

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
DESIGN DIRECTIVE**

**DD-205**  
**GUIDANCE FOR PREPARATION OF DESIGN REPORTS AND STUDIES**  
*June 16, 2006*

This Design Directive will give guidance and instruction on how to prepare, distribute for comments, and begin the final approval process of Design Reports and Studies. This Design Directive will provide uniformity for development of these reports/studies throughout the Division of Highways, to include the various Districts within the Division.

Attachments

## 10. General Purpose of Design Reports and Studies

Design Reports and Studies (hereinafter referred to as “Study”, or “Studies”) are engineering studies of several proposed alignments for a highway project. These Studies are produced for projects such as small bridge replacements, roadway realignments, intersection improvements, turning lane additions, new roadway alignments, etc. By nature, these Studies are considered Initial Engineering by Design Directive (DD) 200, “Project Development Process”. The completion of the Study with an approved alternative alignment is considered the end of Initial Engineering by that particular DD. If a choice of alignments is given, the report will recommend one alignment as the “Preferred Alternate”, otherwise the alignment shown in the Study will be considered the “Preferred Alternate”. A request for “Location & Design (L & D) Approval” will then be made (see DD–206, “Guidance for Location and Design Approvals” for more information concerning this approval process). When L & D Approval is obtained, Preliminary Engineering according to DD–200 can begin, after Notice to Proceed has been given. This Design Directive will cover only the preparation, distribution, receipt of comments, and selection of the Preferred Alignment in the Design Study itself.

These Design Reports and Studies should be prepared in enough detail to adequately hold the Scope of Work meeting for each project. The Study should contain a minimum of items that are unknown at the time of scoping. It is anticipated that these Studies will be handed over to the Division’s Designer or a Consultant Designer (overseen by a Roadway and a Bridge Project Manager (if required) assigned by the Division) for completion of design.

## 20. Preparation of Design Studies

**20.1 General:** DD - 201, “Public Involvement Process” should be reviewed to determine if any of the stipulations contained therein apply to each and every Design Study project. Any public involvement must take place before L & D Approval is requested. Public involvement must be noted in the L & D Approval request.

**20.2 Existing information:** All existing facilities, such as roadways, streams, culverts, storm sewers, bridges, homes/businesses (to include any sewerage facilities required by that facility, such as septic systems, “shotgun sewers”, etc.), railroads, utilities (public and private), etc. are to be field investigated and placed on the Study base mapping. The Division’s and courthouse tax map/assessor’s records are to be researched for any existing roadway, structure, right-of-way plans, property lines/owners, and known environmental information (which can be obtained from the Environmental Services Section of the Engineering Division) which may contain preliminary information vital to the Study (and can further be used when the project is scoped and assigned to a Designer). See DD – 301, “Right of Way Plans” for more information on

the required existing information to be shown on the plan sheet for each alignment. A centerline with stationing is to be provided for all existing roadways, with horizontal curve data to include at minimum the existing radii and superelevation, vertical curve data to include at minimum K-values and lengths, sight distances, etc. Bearings may be obtained from any existing mapping held by the Division, or can be taken from a compass reading. Sight distance for existing intersections/driveways should be determined and placed on the plan sheets also. Existing rights-of-way are to be placed on the plan sheets for each alternative alignment.

- 20.3 Mapping:** As a minimum, statewide base mapping in 1" = 400' scale, with 10' contour intervals, is available from the Planning and Research Division. There are other sources of mapping available within the Division. The Administrative Section of the Engineering Division maintains records of all aerial photography that has been flown and is in the Division's possession, as well as any mapping that has been produced from said photography. In the absence of any mapping the Division may possess, blow-ups of USGS 7 ½ minute topographic sheets may be used, although this is not recommended. Any mapping provided by the Division is to be field-checked by the preparer of the Study for accuracy and then updated, with any and all updates to be made to the base mapping by the Designer. If no existing mapping is available, then conventional surveys or aerial photography and subsequent field-edited mapping may be utilized.
- 20.4 Scale/Paper Size:** The reports/studies should be produced at a 1" = 100' scale, or a larger scale for smaller studies, such as a bridge replacement with very little roadway work. The scale should be chosen with the type and size of the Study, and the desired paper size in mind. If the scale needs to be made larger to show any necessary details, then match marks are to be utilized wherever necessary, based on the existing roadway's centerline. Paper sized 11"x17" folded to 8 ½"x 11" can be used if the preparer of the Study determines that a larger scale on one sheet will contain all of the information required.
- 20.5 Design Criteria:** All design criteria to be used, according to the projected traffic volumes and existing or proposed roadway classification, are to be given, preferably in table format. The roadway classification and projected traffic volumes can be obtained from the Planning and Research Division. The latest approved issues of the AASHTO Green Book, Very Low-Volume Local Roads Guide, Design Directives, Drainage Manual, and the Roadside Design Guide are to be used to determine all necessary criteria. If any design criteria cannot be met, design exceptions are to be indicated, and enough preliminary information given so that the designer can complete the design exception report(s) required during future design stages as described in the latest edition of DD – 605, "Design Exception Policy".

**20.6 Content:** Reference is hereby made to the Design Report Submission Checklists contained in DD – 202, “Field and Office Reviews for Initial Engineering, Preliminary Engineering and Final Design” for the information required in the Study. Depending on the type, size, and complexity of the Study, not all information required by the checklists will be necessary. Any other information that may be known about the Study area, such as visible high water marks, other information gleaned from field surveys and observations, discussions with the residents in the Study area, and at any required public meetings such as location of septic systems, wells, etc. should be included also. The checklists are required to be submitted with each Study submission. The Project Numbers will be shown on each and every Study.

**20.6.1 Existing facilities:** All existing facilities as described in Section 20.2 above are to be contained on each alternative’s plan sheet. It is very important that all existing information be indicated on the Study plans and narratives, as estimates for possible home/business relocations and right-of-way purchases, will be made by the Right-Of-Way Division for the Study. Utilities should be located in the field by notifying Miss Utility of West Virginia before the field visit is made, so as much accurate utility information is shown in the Study as possible. It is to be noted that not all utilities subscribe to Miss Utility, so it is vital that other utilities in the area be investigated for their presence. A list of the affected utilities in the project area is to be included in the narrative (See Section 20.6.6 hereinafter in this Design Directive). The capital cost of all required utility relocations will be made by the Utilities Unit of the Technical Section, Engineering Division. All existing features described here and above in Section 20.1 are to be shown as described by the Division’s CADD Standards, available on the WVDOT website.

**20.6.2 Proposed roadway facilities:** A plan sheet and a profile sheet are to be prepared for each alternative alignment. A centerline is to be shown with stationing, radius and proposed superelevation for each required horizontal curve. Grades and vertical curves with preliminary K-values are to be shown for each proposed alternative’s profile. This information is to be given for the mainline and all side roads.

Proposed detour roads required, such as an upstream and a downstream detour for a small bridge replaced on its existing alignment, are to be shown, along with the design speed.

The proposed construction limits should be shown, as well as property line information, obtained from the assessor’s tax maps. Existing rights-of-way information and proposed right-of-way limits are to be shown. No stations or offsets are required. The cost

of the necessary rights-of-way for each alternative alignment will be obtained from the Right-Of-Way Division.

All work in streams and wetlands in the project area must be indicated. Channel changes are to be shown, as the permits required are more complex and will require more time and design effort to obtain. Natural stream design methods and principles are to be used as necessary when designing any channel change on any US Army Corps of Engineers' jurisdictional stream; however this is only to be indicated in the report, and no design effort put forth. Streams which will require a culvert crossing of the roadway(s) are to be shown also, with preliminary sizes given. Preliminary drainage calculations required to size these culverts are to be included with the Study.

A sheet showing all roadway(s) typical section(s) is to be included, with widths obtained from utilizing the roadway classification and traffic volumes, the AASHTO Green Book, the AASHTO Low-Volume Local Roads Guide, and the Division's Design Directives. The Study should reference all AASHTO publications and Design Directives that were used to develop the Study. This will include a typical section for all required side roads, not including driveways. Also, the typical section for any proposed temporary detour roads and bridges is to be included.

All proposed roadway information is to be shown as described by the Division's CADD Standards, available on the West Virginia Division of Transportation's website.

**20.6.3 Proposed structures:** The intent of this Design Directive in relation to structures is to develop a "Pre-Span Arrangement" report for each structure to be included in the Study. See the Division's "Bridge Design Manual", 2003 (revised March 1, 2004) for more information on this matter. Not all of the requirements for a Span Arrangement submission are required; the necessary information will be indicated in this Section of this Design Directive.

The Bridge Designer's tasks for a Design Study are to provide the necessary bridge information, capital cost estimates, and sketches for the Study to be developed. The Bridge Designer must look at the existing conditions for the project site, such as roadway geometry (both horizontal and vertical), utilities, right-of-way, existing and adjacent structures, etc. Also, historical data such as the latest Bridge Inspection Report, existing bridge plans, etc., hydraulic opening, and the proposed roadway alignments should

be reviewed to assist in the development of the Study. The Bridge Inspection Files are available from the Maintenance Division, Bridge Evaluation Section. The Bridge Designer will develop plans and profile sheets for each structure, and give a capital cost estimate (to include any required Temporary Bridges). The bridge drawings are to be simple line drawings with minimal details, such as stationing, grades, horizontal and vertical curve data. The capital cost estimate is to be based on historical data for similar structures based on a cost per square foot of deck area (including parapets and sidewalks). This cost can be obtained from discussions with any of the Bridge Engineers employed by the Division, or from the Designer's own engineering judgment.

The Bridge Designer is to meet with the Division's assigned Bridge Project Manager to discuss the feasible structural systems and span arrangements that will be included in the Study. The purpose of the meeting will be to eliminate or add additional alternates for further consideration on the Study. The Division's Bridge Project Manager will make the final decision on which alternates are to be carried through and studied in the Span Arrangement.

At this meeting the following information is to be available for use by the Bridge Designers and the Division's Bridge Project Manager: preliminary horizontal and vertical alignments and geometry, site plan for each structure alternate with both plan and profile sheets for each alternate, discussions on why structure options were chosen or rejected, superstructure types being considered, and a capital cost estimate for each alternative. No girder analysis is required in the Study.

As a matter of course, there will always be "No-Build" alternate given in the Study. At times, the preparer of the Study will be asked to include an alternate that is rehabilitation of the existing structure. In this case, unit costs can be obtained from the yearly Unit Bid Price Report, which is available on the Division's website, from discussions with any of the Bridge Engineers employed by the Division, or from the preparer's own engineering judgment.

All proposed structure information is to be shown according to the Division's CADD Standards, available on the WVDOT website.

**20.6.4 Hydraulics:** Hydraulics of any stream impacted by the proposed Study are a very important factor to consider when deciding on a new location for any structure, whether it is a bridge, large culvert, such as a box culvert or very large diameter pipe, or a channel change.

Enough preliminary hydraulic observations and computations are to be made to, at minimum, to determine the low chord elevation of any proposed structure, and the  $Q_{100}$  backwater elevation of the existing structure. Field surveys may be required to determine the stream channel bottom's topography and Manning's "n" values. Also, Flood Insurance Rate Maps should be consulted to see what Flood Zone the Study area is in. The regulatory Base Flood Elevation (BFE) should be shown on the plan and profile for each alternate, and the source cited in the Study. Many published Flood Insurance Studies and maps are available from the Technical Section of the Engineering Division. Further, the US Army Corps of Engineers and/or the local Flood Plain Coordinator should be contacted to determine if a detailed hydraulic study has already been performed in the area. Both tailwater and backwater effects are to be considered, as well as preliminary scour depths for piers in the stream channel. A zero backwater increase is to be striven for. If this cannot be achieved, then easements will have to be acquired to cover the proposed backwater increase possibly involving the purchase of homes/businesses, and at minimum a Conditional Letter of Map Revision will have to be filed with the Federal Emergency Management Authority during final design activities.

The hydraulic aspects of altered streams, whether the work is as simple as locating piers in the stream, floodway or flood fringe, placing embankment in these areas, or a complete channel change become paramount when the new facility will result in water surface elevations very close to any published flood elevation. If there are no published flood elevations in the Study area, then a preliminary HEC-RAS analysis on all affected streams is to be performed and submitted as part of the Study.

**20.6.5 Environmental overview:** A preliminary environmental overview is required. This work will require a representative from the Environmental Services Section of the Engineering Division to examine the project site in enough detail to establish any environmental constraints which would affect the location of alternative alignments in the report, and be of sufficient detail to show in the Study as known constraints to the design. It is preferred that the environmental process be completed for a typical small bridge replacement study. But, studies over larger streams and rivers may require extensive agency coordination and environmental approval, especially federally endangered mussel species are encountered with the preliminary surveys. However, there should be enough surface observations and literature investigations performed to be reasonably sure that there are no major environmental constraints associated with the project.

Wetland involvement, cultural resource considerations for any structure (to include existing railroad facilities and roadway bridges), permit requirements, known endangered species, known hazardous waste/storage tank sites, etc. should be identified so there are no hidden items that come up when the project enters the Preliminary Engineering phase.

It is desired that the environmental process be completed for projects which fall under the Programmatic Categorical Exclusion process to have this document completed and approved at the time the L & D request is made.

**20.6.6 Narrative requirements:** The narrative to accompany each report shall describe the existing facilities, to include traffic data for the present day as well as vehicles per day projected 20 years from the anticipated opening year of the facility to traffic, deficiencies in the existing horizontal/vertical alignments, sight distance obstructions, condition of the existing facilities (to include all roadways, shoulders, drainage facilities, and other structures, such as bridges), etc. The history of the section of roadway in question, such as construction year, any major reconstructions or rehabilitations performed, is to be described. Some of this information can be obtained from the Straight-Line Diagrams and Roadway Inventory Logs maintained by the Planning and Research Division. These diagrams should be obtained and made a part of the project file in any case.

A conceptual Maintenance of Traffic scheme is to be described. At minimum, cases from the latest adopted issue of the Manual on Uniform Traffic Control Devices shall be cited. More complex Maintenance of Traffic schemes may require a more detailed plan. It is not the intent of this Design Directive to show detailed schemes in plan view, rather to describe in words a phasing of construction for the project, and therefore a required Maintenance of Traffic scheme. The length in miles of any detour assuming the facility will be closed is to be indicated. The proposed detour route must be examined for adequate roadway/shoulder widths for the character and amount of traffic which will be utilizing it, as well as the structural capacity/ratings/postings of all bridges along the route.

The proposed work for each alignment is to be described, listing the physical characteristics of each alignment (curvature, grades, length). Capital costs, such as construction costs, right-of-way costs to include home/business relocation costs and utility relocation costs, temporary roadway/bridge are to be indicated for each alignment. Also, each alignment's advantages and disadvantages shall be described. Bridge renovation costs are

required if the existing bridge is potentially eligible for inclusion on the National Register of Historic Places.

The preliminary structure information, with the exception of the plan and profile sheets, described in Section 20.6.3 above is to be included as part of the narrative. The Sufficiency Rating for all existing structures is to be shown.

All utilities affected by the project are to be shown on the plan sheets and listed as a part of this narrative.

All accesses to be affected by each alternative are to be identified and taken into account in the capital cost estimates. If a property is to be landlocked, it shall be indicated as such on the plan sheet for that alternative.

A geotechnical overview shall be presented. This will consist of any known data from Natural Resource Conservation Service mapping, knowledge of the geology of the area (possibly from an adjacent project or one in the vicinity), on-hand literature searches such as bridge inspection reports or original bridge plans, etc.

The environmental overview described in Section 20.6.4 shall be made a part of the narrative.

A table listing all capital costs associated with that particular alternative, such as temporary roadway/structure costs, permanent roadway/structure costs, right-of-way costs, utility relocation costs, structure rehabilitation costs (if required), etc., is to be included with each alternative.

At the end of the report narrative, a Summary Table is to be given, with information for each alternative shown, including engineering costs, construction costs, detour length, and advantages/disadvantages of each alternative alignment, advantages/disadvantages of each structure arrangement, etc. From this information, a Preferred Alternate is then chosen, and indicated. This will be the alignment that L & D Approval is requested on. When there is disagreement among the involved parties the Division's Project Manager or Designer will build a consensus among the parties to choose the Preferred Alternate, provided there are major anticipated environmental constraints.

The typical sections sheet(s) will follow the narrative section of the Study, followed by plan and profile sheets showing the existing situation, followed by plan and profile sheets for each and every alternative alignment. At the very end of the Study, photographs of the existing site showing the project area, including the

bridge/roadway to be improved or replaced, nearby homes/businesses that may be impacted, streams impacted. Finally, a copy of all pertinent information from the most current Bridge Inspection File, the approved Programmatic Categorical Exclusion or the completed Environmental Services Section approval form (See DD – 206 for this form), the completed Design Study checklists, etc. shall be included at the end of the Study.

### **30. Distribution of Design Studies for Comments**

**30.1 Distribution of preliminary report:** Reference is hereby made to DD – 202, “Field and Office Reviews for Initial Engineering, Preliminary Engineering and Final Design”. The Study should be distributed to all entities shown under the Design Report Field Review column.

After each entity’s receipt of the Study, at least 2 weeks should be allotted for review and comment. The transmittal memo is to state the date that comments are due. If no comments have been received by the due date in the transmittal memo, it will be assumed that the entity has no comments and the process will continue. It is highly recommended that each entity receiving a Study review and comment at each submission. For example, comments which would apply to the Field Review should be made at that submission, and not at the Office Review.

**30.2 Distribution of final report:** Reference is hereby made to the Distribution List given in DD – 202, “Field and Office Reviews for Initial Engineering, Preliminary Engineering and Final Design”. The study should be distributed again to all entities indicated in the Design Report Office Review column. At this time, a request should be made to the Utilities Unit of the Engineering Division, Technical Section for preliminary utility relocation cost estimates, and to the Right-of-Way Division with a request for preliminary estimates of the cost of property acquisitions.

Again, it is recommended that at least 2 weeks be given for review, as described above in Section 30.1. The Office Review portion of the study is the last review before a request for L & D Approval is made.

**30.3 Documentation of comments:** All comments received are to be fully documented and made a part of the project file, as stipulated in DD-202.

**40. Location and Design (L & D) Request and Approval:** Once a “Preferred Alternate” is chosen from the Study, an L & D approval request is made to gain the State Highway Engineer’s approval. This process is described in DD – 206, “Guidance for Location and Design Approvals” and shall be followed for all Design Reports for approval of the Preferred Alternate. Again, when there is disagreement among the involved parties the Division’s Project Manager or Designer will build a consensus among the parties to choose the Preferred Alternate. Once L & D Approval is granted, the project will then proceed to

Preliminary Engineering in accordance with DD-200, "Project Development Process", to which reference is hereby made, contingent on funding, priorities, schedule, etc.

50. **Scope of Work notes:** The Scope of Work notes will be developed by the preparer of the Study based on the approved Preferred Alternate from the Study. These notes should be adequate for a complete description of all design work to be performed to make a complete set of Contract Plans. See DD-706 for more information concerning what constitutes a complete set of Contract Plans.
60. **Preliminary Engineering estimate:** The Preliminary Engineering Estimate will also be developed by the preparer of the Study. This Estimate is the estimate of man-hours of time expected to be required to develop the complete set of Contract Plans for the Preferred Alignment, which will be advertised for bids. See DD-706 for more information concerning what constitutes a complete set of Contract Plans.