Drainage	*Chapter* Drainage Folders
	Subject Fundamentals

DR 301-1 PURPOSE OF DRAINAGE FOLDERS

The purpose of the Drainage Folder is to support the development of plans and to serve as the documentation of the drainage design process for a highway project. The folder must contain the basis of the total proposed drainage design for the project. The Transportation Cabinet's policies, specifications, and standards must be reflected through the most economical and hydraulically feasible alternatives for a proposed drainage design presented in the drainage folder. Reports or minutes of all meetings concerning the drainage design process must be included.

Many folders are used long after projects are completed. Since they are legal documents, they provide information for drainage complaints and litigation. Other agencies and the private sector often use information from the folders to assist in acquiring encroachment permits and for other projects, which may or may not have a direct effect on a highway. For these reasons, the Drainage Branch places a strong emphasis on accuracy and completeness of all drainage folder submissions.

Those persons initiating drainage design work who are not familiar with the Cabinet's drainage requirements should contact the District Office or Drainage Branch to familiarize themselves with the current drainage criteria.

Drainage folders are required for the drainage design on any highway project for which the Division of Highway Design has responsibility. The folders shall include any structure that is used to transport water directly through or delays the flow of water into or away from the highway system, and extensions to existing structures or improvement of those structures or drainage systems. All drainage folders shall be submitted to the Drainage Branch for approval.

DR 301-2 TYPES OF FOLDERS

There are two Division of Highway Design drainage folders: the Preliminary Drainage Folder and the Final Drainage Folder (see DR 302 for required contents and layout). There is a third folder, the Advance Situation Folder, which is a Division of Structural Design document. This manual will discuss the Advance Situation Folder only in the context that, for structures that convey or affect runoff, this folder will be reviewed and approved by the Drainage Branch

before passing on to the Division of Structural Design (see DR 303, and Section SD 202-2 of the Structure Design Manual for required contents and layout). It should be noted that all three folders share the same orange cover sheet. A box is checked on the cover sheet to indicate Preliminary, Advance, or Final as applicable (See Exhibit 300-1).

The Preliminary Drainage Folder will be reviewed to ensure that the proposed drainage design is consistent with current procedures, accepted methodologies, policies, standards, and specifications. The Final Drainage Folder shall reflect the recommendations of the review process and become the record legal document for the project drainage design. It shall contain all required information to support the selection of drainage items proposed on the plans. Where variations of current practices and standards are incorporated into the drainage design, those variations shall be fully documented in the folders.

DR 301-3 EXTENT OF FOLDER MATERIAL

A drainage folder must provide sufficient information to allow the review of the design presented. The presentation must adequately address and support the choices and decisions made and give reason to the formulation of the drainage design. The designer should keep in mind that the preliminary folder should mirror the final folder. The preliminary folder is, however, subject to change as a result of the review process.

Variations and innovations in the specific content of the folders are not prohibited. But the designer should keep in mind that the document may be reviewed by a number of disciplines and agencies. Therefore, consistency in the general folder format and minimum requirements is necessary (see DR 302).

Drainage	*Chapter* Drainage Folders
	Subject Drainage Folder Contents

DR 302-1 GENERAL

The following sections discuss the items that will be included in the preliminary and final drainage folders. The intent is not to limit the data to only those items listed, but rather to establish a minimum requirement consistent with KYTC drainage design procedures. If circumstances are such that the drainage facility is sized by other than normal procedures or if the size of the facility is governed by factors other than hydrologic or hydraulic factors, a narrative summary detailing the design basis will be included in the records. Additionally, the designer will include in the documentation items not listed below but which are useful in understanding the analysis, design, findings, and final recommendations.

DR 302-2 DRAINAGE FOLDER COMPONENTS

Drainage folders should be assembled in a manner that will allow the various components to be found as readily as possible. As discussed in previous sections, drainage folders are legal documents that provide information not only to design engineers, but also to other agencies, the private sector, etc. To facilitate the location of information by reviewers with a variety of needs, each drainage folder shall be separated into sections and organized as shown in Table 302-1.

Table 302-1, Sequence of Drainage Folder Components

Section	Description
N/A	Drainage Folder Cover
N/A	Table of Contents
Section 1	Drainage Summary
Section 2	Design Executive Summary
Section 3	Meeting Reports and Correspondence
Section 4	Project Level Hydrology
Section 5	Abbreviated Plans Set
Section 6	Bridges and Culverts
Section 7	Storm Sewer Systems
Section 8	Pavement Inlet Spread Calculations
Section 9	Channel Calculations
Section 10	Other

Each drainage folder section shall be preceded by a title sheet that will serve as a separator between sections. For consistency, each section shall be included in every drainage folder. Sections that are not applicable to a specific project shall be left empty and shall only consist of the title sheet labeled as "Not Applicable." The purpose of this is to remove any doubt about whether a section was erroneously or intentionally omitted.

Each drainage folder section and its subcomponents are described in detail below.

DR 302-3 DRAINAGE FOLDER COVER

The first page of each drainage folder shall be the standard drainage folder cover sheet. The origins of this sheet date back to when each folder was bound and submitted in hard copy format. Required was a pressboard binder cover which contained project specific information and described the contents of the folder. Although submittals are now required to be in electronic format (See DR 304), the drainage folder cover is still required as a title sheet. A template for this cover sheet is available for download on the Drainage Branch's website. See Exhibit 300-1 for a sample drainage folder cover and instructions for completing it.

DR 302-4 TABLE OF CONTENTS

Every drainage folder should contain a Table of Contents that lists the sections of the folder. Each section name should be followed by a brief, general description of its contents. As discussed in DR 302-2, all sections shown in Table 302-1 should be included in the Table of Contents, even if that section will be empty for the specific project. Sections that are not relevant to a project should be labeled as "Not Applicable" or with another equivalent description. It is not required to paginate the Table of Contents.

Due to its general nature, the Table of Contents will essentially be similar for every drainage folder.

DR 302-5 SECTION 1 – DRAINAGE SUMMARY

This section should contain the following components:

- Drainage Structure Summary Form (TC 61-504) – This form is used to list all the drainage structures contained in the folder and the location of each structure's documentation within the folder. Several copies of this form may be required for large projects. See Exhibit 300-2 for a sample of the form and instructions for completing it.

- Project Drainage Discussion – This is an optional item that can be included if the designer deems it necessary. This summary can be used to explain methodologies or to justify project decisions. This should be used to document project-level decisions that affect the drainage design as a whole. If a project-level executive summary is not necessary but a

specific drainage structure requires more explanation, then the designer can alternatively add site-specific documentation to that individual structure's documentation packet in subsequent sections.

- Project Location Map – This will normally consist of a USGS Quadrangle map with the proposed alignment displayed. The map should be plotted at a scale appropriate for displaying the project area and surrounding watersheds. The proposed stationing and north arrow should be shown on the map as well as project and quadrangle identification information.

DR 302-6 SECTION 2 – DESIGN EXECUTIVE SUMMARY

This section should include the approved Design Executive Summary. This document details the basic geometry of the roadway design, as approved.

DR 302-7 SECTION 3 – MEETING REPORTS AND CORRESPONDENCE

This section should include meeting minutes, reports, and all correspondence affecting and influencing the drainage design. The documents should appear in chronological order and give the reviewer a complete overview of all the decisions made governing the design. Decisions and requirements resulting from environmental factors should also be included (this could require including excerpts of text from environmental documents).

This section will usually contain the following documents:

- Selected Alternative Meeting (Preliminary Line & Grade Inspection) Report, including the Water Related Impacts Summary (See DR 202-18)
- Final Inspection Report
- Drainage Inspection Report (if separate from the Final Inspection)
- Other correspondence or meeting minutes pertinent to the drainage design

DR 302-8 SECTION 4 – PROJECT LEVEL HYDROLOGY

This section should contain the following components:

- Project-specific rainfall intensity/rainfall depth data (See DR 401) – This data is the basis for all hydrologic calculations on the project. Typically, it will be used as input for hydrologic software programs.

- Drainage area maps – The type of drainage area maps included in the folder will depend on the size of the watersheds. Large watersheds may be delineated on USGS quad maps. Small drainage areas, such as those for urban inlets, are often delineated using project mapping with contours displayed. All drainage areas should be outlined, and the total drainage area, in acres, should be annotated. When the Rational Method

is used, the runoff coefficient (C-factor) should also be annotated.

The designer has the option to create a set of drainage area maps encompassing the entire project, to be included in this section; or to create separate drainage area maps to be included in each individual drainage structure's documentation in subsequent sections.

DR 302-9 SECTION 5 – ABBREVIATED PLANS SET

To familiarize reviewers with the entire project, the folder should include the following sheets from the plans:

- Typical Sections
- Plan Sheets with existing contours displayed
- Profile Sheets
- Pipe Section Sheets – these can alternatively be included in each individual structure's documentation in subsequent sections.

The plans shown in this section should include all the normal information shown on the roadway plans. See DR 1103 for plan development requirements.

DR 302-10 SECTION 6 – BRIDGES AND CULVERTS (SEE DR 800 AND DR 600, RESPECTIVELY)

This section provides the detailed analysis results and summaries for each bridge and culvert on the project. The documentation for each drainage structure will be assembled into a "packet." Each documentation packet will be placed in the folder relative to its sequence in the plans, regardless of the size or structure type. Documentation packets for bridges and culverts on both the mainline and approaches shall be presented in order as they appear on the mainline stationing.

Every bridge and culvert that is listed on the TC 61-504 form in Section 1 shall have a documentation packet in this section. Each documentation packet should contain the following, in order:

- Drainage Design Summary Form (TC 61-100)
- Site Specific Documentation
- Site Layout
- Drainage Area Map (optional, see DR 302-7)
- Computer Output
- Risk Assessment Form (see DR 807-1)
- Existing FEMA Studies
- Photographs (optional)
- Environmental Commitments or Limitations, if applicable

These items are discussed in more detail below:

Drainage Design Summary Form (TC 61-100) – This form is a summary of the steps and calculations the designer should make in recommending a particular size and type of drainage structure. It is important to view this form as an outline

which guides the designer through a series of operations and provides a means of recording the results in a consistent manner for all structures on a project. The form also requires the designer to describe the existing conditions that give reason to the recommendation. See Exhibit 300-3 for a sample of the form and instructions for completing it.

Site-Specific Documentation

- Summary discussion for the individual structure – For structures that do not require water surface profile computations, the site-specific documentation can be optional (see DR 302-5). This can be useful to document decisions regarding alternatives or special details for individual drainage structures that require more explanation than what can be shown on the Drainage Design Summary Form.

  For structures that require water surface profile computations, a summary discussion is required. It should include a summary of all the methods, assumptions, and resource data used to do the computations. This could include, but is not limited to:

  - Software used (and version) for both hydraulic and hydrologic calculations.
  - Availability of existing studies, including those done for past KYTC projects or FEMA studies.
  - Assumptions or unusual values used.
  - Controlling factors in the design, such as matching an existing FEMA study or a limiting high water elevation.
  - Any other information that would help the reviewer to logically follow the information presented.

- Bridge Inspection Reports, if applicable

Site Layout

- Bridges – Include the Bridge Layout Sheet (See Structure Design Manual section SD 305)

- Large Culverts (See DR 601) – Include a plan view showing culvert details such as alignment, stationing, and skew angle. Also, include a Culvert Situation Sheet (See DR 1103).

- Small Culverts – Include a plan view and a pipe section sheet. The plan view may consist of a half-size plan sheet similar to those used in the plan sheets section, or a site-specific plan view of the structure may be required to focus on the specific drainage structure. Ease of review should be the determining factor for which to use.

For structures that require water surface profile computations, a scaled plan view showing the floodpain sections should also be shown. These may be drawn on the Bridge Layout Sheet or Culvert Situation Sheet if room and scale allow. Sections should be labeled, and the section endpoints should correspond to the extent of the section data. Existing contours should also be shown.

Drainage Area Map – optional, see DR 302-8

Computer Output – Reports generated directly by analysis software are acceptable and should be included in each documentation packet. The required output data depends on the type of analysis, which is discussed in more detail below.

Culvert Computations
For review purposes, the following output data should be included in the drainage folder:

- Runoff Computations – show the following for both the existing and proposed conditions, if applicable.
    - For the Rational Method, the output should include the drainage area, runoff coefficient, time of concentration, intensity, and runoff for the desired return intervals. See DR 403 for more information about the Rational Method.
    - For the Regional Method, the output should include the drainage area, region number, and runoff for the desired return intervals. Where applicable, elevations and flow path lengths, urbanization parameters, and gage stations should also be included. See DR 404 for more information about the Regional Method.
    - For the NRCS Method, the output should indicate the software (and version) used. A summary table for the entire watershed (including each sub-watershed, if subdivided) should be shown and should include the return interval, watershed name, peak runoff, and time of the peak.
    - For time-based hydrologic methods other than NRCS, the data should indicate the software (and version) used, and the methodology used for precipitation modeling, loss, transformation, and routing. The results should include the storm or return interval, watershed name, peak runoff, and time of peak.
    - Where gaging station data is used, include the gage station number, and method used to convert the data to design storms.
- Tailwater Computations – show the following for both the existing and proposed conditions, if applicable; and show the software and version used.
    - For simple, trapezoidal channels, show in tabular or graphic output the bottom width and side slopes, longitudinal slope, Manning's n value(s), and flow elevations for each return interval.
    - For natural or complex channel sections, show in tabular or graphic output the channel geometry, longitudinal slope, Manning's n value(s), and flow elevations for each return interval.

- Where a multi-section water surface profile computation is done for the downstream channel (but not the pipe or culvert), include all the information as detailed in the water surface profile computations discussion below. Where those computations are part of the analysis for another structure, and already included elsewhere in the folder, a reference to that location may be included. However, a plot of the downstream section used for the tailwater elevation should be included with the applicable culvert computation data.

- Headwater Computations – show the following for both the existing and proposed conditions, if applicable; and show the software and version used.

  - For simple, single or multi-barrel analysis, include for each headwater computation the input data (runoff, tailwater, length, slope, size, material, and conditions governing the inlet coefficient) and output data (headwater, outlet velocity, Froude number at the outlet, and outlet depth). Also include whether the computed headwater is in inlet control or outlet control, and the alternative headwater depth.

  - For culverts with improved inlets, include the data for a simple analysis, as well as the details for the improved inlet. This would include the face dimensions, inlet length, throat elevation, taper rate, and barrel length.

  - For culverts with roadway or berm overtopping, include the data for a simple analysis, as well as the details for the berm or roadway. This would include a description of where the overtopping occurs, the berm or roadway low point, the overtopping depth and length, and the weir coefficient.

  - For pipes or culverts with special considerations (such as horizontal or vertical bends, changes in barrel section, or special inlet or outlet controls), include with the normal information any special data, analysis, or computations used for the special condition.

  - A hydraulic performance curve that plots the computed headwater elevation versus peak flows may also be included if deemed useful in the review process.

<u>Water Surface Profile Computations</u>
(This section assumes the use of HEC-RAS when referring to standard tables and output. If other methods are used to perform water surface profile computations, the HEC-RAS tables should be used as a guide to format the results for review)

With the requirement to submit data electronically (See DR 304), generating and

printing complete reports (including an echo of all input data) is no longer necessary. Plan and elevation (profile) views of the structure are already required and give the reviewer much of the geometric information needed. Summary tables and graphic output from computations would be sufficient for detailing results in the folder documentation. The decision on what should be included in the folder should be governed by the readers' need for quick reference and review. The following output data should be included in the folder for water surface profile computations:

- Runoff Computations (same as for culvert computations shown above) – If the runoff calculations from a FEMA study are used, that should be explained in the Discussion section above.

- Summary Tables – One set for existing conditions and another for proposed conditions should be included.

    - The data included in HEC-RAS Standard Table 1 should, at a minimum, be included in the results. Standard Table 2 may also be included, though generally losses used in the energy equations is not needed for review.

    - Where Floodway computations are done, Encroachment Table 1 should also be included. Encroachment Tables 2 and 3 could also be included, however the information there is generally only a rephrasing of data in Table 1.

    - Where a structure is part of the computations, the appropriate Bridge or Culvert Table should be included.

    - Where multiple openings are computed at a single roadway crossing (relief culverts, additional floodplain bridges, etc.), the Multiple Opening Table should be included.

    - When special or unusual circumstances occur, such as junctions or laterals, those Tables may also be added. But keep in mind to include only what is necessary in the review process.

    - Tables can also be modified to include additional output data, where it may be pertinent to the design.

- Graphic Output – One set for existing conditions and another for proposed conditions should be included.
    - Cross section prints often give the reviewer much information on just a single page. Generally, a color print of each floodplain section should be included. Each section should include:
        - Existing ground line.
        - Pertinent water surface elevations (design, check, floodway). Caution should be used in including others, as they tend to clutter the section.
        - Manning's n values across the section.
        - Floodway boundaries, levees, and ineffective flow areas.

- Legend and axis labels.
- Plan title. Geometry and Flow titles are generally not necessary, as the Plan dictates which files are used.

- Profile plots are often helpful, giving a quick view of how deep the flow is, the slope of the profile (both ground and water surface), roadway overtopping, and where the flow passes through critical depth (in jumps and drops). When included, the profiles should be a color plot of:
  - Existing ground line.
  - Pertinent water surface elevations (design, check, floodway). Caution should be used in including others, as they tend to clutter the section.
  - Energy grade line and critical depth (use only as needed to avoid clutter).
  - Legend and axis labels.
  - Plan title. Geometry and Flow titles are generally not necessary, as the Plan dictates which files are used.

Risk Assessment Form – This form is used to evaluate the impacts of proposed bridge projects. The Risk Assessment is described in more detail in DR 807. The risk form is shown in Exhibit 800-1.

Existing FEMA Studies – Copies of relevant data from FEMA studies should be included in the folder. This could include profiles (possibly abbreviated), flood elevation tables, or flood maps.

Photographs – Area photos are encouraged (and may sometimes be required) to show the existing conditions of the drainage structure, the stream/channel, the floodplain, or to show flood information. Only those photos that are deemed necessary for review should be included in the folder.

Environmental Commitments or Limitations - During the detailed design phase, the designers must ensure that all environmental commitments from the permitting process are satisfied. If applicable, summarize all environmental commitments or limitations in this section.

DR 302-11 SECTION 7 – STORM SEWER SYSTEMS (SEE DR 700)

This section provides the detailed analysis results and summaries for each storm sewer system on the project. The documentation for each system will be assembled into a "packet." Each documentation packet will be placed in the folder relative to its sequence in the plans, regardless of the size or type of system. Documentation packets for storm sewer systems on the mainline will be presented first, in station order. These will be followed by systems located on the approach roads, in the order that they appear relative to the mainline stationing.

Every storm sewer system that is listed on the TC 61-504 form in Section 1 shall have a documentation packet in this section. Each documentation packet should contain the following, in order:

- Storm Sewer System Summary Form (TC 61-517)
- Site Specific Documentation
- Site Layout
- Drainage Area Map (optional, see DR 302-8)
- Computer Output
- Photographs (optional)

These items are discussed in more detail below:

Storm Sewer System Summary Form (TC 61- 517) – This form is a summary of the steps and calculations the designer should make in designing a particular storm sewer system. It is important to view this form as an outline which guides the designer through a series of operations and provides a means of recording the results in a consistent manner for all systems on a project. The form also requires the designer to describe the existing conditions that give reason to the recommendation. See Exhibit 300-4 for a sample of the form and instructions for completing it.

Site-Specific Documentation – A summary discussion for the storm sewer system can optionally be included (see DR 302-5). This can be useful to document decisions regarding alternatives or special details for systems that require more explanation than what can be shown on the Storm Sewer System Summary Form.

Site Layout – A plan view of the storm sewer system should be included. This can be a half-size plan sheet, or a schematic plot of the system. Ease of review should be the determining factor for which to use.

Drainage Area Map – optional, see DR 302-8.

Computer Output – Reports generated directly by analysis software are acceptable and should be included in each documentation packet. Since all software packages create unique reports, a specific report format will not be required. The only requirement will be the data that should be included in the report. At a minimum, storm sewer system output should present the following information:

- Node data:
  - Identifying information
  - Physical data such as inlet type, throat/top of grate elevation, and invert elevation
  - Local hydrologic data such as drainage area, runoff coefficient, CA, time of concentration, intensity, and runoff
  - Hydraulic Grade Line elevation (HGL)

Headwater calculations for grate inlets in sag should also be provided in the folder for each applicable inlet. This will often require separate calculations outside of the storm sewer analysis software. See DR 704-11 for details, and see Exhibit 700-2 for a graphic solution. Proprietary computation sheets are also acceptable, as long as their results can be verified.

- Pipe data
  - Identifying information
  - Physical data such as length, slope, diameter, and material roughness
  - Cumulative system flow data such as time of concentration, CA, and flow rate
  - Hydraulic results such as velocity, depth of flow, depth/diameter ratio, and full flow capacity.

Photographs – Area photos are encouraged (and may sometimes be required) to show the existing conditions of the downstream receiving structure, existing systems, special situations, etc. Only those photos that are deemed necessary for review should be included in the folder.

DR 302-12 SECTION 8 – PAVEMENT INLET SPREAD CALCULATIONS (SEE DR 700)

This section should provide the results of all the inlet spread calculations in the project. This information can optionally be included with each individual storm sewer system in Section 7. Reports for spread calculations should show the following data:

- Inlet identification information
- Physical inlet data such as type, local depression, and throat length
- Roadway data such as longitudinal slope, cross slope, gutter width, gutter depression, and pavement roughness
- Hydrologic data such as drainage area, runoff coefficient, rainfall intensity and design gutter flow
- Hydraulic results such as the spread, flow depth, intercepted flow, bypass flow, and efficiency

See Exhibit 300-5 for a sample spread calculation report.

DR 302-13 SECTION 9 – CHANNEL CALCULATIONS (SEE DR 500)

All ditches on the project that require documentation shall be analyzed hydraulically. This includes roadway cut ditches, surface ditches, special ditches, interceptor ditches, inlet and outlet ditches, and small channel changes. See DR 509 for the criteria that ditches must meet to require documentation.

The results of the channel analyses should be summarized in the folder. The Channel Analysis Form, TC 61-507 (see Exhibit 300-6), can be used to summarize the channel analyses, but it is not required. If another method is used, the TC 61-507 form should be used as a general guide for the data that is required to be reported.

DR 302-14 SECTION 10 – OTHER

This section is reserved for special studies that are outside of the scope of the previous sections. Special studies take the form of research, reports, and analyses which distinctively deviate from the normal drainage design of a

highway project. This includes Risk Analysis, Detention/Retention Basin Analysis, Temporary Drainage, modification of a Flood Insurance Study, Finite Element Analysis, and others.

Detention/retention basin analysis and temporary drainage structures are the most common items that will be included in this section. The required documentation for each is discussed in more detail below.

Basin Storage Computations (See DR 900)
Documentation packets for a basin analysis will be similar to those described in previous sections. They should include, in order:

- Site-Specific Documentation
- Site Layout
- Detail Sheets
- Computer Output
- Additional Information (optional)
- Stage-Storage Curve

These items are discussed in more detail below:

Site-Specific Documentation – This should include a summary of all the methods, assumptions, and resource data used to do the computations. This could include, but not be limited to:

- Software used (and version) for both hydraulic and hydrologic calculations.
- Availability of existing studies, including those done for past KYTC projects or other consultants as part of private developments.
- Assumptions or unusual values used.
- Controlling factors in the design, such as matching an existing high water elevations or peak outflow.
- Any other information that would help the reviewer to logically follow the information presented.

Site Layout – This may be a modified Plan Sheet, Bridge Layout Sheet, or Culvert Situation Sheet. Labels and elevations of all the structures in the immediate vicinity (including the overflow weir) should be shown. Existing and proposed contours in and around any basin should also be included.

Detail Sheets – Basin outlet works (pipes, drop boxes, stand pipes, weirs, etc.) should be shown in section and/or profile view with all details necessary to give the reviewer an overview of the hydraulic performance of the basin.

Computer Output – Reports generated directly by analysis software are acceptable and should be included in each documentation packet. Since all software packages create unique reports, a specific report format will not be required. The only requirement will be the data that should be included in the report. At a minimum, basin output should present the following information:

- Graphical plan view showing the watershed basins, routing areas, ponds, and hydraulic links as modeled in the software.

- Indicate the software (and version) used. Also include somewhere in the output summary the methodology used for:
  - Precipitation modeling
  - Loss method
  - Transformation
  - Routing

- For both the existing and proposed conditions, show a summary table for the entire watershed (including each sub-watershed, if subdivided), to include:
  - Storm or return interval
  - Watershed name
  - Peak runoff for the watershed
  - Time of the peak

- For each pond or detention/retention basin, show a summary table (for both existing and proposed conditions, if they apply) to include:
  - Storm or return interval
  - Pond/basin name
  - Total peak inflow, and time it occurs
  - Total peak outflow, and time it occurs
  - Peak water surface elevation, and time it occurs
  - Tabular stage-storage relationships

- If a particular location is of special interest, a summary table with its own details may also need to be shown. The format may be the same as for the watershed data.

- If a routing curve is used for computing basin outflow, the data should be shown in either tabular or graphical format.

- Graphical plots for runoff, water surface elevation, etc. may also be included if deemed useful in the review process.

Additional Information – This should contain any additional information, such as area photos or existing studies that would be useful in showing how or why the analysis was completed.

Temporary Drainage Structures (See DR 1101)

The required documentation for temporary drainage structures will be similar in format to a permanent structure of similar type. For example, the documentation packet for a temporary culvert should be assembled as described in the bridges and culverts section. However, it should be clearly labeled as “Temporary” and placed in this section of the drainage folder.

For temporary structures, the process used to select the design storm must be documented. The process described in DR 1101 shall be used, and the appropriate tables and figures shall be included with the site-specific

documentation for the temporary structure.

Drainage	Chapter: Drainage Folders
	Subject: Advance Situation Folder

DR 303-1 GENERAL

The following sections discuss the items that will be included in the Advance Situation Folder. The intent is not to limit the data to only those items listed, but rather to establish a minimum requirement consistent with KYTC drainage and structure design procedures. If circumstances are such that the facility is sized or designed by other than normal procedures a narrative summary detailing the design basis will be included in the records. Additionally, the designer will include in the documentation items not listed below but which are useful in understanding the analysis, design, findings, and final recommendations. The information presented in this folder should include all data and detail as shown in the Structural Design Manual, Section SD 202-2.

DR 303-2 ADVANCE SITUATION FOLDER COMPONENTS

The Advance Situation Folder is a document assembled and distributed to ensure the structure detailed in it meets all the design decisions previously made in the project development process (including the Drainage Inspection), and it is reviewed and approved by the Structure Section prior to final design. It is considered to be the "order form" from the project manager to the Division of Structural Design to begin the structure design. Contrary to Final Drainage Folders, the advance folder is not a legal document and is not archived.

The Advance Situation Folder should be assembled in a manner that will allow the various components to be found as readily as possible. To facilitate the transfer of information between drainage folders and advance folders, each Advance Situation Folder shall be separated into sections and organized as shown in Table 303-1. Advance folders shall always be separate documents. Therefore, combined Preliminary Drainage/Advance Folders will not be permitted.

Table 303-1, Sequence of Folder Components	
Section	**Description**
N/A	Drainage Folder Cover
Section 1	Design Executive Summary
Section 2	Meeting Reports and Correspondence
Section 3	Hydrology and Hydraulics
Section 4	Plan / Profile / Typical Section Sheets
Section 5	Discussion of Structure Critical Features
Section 6	Structure Plan and Elevation
Section 7	Detail Sheets
Section 8	Close-out Form and Cost Estimate
Section 9	Grade Separation Crossing Details

Each Advance Situation Folder section shall be preceded by a title sheet that will serve as a separator sheet between sections. For consistency, each section shall be included in every folder. Sections that are not applicable to a specific project shall be left empty and shall only consist of the title sheet labeled as "Not Applicable." The purpose of this is to remove any doubt about whether a section was erroneously or intentionally omitted.

This section format mimics the organization of the drainage folder to allow relevant sections to be easily transferred from the drainage folder to the advance folder. For example, the Design Executive Summary section can be directly copied from the drainage folder to the advance folder. For the Hydrology/Hydraulics/Deck Drains section, the individual structure documentation packet can be copied from the drainage folder into the advance folder.

Each Advance Situation Folder section and its subcomponents are described in detail in the following sections.

DR 303-3 ADVANCE SITUATION FOLDER COVER

The first page of each Advance Situation Folder shall be the standard drainage folder cover sheet. The origins of this sheet date back to when each folder was bound and submitted in hard copy format. Required was a pressboard binder cover which contained project specific information and described the contents of the folder. Although submittals are now required to be in electronic format (See DR 304), the folder cover is still required as a title sheet. A template for this cover sheet is available for download on the Drainage Branch's website. See Exhibit 300-1 for a sample drainage folder cover and instructions for completing it.

DR 303-4 SECTION 1 – DESIGN EXECUTIVE SUMMARY

This section should include the approved Design Executive Summary. This document details the basic geometry of the roadway design, as approved.

DR 303-5 SECTION 2 – MEETING REPORTS AND CORRESPONDENCE

This section should include meeting minutes, reports, and all correspondence affecting and influencing the design of the structure. The documents should appear in chronological order, and give the reviewer a complete overview of all the decisions made governing the structure layout, design, and alternatives studied. Decisions and requirements resulting from environmental factors should also be included (this could require including excerpts of text from environmental documents).

This section should be completed in such as way as to ensure that all decisions made during the design process are carried through.

DR 303-6 SECTION 3 – HYDROLOGY AND HYDRAULICS

For stream crossings, this section should begin with the Bridge and Drainage Summary (TC 61-504) and Drainage Design Summary (TC 61-100). These would be followed by all the hydrologic and hydraulic computations used to size and analyze the proposed structure. It should appear in the same order and format as in the drainage folders (see DR 302), and reflect all the changes (if any) made at the Drainage Inspection.

DR 303-7 SECTION 4 – PLAN, PROFILE, AND TYPICAL SECTION SHEETS

The applicable roadway and bridge Typical Sections, Plan Sheets, and Profile Sheets should appear in this section, including the plan and profile sheets immediately before and after the sheets on which the structure appears. The plans shown in this section should include all the normal information shown on the roadway plans and should have the utilities clearly labeled. See DR 1103 for plan development requirements.

DR 303-8 SECTION 5 – DISCUSSION OF STRUCTURE CRITICAL FEATURES

This section would include a discussion of all critical features affecting the design of the structure (see the Structure Design Manual, Section SD-202-2). Hydraulic design features should be included in a discussion in the hydraulic computation section (Section 3). Include a discussion for web walls, approach slabs, and culvert low flow diverters, when applicable.

DR 303-9 SECTION 6 – STRUCTURE PLAN AND ELEVATION

This section should include a natural scale plan and elevation view of the proposed structure. A plan view with site contours, centerline, and proposed structure should also be included.

DR 303-10 SECTION 7 – DETAIL SHEETS

This section would include all additional sheets showing additional design considerations and controls. This would include:

- Architectural and/or aesthetic requirements.
- Lighting, signing, and utility requirements.
- Reference the existing structure (if any), its relation to the proposed structure, and if phased construction if required

DR 303-11 SECTION 8 – CLOSEOUT FORM AND COST ESTIMATE

These should be included for the recommended and any alternative structures.

DR 303-12 SECTION 9 – GRADE SEPARATION CROSSING DETAILS

Show a roadway plan and profile of the route under the proposed structure.

For railroad crossings, show a milepost tie-in to the centerline and detail the highest rail on the profile. Indicate which specific rail is the high rail. Also locate the centerline of track from tangent offsets at 25 foot intervals in each direction, to establish the track curvature within the bridge site limits.

Drainage	Chapter: Drainage Folders
	Subject: Submittal Requirements

DR 304-1 GENERAL

The policy of the Cabinet shall be to require the submittal of folders in electronic format in accordance with PDF (Portable Document Format) standards. The PDF file format has been proven to be a universal format in the preparation of project documents that are distributed via the internet or other media and as a format that lends itself well for project archival.

The following guidelines shall be observed when creating electronic drainage submittals.

DR 304-2 PDF REQUIREMENTS

- PDF files shall be created using Adobe Acrobat Standard Edition, using the version currently approved by the Cabinet. If a different version or program is desired, it must be approved by Division of Highway Design, Drainage Branch prior to submittal. All unreadable files or portions of files must be resubmitted in a readable condition.

- All pages shall be sized to accommodate a physical sheet size of 8.5" x 11" or 11" x 17". A bar scale shall be shown on all drainage maps. The use of scanned images is discouraged unless absolutely necessary.

- The PDF document may be composed of color or black and white text or images and will be stored on KYTC servers with access provided through ProjectWise.

- Bookmarks shall be created in Acrobat, Standard Edition equivalent to the table of contents.

- Each PDF shall include footers. Page numbers shall be shown in the lower right comer of the footer in Arial font with a font size of 10 and noted as "Page x of y."

DR 304-3 SOURCE DATA REQUIREMENTS

Drainage source data shall be submitted as a zip file named “Source Data.zip”. The zip file shall contain input and output files used to perform the drainage

design. Documentation such as meeting reports and correspondence are not considered drainage source data.

The zip file shall be organized to follow the order of the drainage structures and group items as they appear on the TC 61-504 form. Standard or non-standard forms and summaries should be included. All stand alone documents must have a descriptive name for easy identification. Other user defined folder names may be added as needed. Structure packet folders shall be appropriately named. For example, bridge analysis files could be contained in a folder named "Sta. 20+23, Bridge, 60' PCIB" and could include the subfolders "HEC-RAS", "Diversion" and the TC 61-504.

As source data is being used in the drainage design process, the results shall be compiled for inclusion into a PDF file that will become the drainage folder submittal document. The zip file containing the drainage source data shall be submitted with the PDF file.

Drainage source data and PDF files may be kept on the designer's workstation during project development. These files shall be included with the plans submittal and placed in ProjectWise prior to a scheduled inspection, drainage review or Project Development Team Meeting.

DR 304-4 ADVANCE SITUATION FOLDER CONSIDERATIONS

The Advance Situation Folder submittal review requires the inclusion of additional files for use by the Division of Structural Design. It is recommended that these files be included in a zip file named "Structure Files.zip". The files for structure design review shall include the following files in DGN and PDF format:

- Roadway Plan Sheets, including those immediately before and after the sheet on which the structure appears
- Roadway Profile Sheets, including those immediately before and after the sheet on which the structure appears
- Roadway and Bridge Typical Sections
- Bridge Layout Sheet
- Cross Sections (only in special situations such as retaining walls)
- Existing Contours Reference File (DGN only)

DR 304-5 CONSULTANT RESPONSIBILITIES

All electronic drainage submittals shall be sent to the District project manager. The PDF and the source data must be supplied in an electronic format that is compatible with the ProjectWise folder structure. Only one copy per drainage submittal type is required. A typical ProjectWise folder structure is shown below in Figure 304-1:

Figure 304-1 Standard ProjectWise Drainage Folder Structure

DR 304-6 DISTRICT RESPONSIBILITIES

All PDF and zip files shall be placed by the District project manager into the appropriate ProjectWise folder. The project manager shall notify the Drainage Branch drainage engineer responsible for that project by email when a drainage submittal or resubmittal has been placed into ProjectWise.

The district is responsible for reviewing each electronic drainage submittal for compliance of content and supplying review comments to the Drainage Branch and to the designer. The district reviewer shall use Adobe Acrobat Standard Edition to affix an electronic review status stamp to the cover sheet when finished with the review and shall notify the Drainage Branch of this event. The electronic stamp documents the level of review. Typical responses include "received", "reviewed", "revised" or "approved". Drainage Branch and District Office reviews may occur concurrently.

DR 304-7 DRAINAGE BRANCH RESPONSIBILITIES

The Drainage Branch reviewer shall log in each drainage folder submittal once notification has been received from the district and shall notify the district, Central Office personnel including the location engineer, the Division of Structural Design and the Division of Environmental Analysis of this event. The Central Office drainage reviewer shall provide recommendations to the location engineer and district project manager. In certain instances, comments will be provided to other interested parties such as the local FEMA floodplain coordinator. When the review of a drainage submittal has been completed, the Central Office drainage reviewer shall:

- Affix an electronic review status stamp to the cover sheet
- Enter a completion date into the drainage log
- Send an email confirmation to the district project manager, the consultant (if applicable), Central Office personnel including the location engineer, the Division of Structural Design and the Division of Environmental Analysis. The final structure design cannot proceed until the Division of Structural Design is notified of the Drainage Branch's approval of the folder.

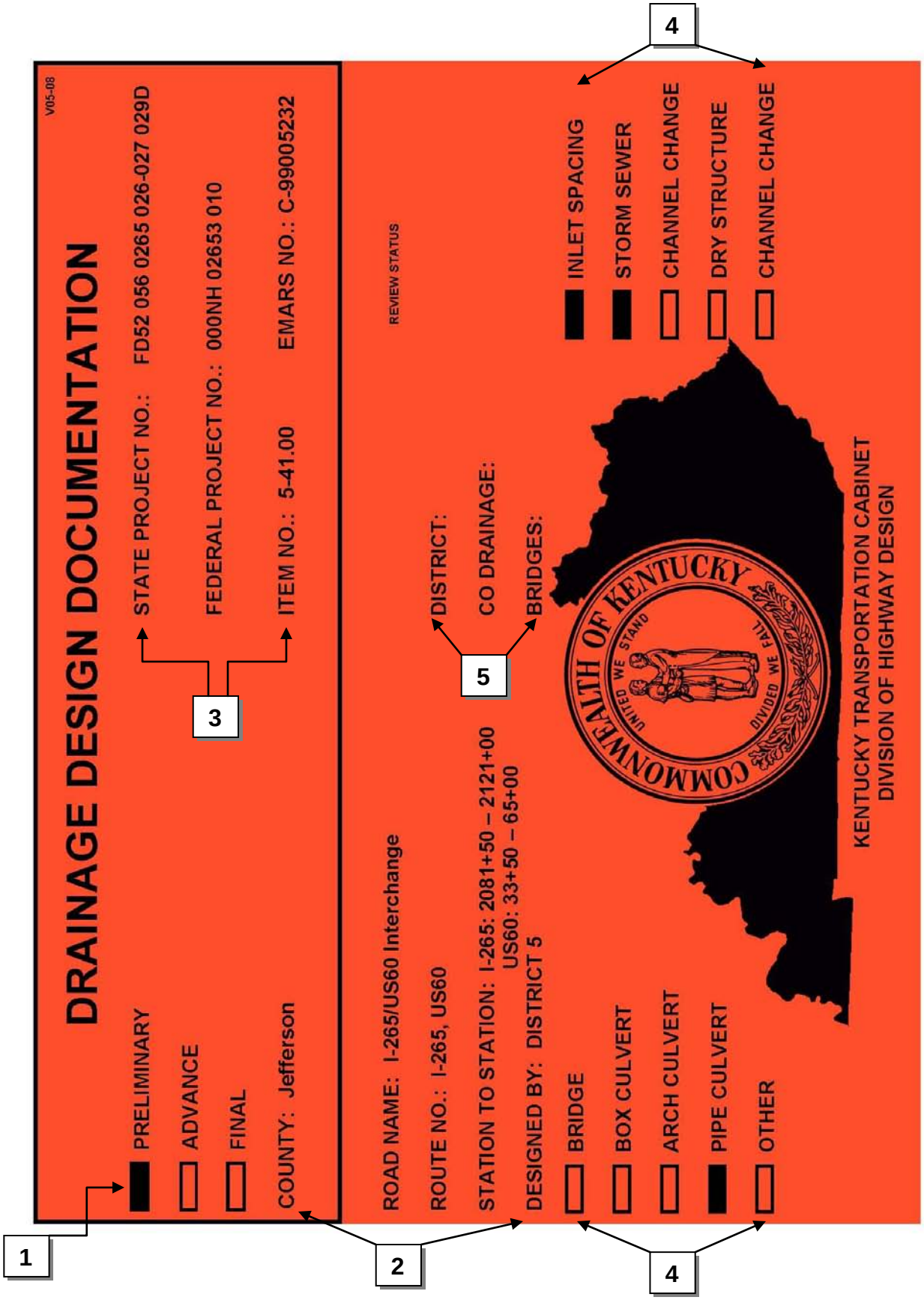
DR 304-8 DIVISION OF STRUCTURAL DESIGN RESPONSIBILITIES

The Division of Structural Design and the Division of Highway Design, Drainage Branch shall maintain close communication with each other and with the District to ensure coordinated and prompt review of each Advance Situation Folder submittal. The Division of Structural Design shall send a notification of the folder's approval to the District project manager and to the design engineer responsible for the structure.

DR 304-9 ARCHIVAL CONSIDERATIONS

The Final Drainage Folder will be stored by the Kentucky Transportation Cabinet (KYTC) and shall be considered the Legal Document of record to be retained permanently.

Open records requests for Drainage Folders are made to the Legal Service. The Legal Service forwards the request to the Drainage Branch for the retrieval of the Drainage Folder which may be a hard copy or an electronic copy. The Cabinet may prescribe a processing fee for the copies provided in response to open records requests.


V05-08
DRAINAGE DESIGN DOCUMENTATION
PRELIMINARY
ADVANCE
FINAL
COUNTY: Jefferson
STATE PROJECT NO.: FD52 056 0265 026-027 029D
FEDERAL PROJECT NO.: 000NH 02653 010
ITEM NO.: 5-41.00
EMARS NO.: C-99005232
REVIEW STATUS
ROAD NAME: I-265/US60 Interchange
ROUTE NO.: I-265, US60
STATION TO STATION: I-265: 2081+50 – 2121+00
US60: 33+50 – 65+00
DESIGNED BY: DISTRICT 5
DISTRICT:
CO DRAINAGE:
BRIDGES:
BRIDGE
BOX CULVERT
ARCH CULVERT
PIPE CULVERT
OTHER
INLET SPACING
STORM SEWER
CHANNEL CHANGE
DRY STRUCTURE
CHANNEL CHANGE
COMMONWEALTH OF KENTUCKY
UNITED WE STAND
DIVIDED WE FALL
KENTUCKY TRANSPORTATION CABINET
DIVISION OF HIGHWAY DESIGN
1
2
3
4
5
4

INSTRUCTIONS:

1. Fill in the appropriate box to indicate the type of folder being submitted.

2. Add project specific information to the appropriate fields, such as County, Road Name, etc.

3. Add all project numbers.

4. Fill in the itemized boxes applicable to the contents of the folder being submitted. For content items that are not applicable, leave the boxes blank.

5. The Review Status fields are reserved for the use of District, Drainage Branch, and Division of Structural Design reviewers. These fields should be left blank by the designer submitting the folder.

Kentucky Transportation Cabinet Division of Highway Design 8-10	DRAINAGE STRUCTURE SUMMARY	TC 61-504 Page 1 of 1

1

County:	Mason	Route:	CR 1016	Item No.	9-124.01
Road Name:	North South Connector			Section:	
UPN:	FD52 081 0068 009-014 006D	FPN:	000NH 00681 014		
Project Description:	New Construction				
Designer:	District 9	Central Office Reviewer:	Richard Thomas		
Termini:	500+00 to 738+38				

2

Bridges:	1	Box Culverts:	0	Pipe Culverts:	6
Arch Culverts:	0	Entrance Pipes:	0	Box Inlets:	3
Channel Changes:	0	Other:	0		

3

Station	Structure / Group Description	Drawing No.	Remarks	Page No.
519+30	84" Pipe			80
549+25	54" Pipe			89
557+38	42" Pipe			98
589+00	42" Pipe			107
611+00	30" Pipe			116
633+57	4-SPAN PCI BEAM BRIDGE OVER CLARKS RUN			
663+25	24" Pipe			125
573+00	Storm Sewer Outfall			134
	Channel Calculations			150

INSTRUCTIONS:

1. The upper portion of the form contains fields for project information. Add data to all fields that apply. See the Drainage Branch's website to verify the appropriate Central Office reviewer for the project.

2. This area serves as an inventory of drainage structures on the project. Enter the total number of each type of drainage structure on the project.

3. The lower portion of the form shall be used to itemize the drainage. All bridges and culverts on a project shall be listed on this form, followed by any Group items in the folder. Group items in folders are those for which a single station reference does not directly apply. Storm sewers, spread calculations, and channel calculations are examples of group items.

   The Station column shall be used to list all of the drainage structures in the order they appear on the mainline stationing. For storm sewer systems, list the outfall station. For group items such as channel calculations, list the group name with no station reference.

   The Structure/Group Description column is used to give the size and type of the proposed structure. For Group items, list the group name.

   The Drawing No. column is reserved for use by the Division of Structural Design only.

   The Remarks column shall contain notes to draw special attention to a particular structure. Items that should be shown here, if applicable are:

   - Drainage areas which are one square mile or greater
   - Level determination from Risk Assessment Form
   - Reference to site-specific summary discussion if one is included in an individual structure's documentation packet
   - Other information deemed necessary by the designer.

   The Page column shall list the page number within the folder where a structure or group's documentation is located.

Kentucky Transportation Cabinet Division of Highway Design	DRAINAGE DESIGN SUMMARY	TC 61-100	1 of 2

1

County :	FAYETTE	Route :	US 68	Item # :	7-318.01
UPN :	FD04 057 0068 004-011	FPN :	OSTPR 0268 017	Sta.:	
Latitude (dec deg):		Longitude (dec deg):			

EXISTING CONDITIONS

2

Downstream Channel Data			Drainage Area:	50.7	Ac	Slope :	0.50%
Stream Name or Description:							

Return Interval (years)	2	5	10	25	50	100	500
Discharge (cfs)	5	10	15	20	25	30	35
Flow Depth ; Tailwater (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50

Normal Pool El.		OHW Elev.		Bed Material:		D50 (mm)	
Drift:		Abrasion Level:		pH:	M	Resistivity:		Date Taken:	
FEMA Flood Zone:	No	Zone Type:		Flood Map No(s):			

3

Existing Bridge or Culvert				Drainage Area:	50.7	Ac
Size, Length, Type & Material:				Skew:		
Lt. Abut./Inlet:			Rt. Abut./Outlet:			
Inlet El.:		Outlet El.:		Slope:		Top/Grate El.:	
Low Road El.:		Low Beam El.:		Net Opening:		

Return Interval (years)	2	5	10	25	50	100	500
Discharge (cfs)	2	4	6	8	10	12	14
Headwater Elev.	1.10	1.20	1.36	1.50	1.68	2.00	2.50
Outlet Velocity (ft/s)	2.50	2.60	2.71	2.85	3.00	3.04	3.50

PROPOSED CONDITIONS

4

Downstream Channel Data			Drainage Area:	50.7	Ac	Slope :	0.50%
Stream Name or Description:							

Return Interval (years)	2	5	10	25	50	100	500
Discharge (cfs)	5	10	15	20	25	30	35
Flow Depth ; Tailwater (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50

5

Proposed Bridge or Culvert				Drainage Area:	50.7	Ac
Size, Length, Type & Material:				Skew:		
Lt. Abut./Inlet:			Rt. Abut./Outlet:			
Inlet El.:		Outlet El.:		Slope:		Top/Grate El.:	
Low Road El.:		Low Beam El.:		Net Opening:		

Return Interval (years)	2	5	10	25	50	100	500
Discharge (cfs)	2	4	6	8	10	12	14
Headwater Elev.	1.10	1.20	1.36	1.50	1.68	2.00	2.50
Outlet Velocity (ft/s)	2.50	2.60	2.71	2.85	3.00	3.04	3.50
Flow Over Road (cfs)	2.50	2.60	2.71	2.85	3.00	3.04	3.50

Kentucky Transportation Cabinet Division of Highway Design	DRAINAGE DESIGN SUMMARY	TC 61-100	2 of 2

6

REMARKS and / or CONTROLS

7

RECORD HIGHWATER DATA

Source	1:	2:	3:
Elevation			
Date			
Location			

8

PROPOSED CHANNEL LINING / STREAM DISTURBANCE

Location	Class	Thickness	Depth	Length	Quantity	Quantity Below OHW (CY)
Upstream						
Downstream						

Total Length of Stream Disturbance (ft):

9

PROPOSED DIVERSION

Flooding	Return Interval (yrs)	Discharge (cfs)	Elevation
Design Storm			
Overtopping Storm			

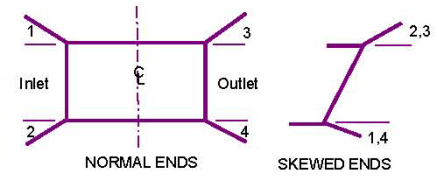
Recommended Size and Type of Opening(s):

10

PROPOSED BOX CULVERT OR SPECIAL WING WALLS

Inlet/Lt. Abut. Skewed ☐ Outlet/Rt. Abut. Skewed ☐

Location	1	2	3	4
30 Degree				
Skewed				
Special				



11

SCOUR

Analysis Method:	CSU	Flow Angle (deg):		D50 (mm)		D95 (mm)	
Contraction Scour (ft):	2.00	Local Abut. Scour (ft):	5.00	Total Abut. Scour (ft):	7.00		

Pier No.:												
Length (ft):												
Width (ft):												
* Type:												
Local Scour:												
Total Scour:	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

* (1) Triangular Nose (2) Square Nose (3) Round Nose (4) Circular Cylinder (5) Group Cylinders

Potential for Aggradation/Degradation/Movement:

Other Factors Affecting Abut./Pier Location:

Scour Mitigation Measures:

INSTRUCTIONS:

1. Identification – Add all project information and the unique station identifier for the structure.

2. Existing Conditions: Downstream Channel Data – Identify existing conditions prior to installing the proposed structure. It is a "before" view of the channel near the structure site. More detailed instructions for specific fields are below.

    - Stream – Enter the stream name, if known. Where an unnamed stream is a tributary of a known stream, it should be identified as such. If the stream is a drain that is not a part of a tributary system, it should be labeled here as a "Drain."
    - Drainage Area – Enter the size of the drainage area in acres for areas up to one square mile. For larger areas, enter the size in square miles.
    - Slope – Enter the existing channel slope
    - Discharge (cfs), Flow Depth – Enter the results of the runoff calculations for the existing channel for the required return intervals. Provide values for the 2- through 500-Year storms for large drainage structures, as defined in DR 600.
    - Normal Pool / Ordinary High Water Elev. – For regulated bodies of water, enter the normal pool elevation. Ordinary High Water is defined by the U.S. Army Corps of Engineers as "that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas." See DR 1104 for more details about obtaining the OHW.
    - Bed Material and D_{50}– Indicate the type and size of material in the stream. This has a bearing on the structure type selected due to the abrasive effect it may possess.
    - Drift – Estimate the potential for drift. This may be used to justify a trash guard near the inlet of a structure or to estimate the maintenance that may be required for the structure.
    - Abrasion Level, pH, and Resistivity – Enter the data from the field investigation and the date taken. This information helps determine the possible alternates for the culverts.
    - FEMA Information – For sites that lie within a mapped FEMA floodplain, enter the applicable Zone Type and Flood Map No(s).

3. Existing Conditions: Existing Bridge or Culvert – If there is an existing structure, enter its site data and geometric information. Also enter the results of the runoff calculations and the existing hydraulic performance. The Headwater Elevation represents the water surface elevation caused by the structure at the culvert face or one bridge length upstream, whichever is applicable. The "net opening" shall be that below the low beam for a bridge or crown of multi-cell box culvert. This information represents the "before" view to be used for comparison when replacing an existing structure.

4. Proposed Conditions: Downstream Channel Data – Identify the proposed conditions after installing the proposed structure. It is the companion "after" view of the hydrologic conditions. The information required is similar to the existing conditions described above. However, the proposed drainage area and runoff is often different for the proposed condition than for the existing condition. Therefore, space is provided here to show the proposed data for easy comparison to the existing.

5. Proposed Conditions: Proposed Bridge or Culvert – Enter the results of the hydraulic analysis for the proposed structure. It is the companion "after" view of the hydraulic conditions. The information required is similar to the existing bridge or culvert data described above.

   The Discharge and Headwater Elevation data shall be used for the Flood Evaluation Data in the plans set and shall be shown on the profile sheets, structure section sheets, and pipe sheets.

   The Outlet Velocity for the structure is necessary to determine the need for channel lining and/or energy dissipation to offset increases in water speed caused by the proposed structure.

6. Remarks and/or Controls – Indicate any control features that may influence the horizontal or vertical placement of the proposed structure or its size. Controls could be such things as the shoulder elevation, stage in the natural stream, existing, proposed or potential development upstream from the site, utilities, etc. Give a return interval when describing an Allowable Headwater Elevation (e.g. 1.5’ below shoulder for 100-year flood). Use this part to display controlled discharges used in the design when obtained from regulated streams, from Flood Insurance Studies, or other sources, especially when these discharges differ from the calculated values.

7. Record Highwater Data – There is space for information from three witnesses to the high water observed. See DR 1104 for details about obtaining record highwater data.

8. Proposed Channel Lining – This section summarizes the channel lining required for the proposed structure, if applicable. Show the thickness, type, depth to protect, and the quantity of material. In addition, show the quantity below ordinary high water and the total length of stream disturbance. This additional information is useful in the permitting process. The depth to protect is measured vertically from the flow line or invert of the channel to the top of the proposed lining. Do not measure along the side slope of the channel. The channel lining information must also be placed on the plans in inlet and outlet ditch notes and in channel change notes.

9. Proposed Diversion – Diversions are temporary highways that allow continuous traffic flow around a construction site. The diversions are constructed across bodies of water using temporary fills, temporary bridges, or a combination of the two. See DR 1101 for temporary drainage structure design procedures.

   The designer shall provide a minimum allowable opening size on the plans (Diversion Profile Sheet). The type of diversion structure may be recommended by the designer. The choice of a structure type that meets the minimum opening size shall be left up to the contractor.

10. Proposed Box Culvert or Special Wingwalls l– The designer shall provide the angles of proposed wingwalls as shown by the diagram for all box culverts and arch culverts. The fields "Normal End" and "Skewed End" are to indicate the skew of the barrel. There are instances when one end of a culvert is skewed and the other is normal (Zero degree skew). The values entered shall indicate both the skew angle and the direction of the skew (Lt. or Rt.), if applicable. If these fields are left blank, it can be expected that the structural designers will use 30° wingwalls.

11. Scour – This area of the form is used to summarize scour data for bridges. See DR 800 and the FHWA publication HEC-18 “Evaluating Scour at Bridges” for more information about scour analysis and the data required in this section.

Kentucky Transportation Cabinet Division of Highway Design 8-10	STORM SEWER SYSTEM SUMMARY	TC 61-517

1

County :	FAYETTE	Route :	US 68	Item # :	7-318.01
UPN :	FD04 057 0068 004-011	FPN :	OSTPR 0268 017		
Outfall Station:		Outfall Offset:		ft	Lt
System Sta. to Sta. :	571+50	to	580+00		

EXISTING CONDITIONS

2

Downstream Receiving Structure :	Pipe Inlet			Tailwater Control :	Pipe Headwater								
Receiving Structure	Area :	30	Ac	Wtd "C":	0.33	Tc:	7.7	min.	Slope :	0.50%			
Return Interval (years)	2	5	10	25	50	100	500						
Discharge (cfs)	5	10	15	20	25	30	35						
Flow Depth ; Tailwater (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50						
Existing Culvert or Channel at Outfall													
Channel	Trapezoidal	Side Slopes	Lt:	4.5	:1	Rt:	4.5	:1	Bottom Width:	4	ft	Slope:	0.50%
Culvert Outlet	Size :	30	In	Dia		N/A	N/A	Material	RCP	Outlet Elev.			
Outlet Conditions	Area :	20	Ac	Wtd "C":	0.27	Tc:	6	min.	Slope :	0.50%			
Return Interval (years)	2	5	10	25	50	100	500						
Discharge (cfs)	2	4	6	8	10	12	14						
Flow Depth (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50						
Velocity (ft/s)	2.50	2.60	2.71	2.85	3.00	3.04	3.50						

PROPOSED CONDITIONS

3

Downstream Receiving Structure :	Pipe Inlet			Tailwater Control :	Pipe Headwater								
Receiving Structure	Area :	30	Ac	Wtd "C":	0.33	Tc:	7.7	min.	Slope :	0.50%			
Return Interval (years)	2	5	10	25	50	100	500						
Discharge (cfs)	5	10	15	20	25	30	35						
Flow Depth ; Tailwater (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50						
Proposed Outfall Structure													
Stm Swr Outfall	Size :	30	In	Dia		N/A	N/A	Material	RCP	Outlet Elev.			
Outlet Conditions	Area :	20	Ac	Wtd "C":	0.27	Tc:	6	min.	Slope :	0.50%			
Return Interval (years)	2	5	10	25	50	100	500						
Discharge (cfs)	2	4	6	8	10	12	14						
Flow Depth (ft)	1.10	1.20	1.36	1.50	1.68	2.00	2.50						
Velocity (ft/s)	2.50	2.60	2.71	2.85	3.00	3.04	3.50						

Analysis Software (and version)	
Additional Comments:	

4

INSTRUCTIONS:

1. Identification – Add all project information and the unique station identifiers for the system.

    - Outfall Station/Offset – Enter the centerline station and offset of the proposed storm sewer outfall
    - System Sta. to Sta. – Enter the centerline station range of the entire storm sewer system contributing to the outlet.

2. Existing Conditions – Identify existing conditions prior to installing the proposed system. It is a “before” view of the drainage conditions near the system site. More detailed instructions are below.

    - Downstream Receiving Structure – Enter the details of the structure downstream of the proposed storm sewer outfall controlling the existing tailwater conditions. Note: For comparatively large drainage areas downstream of the proposed storm sewer outfall, a lower flow depth may be used for tailwater conditions.
    - Existing Culvert or Channel at Outfall – Enter the details of the pre-construction conditions at the location of the proposed storm sewer outfall. Data should be entered for either a channel or culvert, but not both.

3. Proposed Conditions – Enter the results of the storm sewer system analysis. This is the companion "after" view of the results of the proposed construction.

    - Downstream Receiving Structure – Enter the details of the structure downstream of the proposed storm sewer outfall controlling the proposed tailwater conditions.
    - Proposed Outfall Structure – Enter the details of the proposed storm sewer outfall.

4. Additional Comments – Enter any additional site specific information that requires documentation. If a lengthy discussion is required, then a separate summary discussion sheet should be used. See DR 302 for details.

CURB BOX INLET CALCULATIONS v05a-10

County	Warren	Item No.	3-17.0	Road No.	US 231	Road Name	I-65 / US 231 Interchange

Speed Limit	Lane Width	W (ft)	n	I (iph)	Gu.Dp. (in)
45	12	2	0.016	4	0

State Project No.	114 0065 022-023
Federal Project No.	IM 65-1(087)22
Emars No.	8022301D

Sag Location	Station	CBI Type	L (ft)	C	Area (ac)	Sl (ft/ft)	Sx (ft/ft)	Sw (ft/ft)	LTI (ft)	Qt (cfs)	T (ft)	Ts (ft)	Qs (cfs)	di (ft)	Eo	Se (ft/ft)	E	Qi (cfs)	Qby (cfs)	Allow T (ft)
	10+00	AS	10	0.9	0.16	0.0104	0.023	0.023	6.46	0.576	5.335	3.335	0.165	0.123	0.714	0.083	1	0.576	0	8
	20+00	AS	10	0.9	0.178	0.0104	0.023	0.023	6.831	0.641	5.552	3.552	0.195	0.128	0.696	0.081	1	0.641	0	8
	30+00	AS	10	0.9	0.25	0.0104	0.023	0.023	8.17	0.9	6.297	4.297	0.324	0.145	0.639	0.076	1	0.9	0	8
	40+00	AS	10	0.9	0.2	0.0104	0.023	0.023	7.263	0.72	5.8	3.8	0.233	0.133	0.676	0.079	1	0.72	0	8
sag	50+00	AS	10	0.9	0.178	0	0.023	0.106		0.641	3.255			0.242	0.984	0.106		0.641	0	8
	60+00	AS	10	0.9	0.2	0.0104	0.023	0.023	7.263	0.72	5.8	3.8	0.233	0.133	0.676	0.079	1	0.72	0	8
	70+00	AS	10	0.9	0.25	0.0104	0.023	0.023	8.17	0.9	6.297	4.297	0.324	0.145	0.639	0.076	1	0.9	0	8
	80+00	AS	10	0.9	0.178	0.0104	0.023	0.023	6.831	0.641	5.552	3.552	0.195	0.128	0.696	0.081	1	0.641	0	8
	90+00	AS	10	0.9	0.16	0.0104	0.023	0.023	6.46	0.576	5.335	3.335	0.165	0.123	0.714	0.083	1	0.576	0	8

Kentucky Transportation Cabinet Division of Highway Design 4-06	**CHANNEL ANALYSIS**										**TC 61-507** Page 1 of 1
County : Scott							Item No : 7-1102.0				
Proj. No. : FD52 105 0356							Route : KY 356				
Location	∑ Acres	C	Tc (min)	I (iph)	Q (cfs)	Channel Section z : 1 __w__/ z : 1	n	So (ft/ft)	dn (ft)	V (fps)	Remarks
RIGHT						_ _/					
13+50						_ _/					
to	0.24	0.30	5.0	6.28	0.45	4 _ 0.0 _/ 3		0.109	0.43	0.71	81 sy ECB
14+50						_ _/					
to	0.32	0.30		6.28	0.60	4 _ 2.0 _/ 4		0.100	0.29	0.67	94 tns CL 2
15+82						_ _/					
to						_ _/					
Ex.Ditch						_ _/					
LEFT						_ _/					
13+50						_ _/					
to	0.079	0.64	5.0	6.28	0.32	4 _ 0.0 _/ 4		0.098	0.40	0.49	92 sy CL2
14+50						_ _/					
to	0.14	0.64		6.28	0.56	3 _ 2.0 _/ 4		0.080	0.30	0.61	64 tns CL2
15+50						_ _/					
to	0.05	0.64		6.28	0.20	3 _ 2.0 _/ 4		0.077	0.27	0.25	38 tns CL2
16+09						_ _/					
						_ _/					
17+55						_ _/					
to	0.01	0.35	5.0	6.28	0.22	2 _ 2.0 _/ 4		0.021	0.25	0.33	65 sy ECB
18+25						_ _/					
to	0.59	0.35		6.28	1.30	2 _ 2.0 _/ 3		0.054	0.42	1.02	39 tns CL2
19+00						_ _/					
to	0.27	0.35		6.28	0.59	2 _ 0.0 _/ 4		0.056	0.55	0.66	53 sy ECB
19+75						_ _/					