pavement contributing runoff (ft)

E = drain or scupper efficiency

Adapt the spacing of any required drain or scupper to bridge structural or aesthetic constraints (bent spacing). The last drain or scupper should be spaced closer than the constant distance uniform such that no bypass occurs. Refer to HEC 21 Chapter 7 Bridge End Collectors if bypass is unavoidable at the end of a bridge.

Flat Bridges – Bridges whose longitudinal slope is less than 0.003 ft/ft causes each deck drain or scupper to operate as if in a vertical sag situation. The deck area which causes the flow at the drainage structure is based on the design spread for a constant distance between the structures. These drainage structures operate in weir flow by their effective perimeter. The effective perimeter length is calculated based on the assumption that the flow is at critical depth

around the perimeter of the drainage structure that receives flow. It is important to note that any part of the perimeter which lies along the parapet is not effective.

Step 1: For flat bridges, the time of concentration to each inlet is assumed to be 5 minutes thus the rainfall intensity can be determined for the storm return period from the intensity-duration-frequency curve.

Step 2: The constant distance can be computed from the nomograph in Chart 12 or from the following equation.

$$L_c = \frac{1312}{\left(nCiW_p\right)^{0.67}} {S_x}^{1.44} T^{2.11}$$

L_c = constant distance between drains or scuppers (ft)

n = roughness coefficient, usually 0.016 for asphalt 0.013 or concrete

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity from step 1 (in/hr)

W_p = width of pavement contributing runoff (ft)

S_x = uniform cross slope of the gutter and deck (ft/ft)

T = design spread (ft)

Step 3: If L_c is greater than the total bridge length, drains or scuppers are not needed. If L_c is less than the bridge length, the required effective perimeter (P) of the drain or scupper can be determined using Chart 10-13 or computed from the following equation.

$$P = \frac{\left(CiW_p\right)^{0.33} T^{0.61}}{102.5 {S_x}^{0.06} n^{0.67}}$$

P = effective drain or scupper perimeter (ft)

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity from step 1 (in/hr)

W_p = width of pavement contributing runoff (ft)

T = design spread (ft)

S_x = uniform cross slope of the gutter and deck (ft/ft)

n = roughness coefficient, usually 0.016 for asphalt 0.013 or concrete

Step 4 & 5: Adapt the spacing of any required drain or scupper to bridge structural or aesthetic constraints. Design end collectors if needed.

Vertical Crest Curve Bridges – Bridges which have a profile with a vertical crest curve have a similar process as a bridge with a constant grade except the spacing of the drainage structures is variable due to the changing profile slope (local slope, S_L) at each structure. The spacing process is iterative and performed for the long side of the crest curve (L_{E2}) beginning at the crest. Once determined, the same spacing is utilized for the short side of the crest curve (L_{E1}) by assuming a parabolic vertical curve. Efficiency E is determined by the same method as a bridge on constant grade except an interception coefficient (K) is used in place of E to compute the distance to the next structure on the long side of the crest curve (L_i). The interception coefficient depends upon a ratio of the local slope for the preceding upstream structure to the local slope of the present structure (S_u / S_L). Spacing of the structures is noted by the distance (X) from the begin bridge station until the length of the bridge (L_B) is reached. The rainfall intensity to the first drain or scupper is used throughout the analysis.

Step 1: Determine the distance to the vertical curve crest (X_{HP}) and the short and long sides of the bridge using the formula for local slope equal to zero:

$$S_L = \frac{g_2 - g_1}{L_B} X + g_1$$

S_L = local slope (ft/ft)

g_2 = following tangent slope (ft/ft)

g_1 = first tangent slope (ft/ft)

L_B = length of the bridge (ft)

X = distance from begin bridge station (ft)

Step 2: Utilizing the same steps of a constant grade bridge, determine the required distance to the first drain or scupper L_o for the design spread on the long side of the crest curve. This will require a trial distance from the crest with a computation of the local slope S_L at that distance. Once Tc is determined, i is read from the IDF curve, Q, and T are computed, then L_o is calculated and compared to the trial distance. The local slope (S_L) is used to determine the gutter flow Q. If the distances do not match repeat the step until they match.

Step 3: Determine the distance to the next drain or scupper on the long side of the crest curve (L_i) through the same trial process of Step 2. When determining the frontal flow interception efficiency (R_f) to compute the efficiency E the gutter velocity calculation uses the local slope (S_L). The same rainfall intensity from Step 2 is used for the rest of the spacing determinations.

$$K = 1 - (1 - E)\left(\frac{S_U}{S_L}\right)^{0.5}$$

K = interception coefficient

E = drain or scupper efficiency

S_U = local slope for the preceding upstream structure (ft/ft)

S_L = local slope of the present structure (ft/ft)

$$L_i = \frac{43560Q}{CiW_p}K$$

L_i = distance to the next structure on the long side of the crest curve (ft)

Q = flow rate (ft^3/s)

C = runoff coefficient 0.9 for the pavement of the deck

i = rainfall intensity from L_o (in/hr)

W_p = width of pavement contributing runoff (ft)

K = interception coefficient

Step 4: Repeat step 3 until the sum of the spacing exceeds the long side of the bridge. The same structure spacing is utilized for the short side of the crest curve.

Step 5 & 6:

Adapt the spacing of any required drain or scupper to bridge structural or aesthetic constraints. Design end collectors if needed.

Form 10-1
Bridge Deck Drainage Calculations Constant Grade & Flat Bridges

BRIDGE DECK DRAINAGE CALCULATIONS
Constant Grade and Flat Bridges

By
Date
Project
Checked By
Date

Distance to First Drain or Scupper Location				
Step 1 Compute the Time of Concentration Tc and Rainfall Intensity i				
Assume an initial time of concentration	Tc_a	5	min	Adjust the assumed Tc_a until the values converge. This may require several iterations.
Calculated time of concentration	Tc_c		min	
Rainfall Intensity Read from Curve if $T_c > 5$	i_c		in/hr	Leave blank if T_c is <= 5 minutes.
Rainfall Intensity	i		in/hr	Scuppers use the 10-yr design storm.
Step 2 Compute the Gutter Flow Q for the Design Spread T				
Manning's Roughness Coefficient	n			Usually 0.016 for concrete decks.
Uniform Cross Slope	S_x		ft/ft	
Is the Bridge Deck Flat?				
Longitudinal Slope	S		ft/ft	
Design Spread	T		ft	
Gutter Flow Rate	Q		cfs	Chart 10-4
Step 3 Compute the Distance to the First Drain or Scupper L_o from the Upslope End of the Bridge				
Bridge Length	L		ft	
Runoff Coefficient	C			Usually 0.9 for concrete decks.
Overall Deck Width			ft	
Width of Pavement Contributing Runoff	W_p		ft	
Distance to First Drain or Scupper	L_o		ft	Chart 10-5 with E=1
Are Drains or Scuppers Required ?				
Constant Distance to Remaining Drains or Scuppers for Constant Grade				
Step 4 Compute the Interception Efficiency E				
Width of the drain or scupper	W		ft	
Grate Splashover Velocity	V_0		ft/s	Chart 10-8
Frontal Flow / Total Gutter Flow	E_o			Chart 10-7
Gutter Flow Velocity	V		ft/s	Chart 10-9
Frontal Flow / Intercepted Frontal Flow	R_f			Chart 10-10
Interception Efficiency	E			Circular Scuppers Chart 10-6
Step 5 Compute a Constant Distance for Remainder of Drains or Scuppers L_c				
Constant Distance Between Drains or Scuppers	L_c		ft	Chart 10-5
Are Additional Drains or Scuppers Required ?				
Constant Distance to Drains or Scuppers for Flat Bridges				
Constant Distance Between Drains or Scuppers	L_c		ft	Chart 10-12
Effective Drain or Scupper Perimeter	P		ft	Chart 10-13

Form 10-2
Bridge Deck Drainage Calculations Vertical Curve Bridges

BRIDGE DECK DRAINAGE CALCULATIONS
Vertical Curve Bridges

By
Date
Project
ed By
Date

Distance to First Drain or Scupper Location L_o on the Long Side of Vertical Curve L_{E2}

Step 1 Compute the High Point X_{XP} and the Short L_{E1} and Long Sides of the Vertical Curve L_{E2}

Short Side of Vertical Curve L_{E1}		ft	High Point from Begin Bridge X_{XP}		ft
Long Side of Vertical Curve L_{E2}		ft			

Step 2a Compute the Time of Concentration Tc and Rainfall Intensity I for All Drains or Scuppers

Trial Distance to First Drain or Scupper	L_{OT}		ft	
Assume an initial time of concentration	Tc_a	5	min	Adjust the assumed Tc_a until the values converge. This may require several iterations.
Calculated time of concentration	Tc_c		min	
Rainfall Intensity Read from Curve if $T_c > 5$	i_c		in/hr	Leave blank if T_c is <= 5 minutes.
Rainfall Intensity for All Drains or Scuppers	i		in/hr	Scuppers use the 10-yr design storm

Step 2b Compute the Gutter Flow Q for the Design Spread T

Manning's Roughness Coefficient	n			Usually 0.016 for concrete decks.
Uniform Cross Slope	S_x		ft/ft	
Distance from Begin Bridge Station	X		ft	
Local Slope	S_L		ft/ft	
Design Spread	T		ft	
Gutter Flow Rate	Q		cfs	Chart 10-4

Step 2c Check Trial Distance to Computed Distance Note Actual Distance to the First Drain or Supper

Runoff Coefficient	C			Usually 0.9 for concrete decks.
Width of Pavement Contributing Runoff	W_p		ft	
Computed Distance to First Drain or Scupper	L_{oc}		ft	Chart 10-5 with E & K =1
Actual Distance after Convergence of Iteration	L_o		ft	After a few iterations

Distance to Remaining Drain or Scupper Locations on the Long Side of Vertical Curve L_{E2}

Step 3 Distance to the Next Drain or Supper L_1 on the Long Side of the Vertical Curve

Width of the drain or scupper	W		ft	
Grate Splashover Velocity	V_0		ft/s	Chart 10-8 Chart 10-10
Trial Distance to Next Drain or Scupper	L_{IT}			
Frontal Flow / Total Gutter Flow	E_o			Chart 10-7
Gutter Flow Velocity	V		ft/s	Chart 10-9
Frontal Flow / Intercepted Frontal Flow	R_f			Chart 10-10
Local Slope	S_L		ft/ft	
Interception Coeff. to Next Structure on the Long Side	K			Circular Scuppers Chart 10-6
Gutter Flow to Next Structure on the Long Side	Q		cfs	Chart 10-4
Computed Distance to Next Structure on the Long Side	L_{IC}		ft	Chart 10-5 with K in place of E
Actual Distance after Convergence of Iteration	L_1		ft	After a few iterations

Step 4 Distance to Remaining Drains or Suppers on the Long Side of the Vertical Curve

Local Slope	S_L		ft/ft	Interc Coeff.	K		L_2		ft
Local Slope	S_L		ft/ft	Interc Coeff.	K		L_3		ft
Local Slope	S_L		ft/ft	Interc Coeff.	K		L_4		ft
Local Slope	S_L		ft/ft	Interc Coeff.	K		L_5		ft
	L_6		ft	L_7		ft	L_8		ft

Spacing for the short side of the vertical curve will be the same as the long side until L_{E1} is exceeded.

Chart 10-1
Logic for Drain or Scupper Spacing on Constant Grade

Step 1

Determine the Tc and corresponding intensity to the first drain or scupper. Charts 10-2, 10-3 & IDF curve from Chapter 4.

Step 2

Determine the gutter flow based on the design spread T. Chart 10-4.

Step 3

Determine the distance to the first drain or scupper Lo using the equation. Chart 10-5 may also be used with the drain or scupper efficiency E = 1.

If the distance to the first drain or scupper exceeds the length of the bridge then they are not needed.

Step 4

Determine each drain or scupper efficiency E for interception of the gutter flow Q due to design spread T. E is based on the ratio of frontal flow / intercepted frontal flow Rf which relies on the splashover velocity Vo of the drain or scupper.

Charts 10-6, 10-7, 10-9, 10-10.

Step 5

Determine the constant distance for subsequent drain or scuppers Lc for the remainder of the deck. Chart 10-5.

Step 6

Adapt the constant distance to bridge structural constraints (such as bent spacing).

Step 7

If needed, design bridge end collectors using pavement drainage methods of Chapter 5 Section 5.3.4. Also refer to HEC-21 Chapter 7.

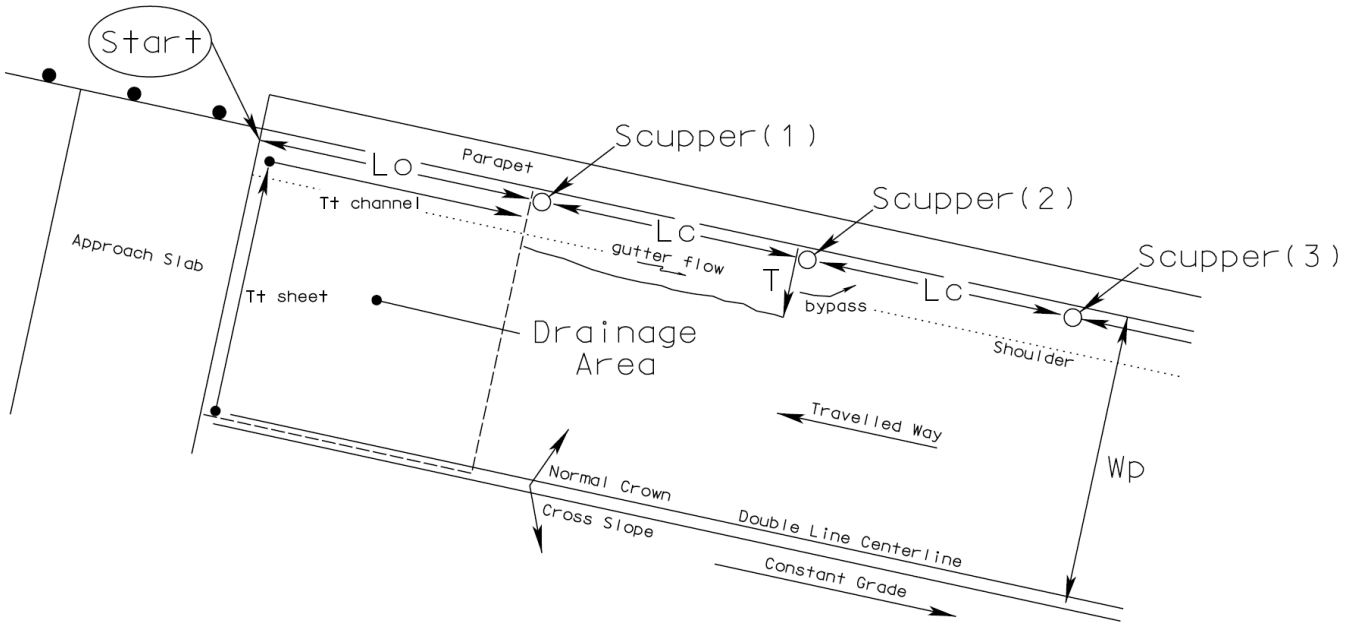


Chart 10-2
Overland Time of Concentration

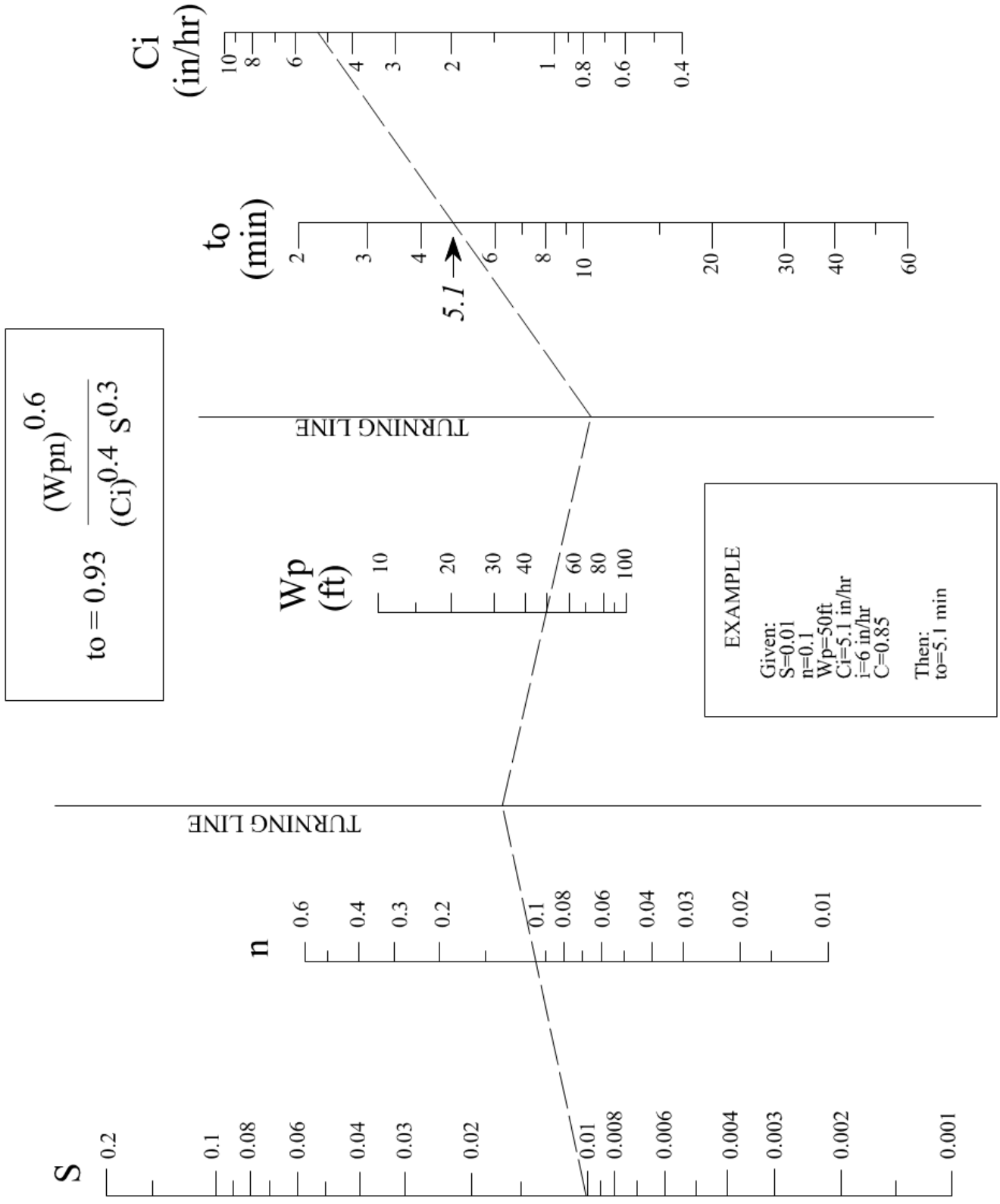


Chart 10-3
Gutter Time of Concentration

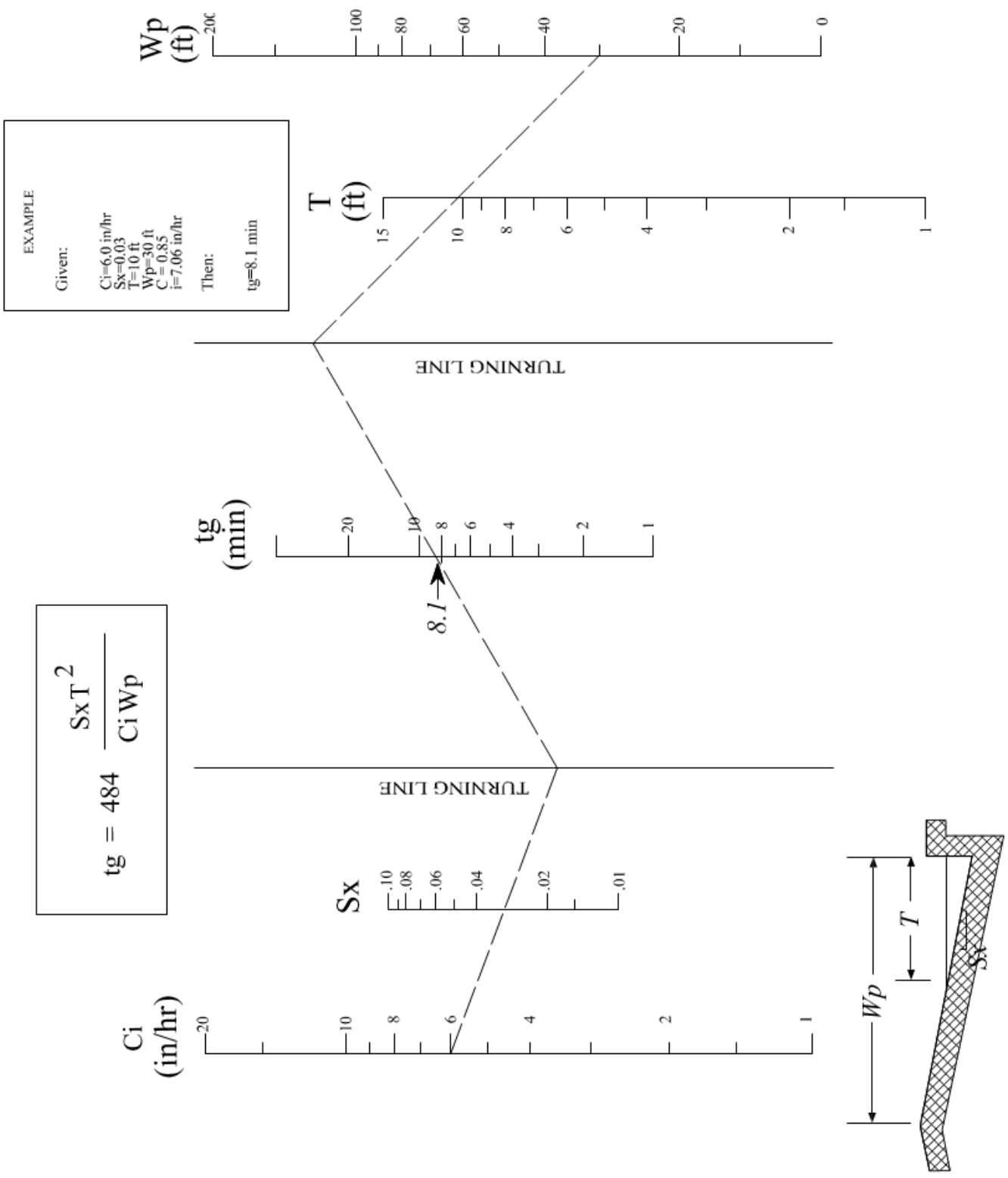


Chart 10-4
Flow in Triangular Gutter Sections

$$Qf = \frac{0.56}{n} Sx^{1.67} S^{0.5} T^{2.67}$$

EXAMPLE

Given:

n=0.016, Sx=0.03
S=0.04, T=6 ft

Then:

Qf=2.4 cfs
Qn=0.030 cfs

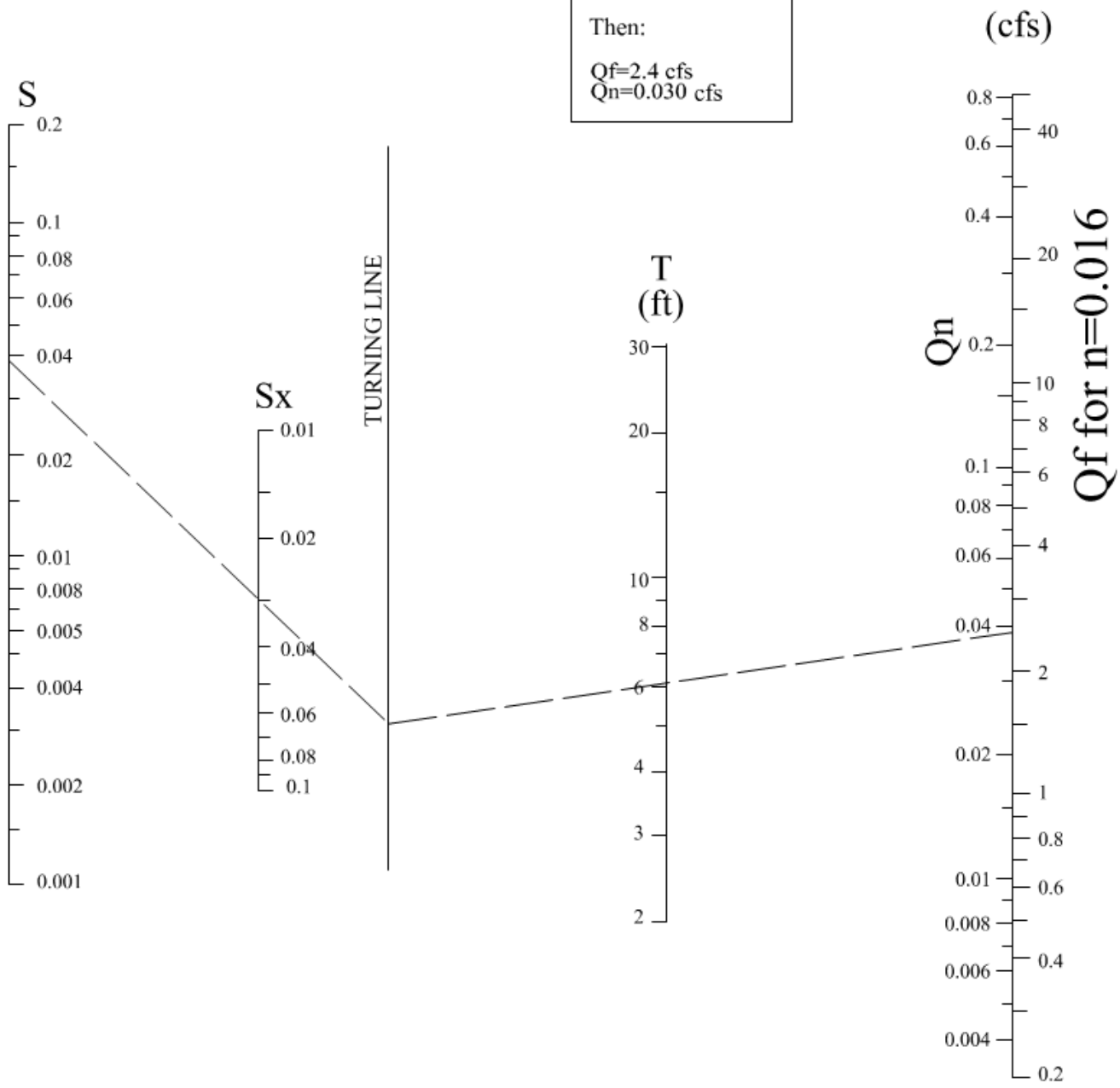


Chart 10-5
Constant Distance Between Drains or Scuppers on Constant Grade

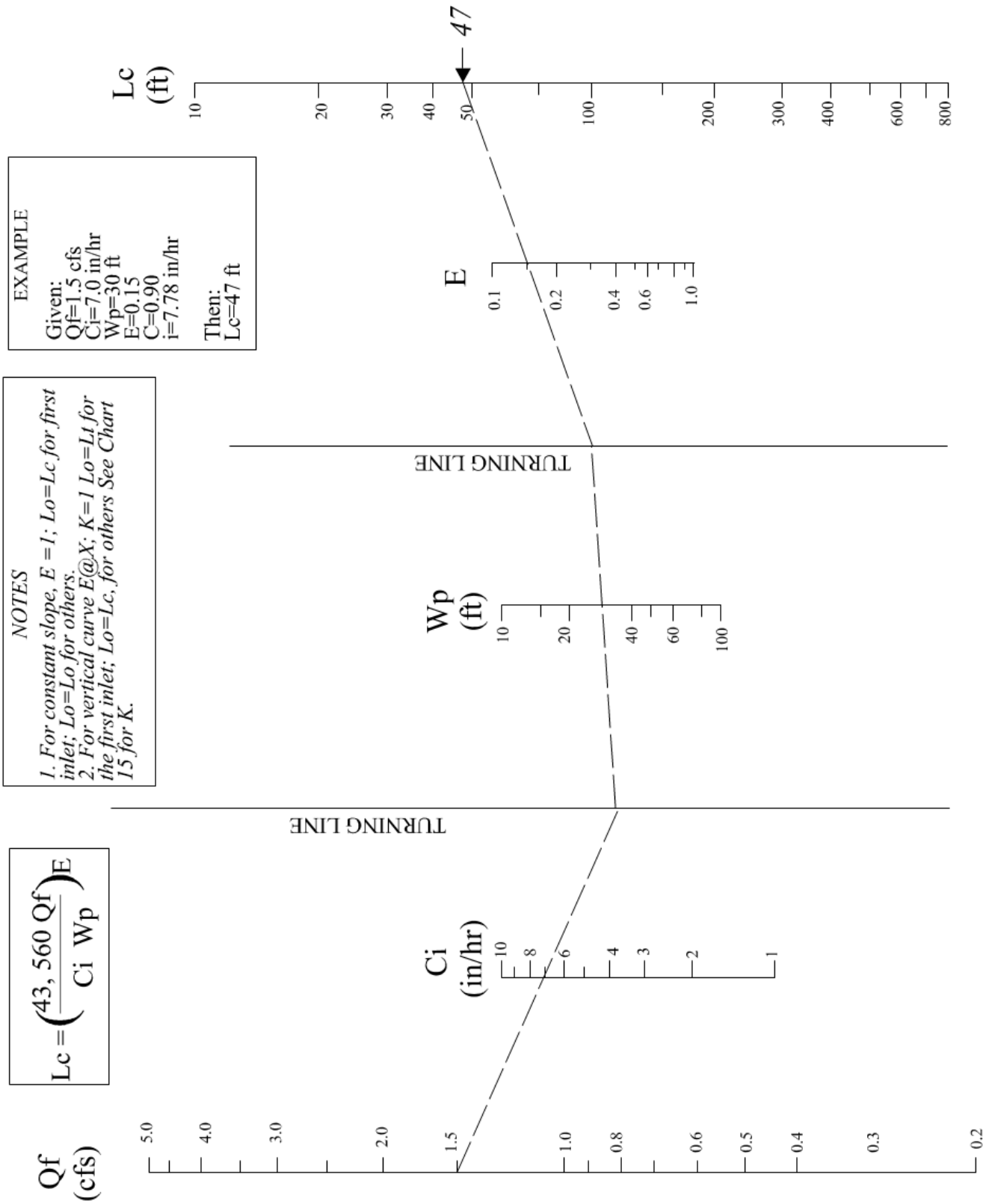


Chart 10-6
Efficiency Curves for Circular Scuppers

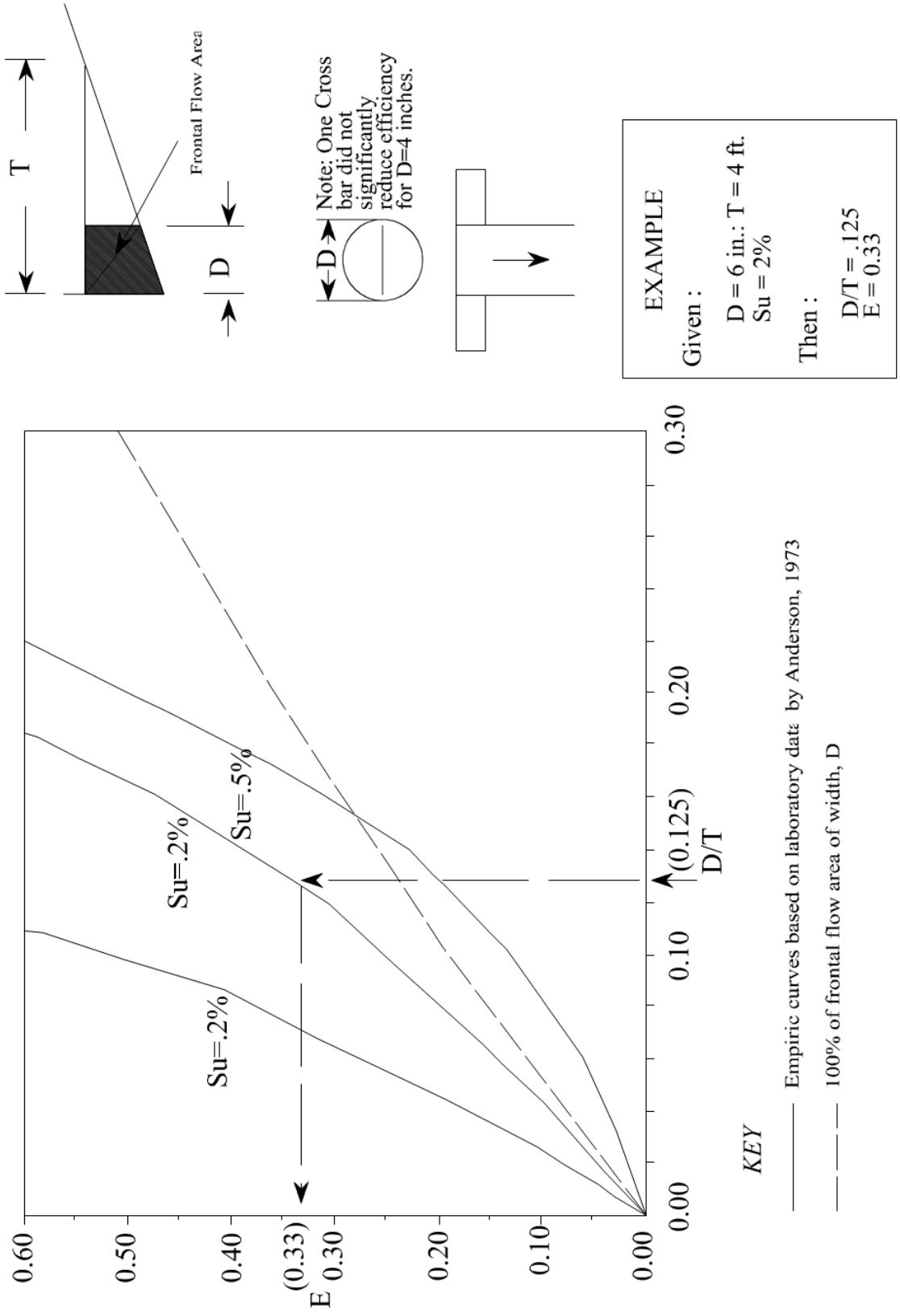


Chart 10-7
Ratio Frontal Flow to Total Gutter Flow

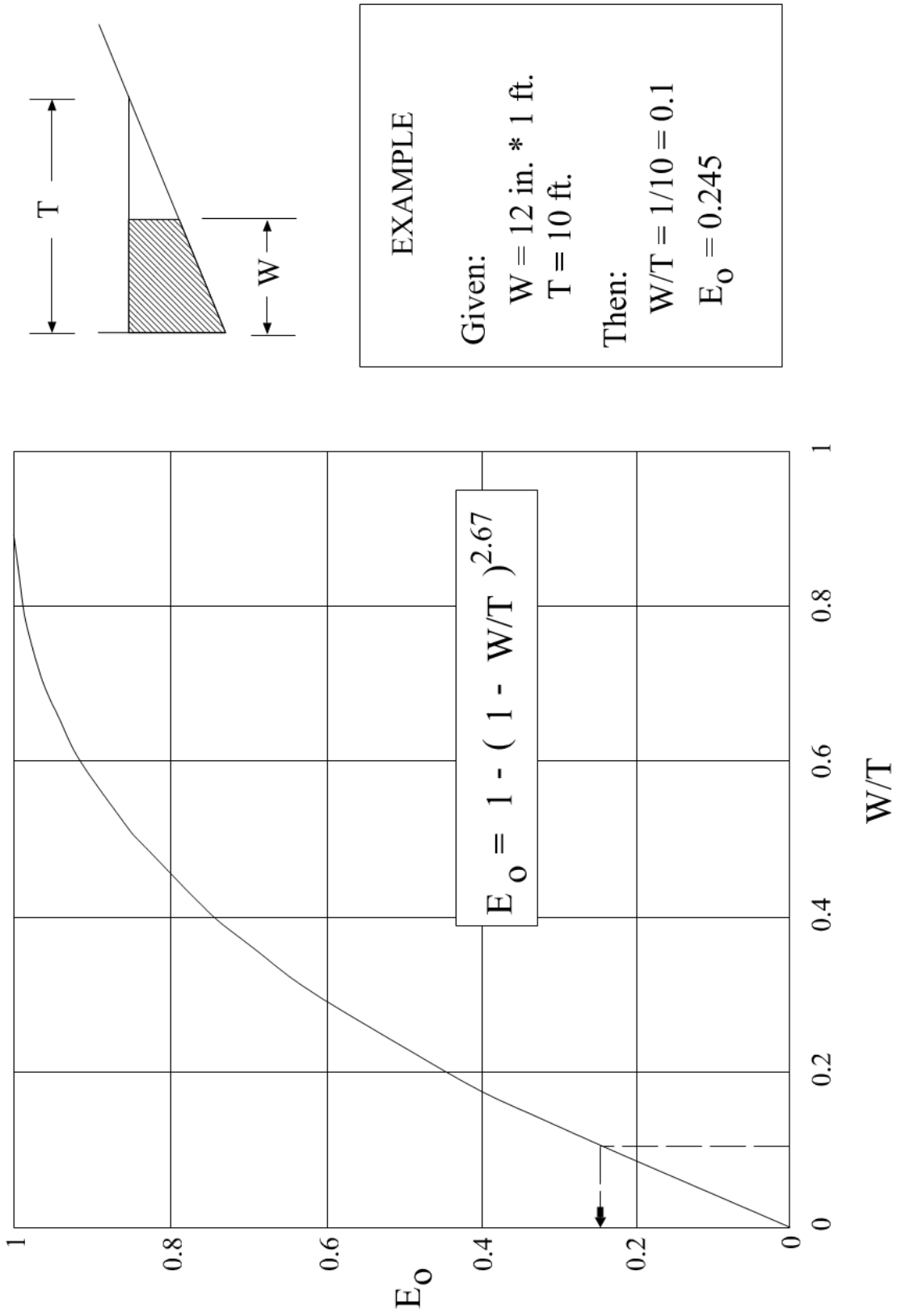
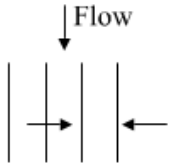
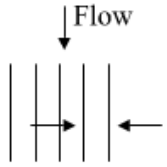
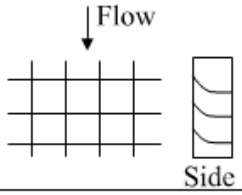
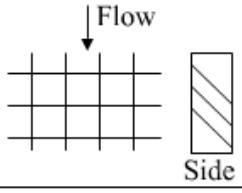
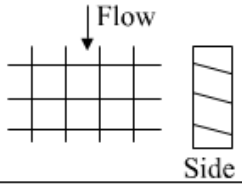
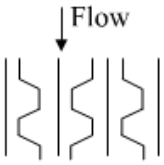


Chart 10-8
Typical Bar Grate Details

Grate Type		Description	Comments
Parallel bars with 1-7/8" spacing (not bicycle safe) Ⓐ		• 1/4 x 4" bars • 1-7/8" bar spacing on center	Ⓖ Adding transverse bars 4" o.c. to bicycle-proof this grate reduces performance to that of 30° vane.
Parallel bars with 1-1/8" spacing (not bicycle safe) Ⓑ		• 3/8 x 4" bars • 1-1/8" bar spacing on center	(See fig. 9. HEC-12)
Curved vane Ⓒ		• 4-1/2" vane spacing • 1/2 x 2" flat longitudinal bars • 3-7/32" bar spacing on center	(See fig. 10. HEC-12)
45° tilt bar Ⓓ		• 4" vane spacing • 1/2 x 2" flat longitudinal bars • 2-1/4" bar spacing on center	
30° tilt bar Ⓔ		• 4" vane spacing • 1/2 x 2" flat longitudinal bars • 3-7/32" bar spacing on center	(See fig. 12. HEC-12)
Reticuline Ⓕ		• 1/4 x 4" flat longitudinal bars. 2-9/16" o.c. • 3/16 x 2" reticuline bars	Grates with unvaned transverse members approximate reticuline performance.

Note: Letters in circles refer to chart 10
Letter Ⓖ refers to 1-7/8 parallel bars with bicycle-safe transverse bars 4" o.c.

Chart 10-9
Velocity in Triangular Gutter Sections

$$V = \frac{1.12}{n} Sx^{0.67} S^{0.5} T^{0.67}$$

EXAMPLE

Given:
n=0.016
Sx=0.015
S=0.02, T=6 ft

Then:
V=1.95 ft/s
Vn=0.032 ft/s

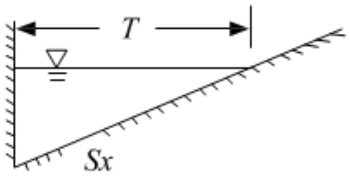


Chart 10-10
Frontal Flow Interception Efficiency for Typical Bar Grates

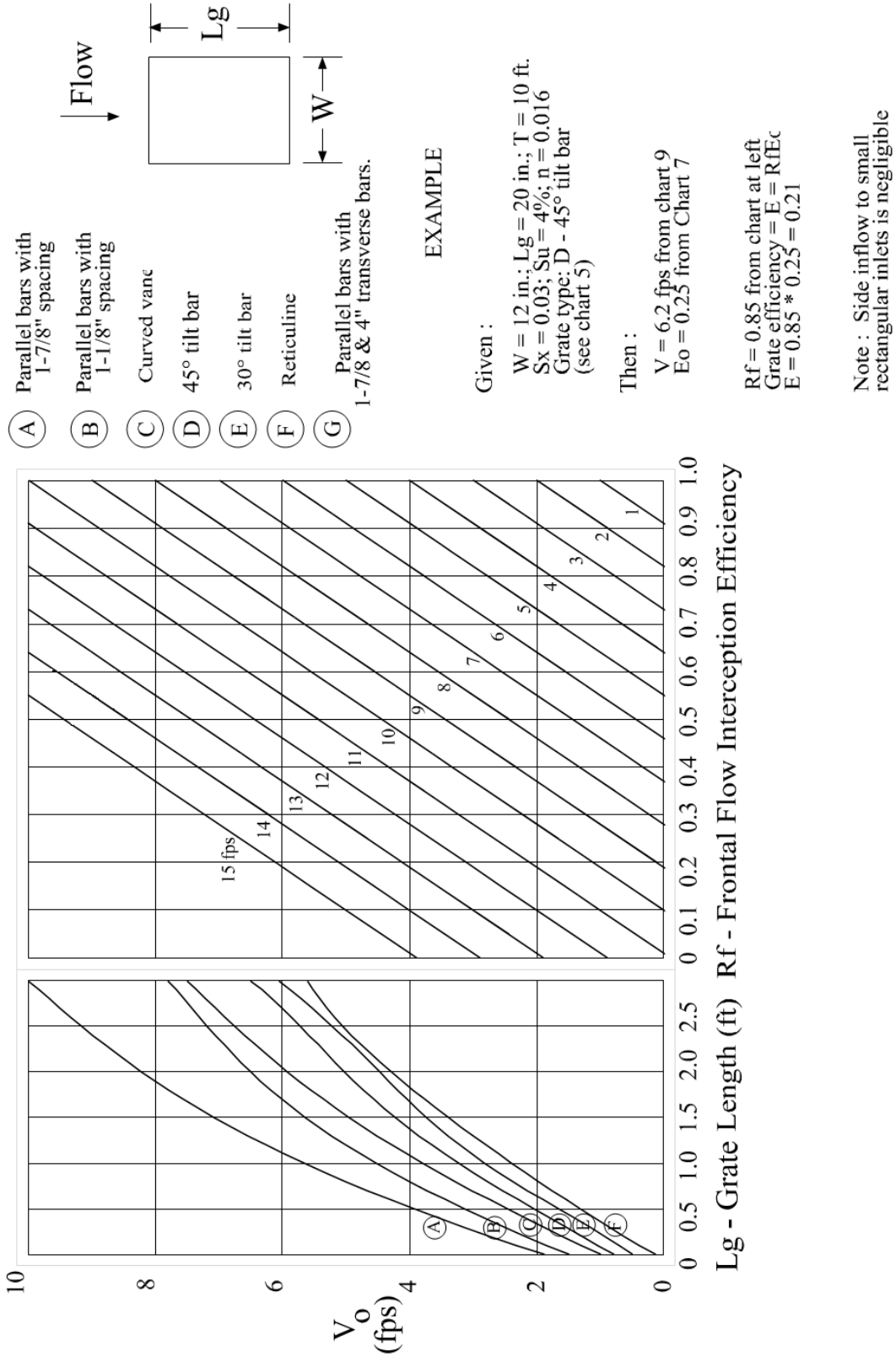


Chart 10-11
Logic for Drain or Scupper Spacing on a Flat Grade

Step 1

Determine intensity for Tc of 5 minutes from an IDF curve of Chapter 4.

Step 2

Compute the constant distance between drains or scuppers. If the distance exceeds the length of the bridge then they are not required. Chart 10-12.

Step 3

Compute the required effective perimeter for the drain or scupper and select the type to be used. Chart 10-13.

Step 4

Adapt the constant distance to bridge structural constraints (such as bent spacing).

Step 5

If needed, design bridge end collectors using pavement drainage methods of Chapter 5 Section 5.3.4. Also refer to HEC-21 Chapter 7.

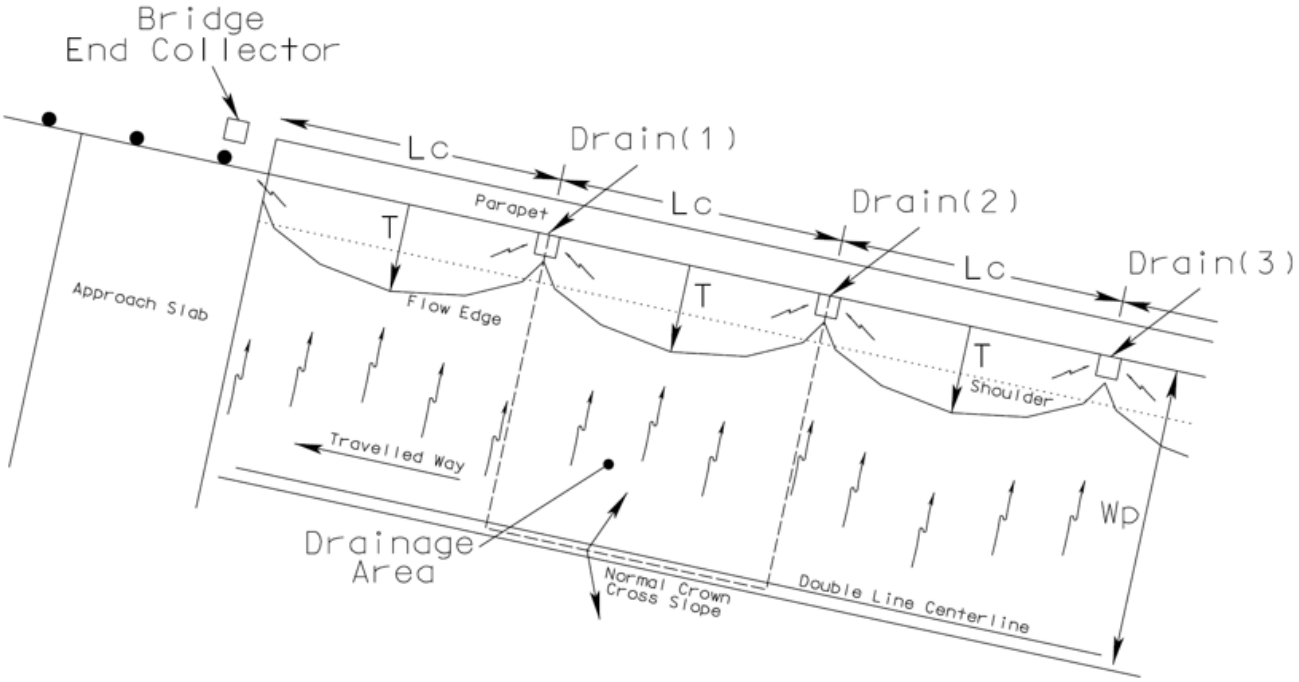


Chart 10-12
Constant Distance Between Drains or Scuppers on a Flat Bridge

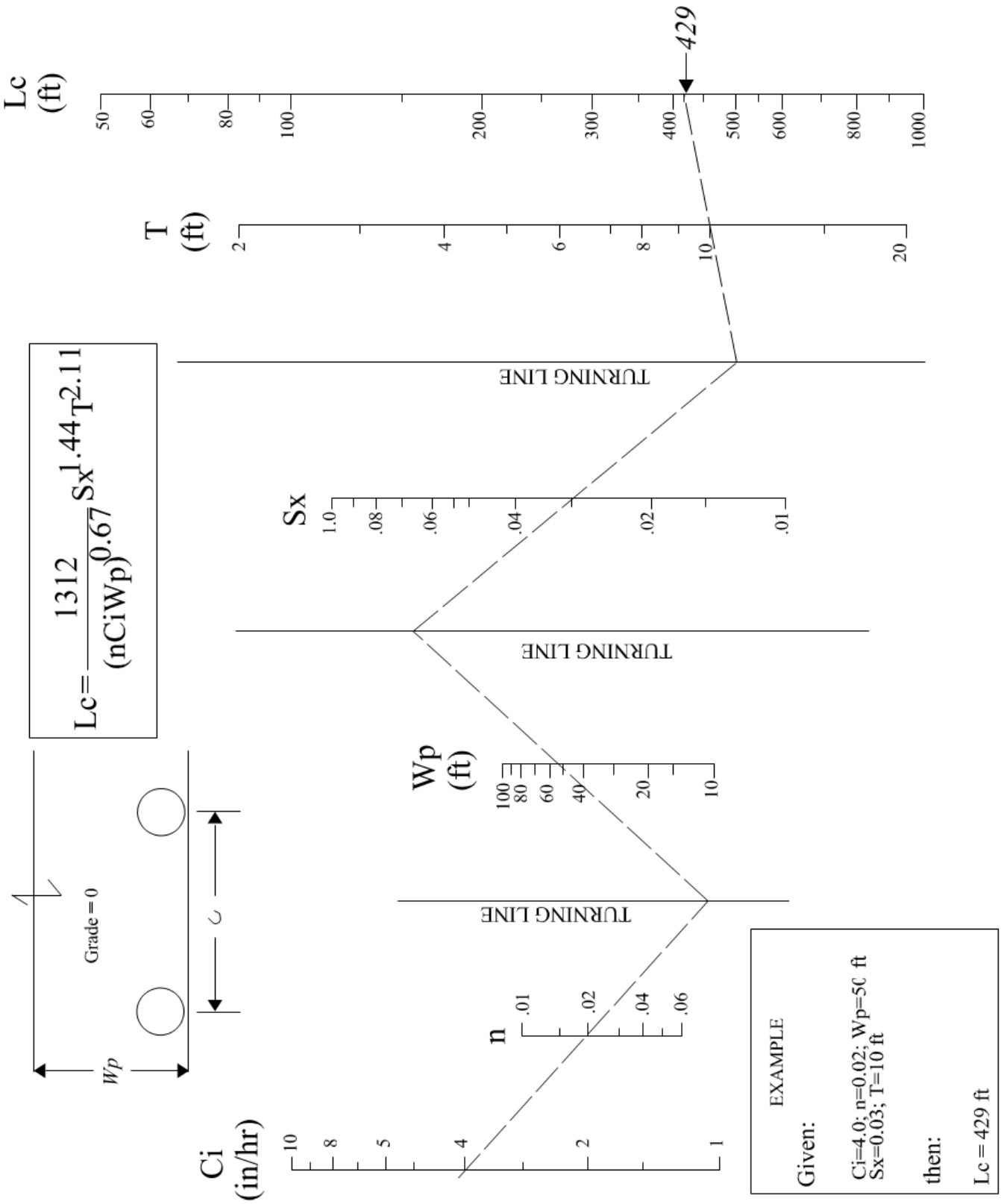


Chart 10-13
Effective Drain or Scupper Perimeter on a Flat Bridge

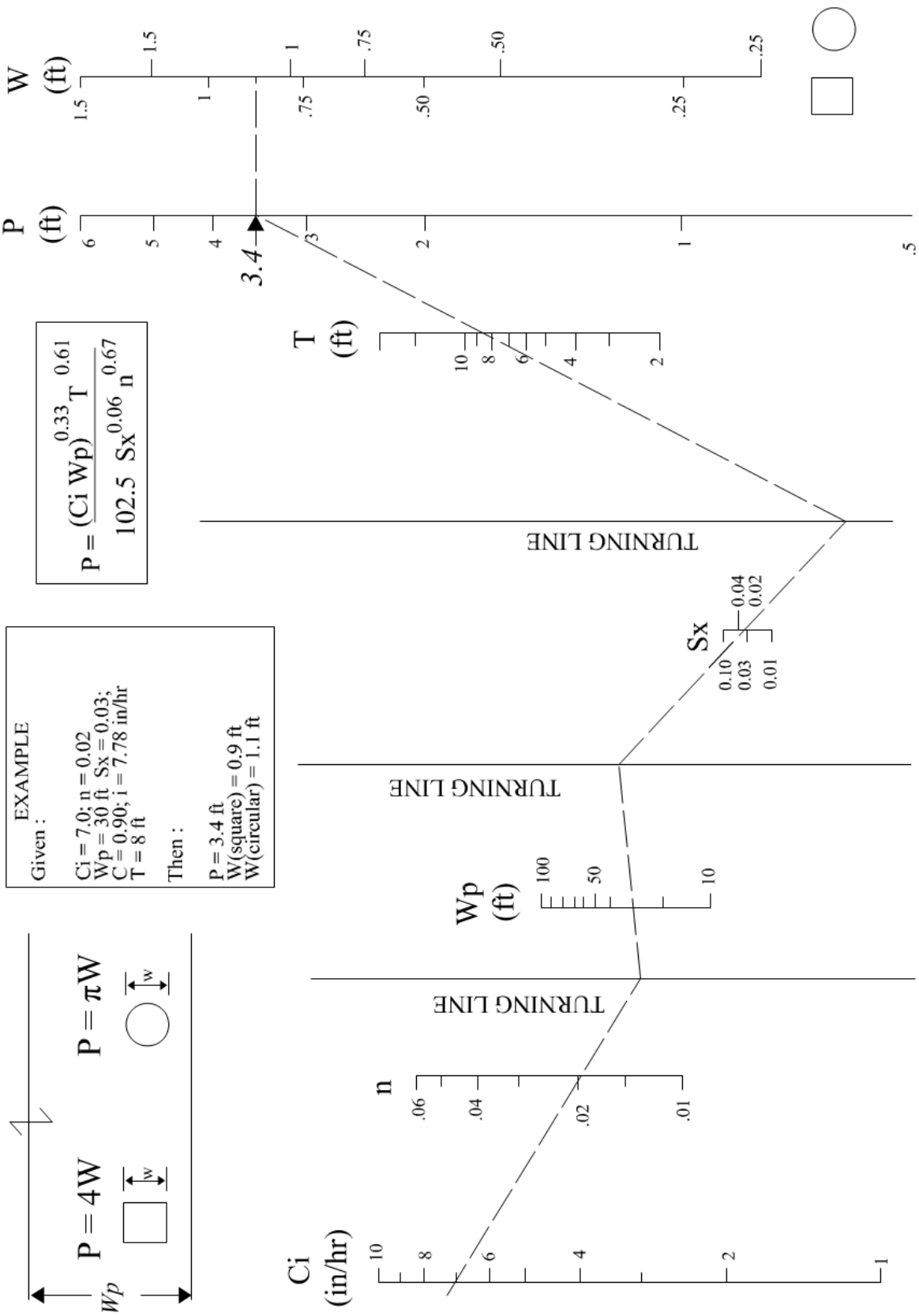


Chart 10-14
Logic for Drain or Scupper Spacing on Vertical Curve Bridges

Step 1

Determine distance to the vertical curve crest X_{HP} (S=0, solve for X) and the short L_{E1} and long side L_{E2} of the bridge.

Step 2

Begin at the crest and select a distance to the first drain or scupper Lo on the long side of the bridge.

Step 2a

Determine the Tc and corresponding intensity to the first drain or scupper. Charts 10-2, 10-3 & IDF curve from Chapter 4.

Step 2b

Determine the gutter flow based on the design spread T using local slope S_L. Chart 10-4 with S_L substituted for S.

Step 2c

Calculate the distance Lo on the long side of the bridge and compare to the selected distance for K=1. If the distance does not match, the computation is repeated until there is agreement. If the distance to the first drain or scupper exceeds the length of the bridge then they are not needed. Chart 10-5 Lo substituted for Lc and K substituted for E.

Step 3

Select a distance to the next drain or scupper L_i. Calculate the distance utilizing the interception coefficient K and compare to the selected distance. If the distance does not match, the computation is repeated until there is agreement. The same rainfall intensity value is used from Step 2. Chart 10-9 with S_L substituted for S. Chart 10-15 for K.

Step 4

Repeat step 3 for the next drain or scupper until the sum of the spacing exceeds the long side of the bridge. The short side spacing will be the same as the long side until L_{E1} is exceeded.

Step 5

Adapt the constant distance to bridge structural constraints (such as bent spacing).

Step 6

If needed, design bridge end collectors using pavement drainage methods of Chapter 5 Section 5.3.4. Also refer to HEC-21 Chapter 7.

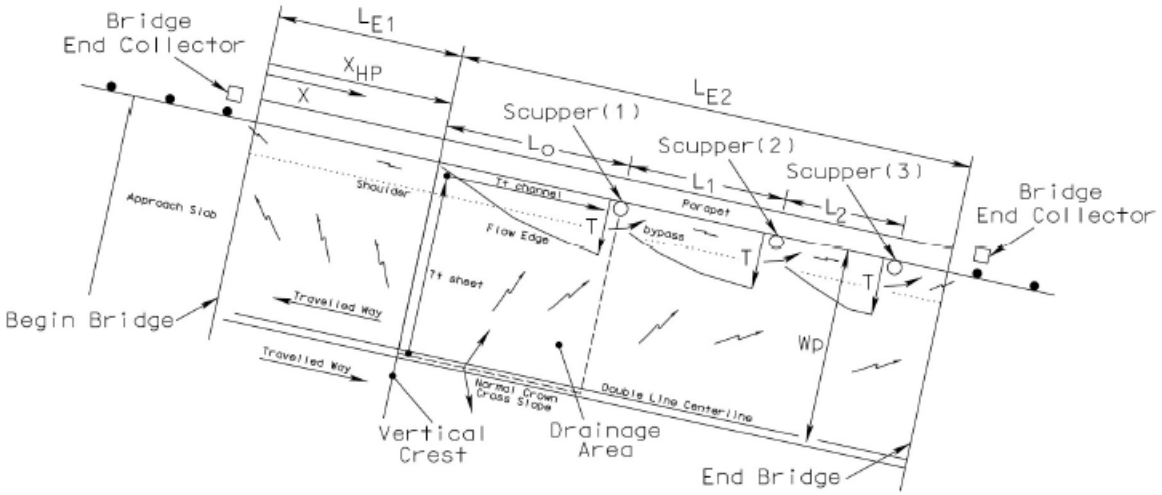
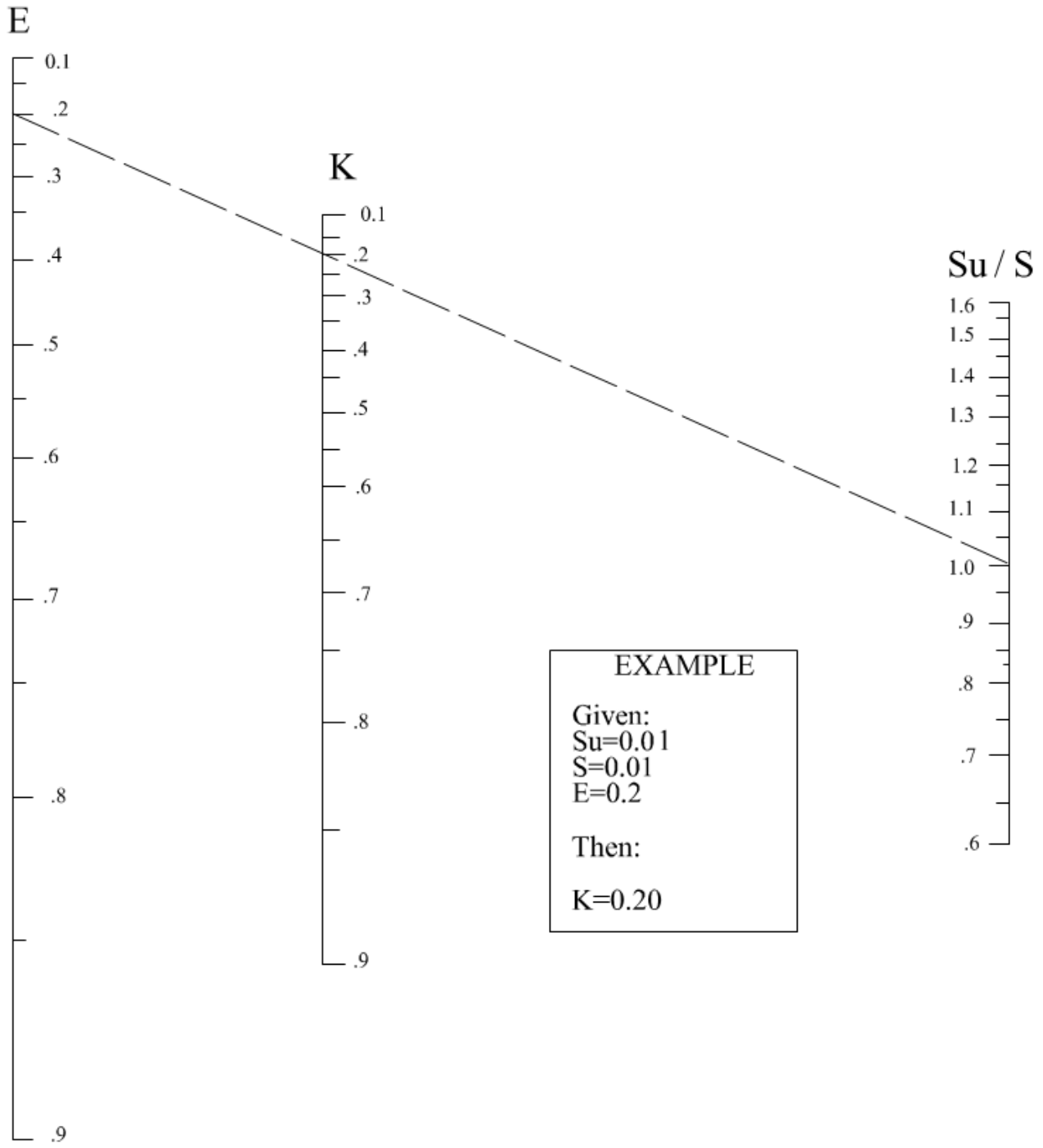


Chart 10-15
Interception Coefficient K for Vertical Bridges

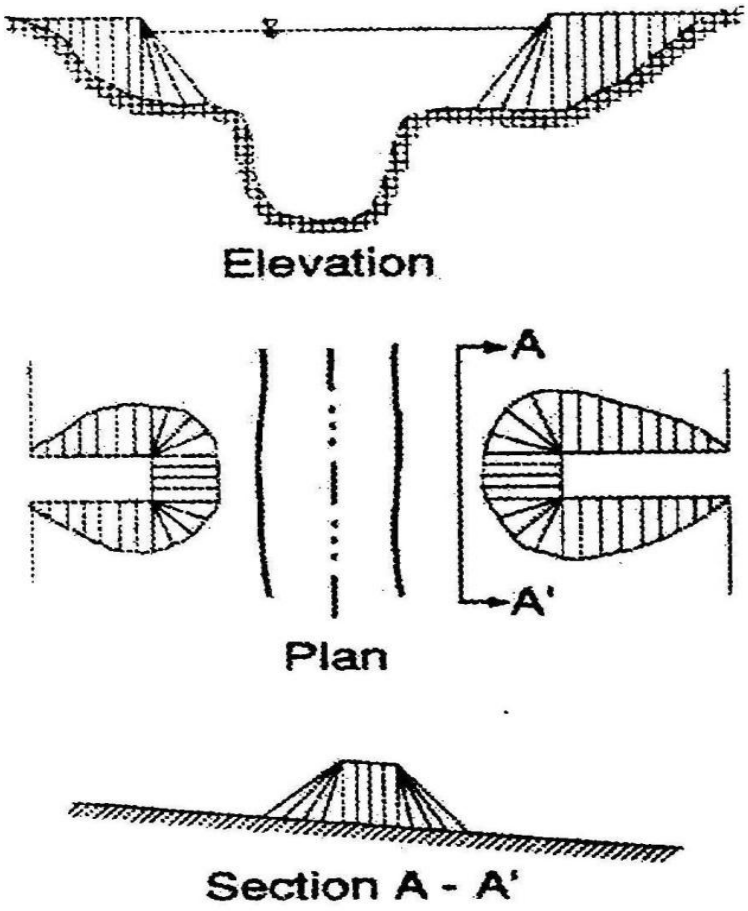
$$K = 1 - (1-E)\,(Su/S)^{0.5}$$



10.7 BRIDGE ABUTMENT PROTECTION

Rock is frequently used for protection of the earthen fill slopes in spill-through abutments. A spill-through abutment is a bridge abutment having a fill slope on the streamward side as shown in Figure 10-5. In such situations, rock protection serves the two-fold purpose of protecting the underlying abutment shelf against runoff coming from the approach roadway and bridge superstructure as well as from scouring due to impinging flow from floodwaters. Rock can also be used around tall abutments on spread footings to protect against scour.

Figure 10-5
Spill-Through Abutment



Source: HEC-18, 4TH Edition, FHWA

10.8 REFERENCES

1. Code of Federal Regulations (CFR), National Flood Insurance Program, Title 44 – Emergency Management and Assistance, Chapter I – Federal Emergency Management Agency, Part 60 - Criteria for Land Management and Use, Subpart 60.3 (Floodplain Management Criteria for Flood-prone Areas).

2. Hydraulic Engineering Circular No. 18, Evaluating Scour at Bridges (HEC 18), FHWA

3. Hydraulic Engineering Circular No. 20 Stream Stability at Highway Structures (HEC 20).

4. Model Drainage Manual, AASHTO, 2005.