

**Forest Service Handbook
National Headquarters – Washington Office
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**Forest Service Handbook 7709.56b – Transportation Structures Handbook
Chapter 10 - Planning**

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Approved by: Gregory Smith, Acting Associate Deputy Chief, NFS

Date approved: November 18, 2014

Responsible Staff:

Explanation of changes: Following is an explanation of the changes throughout the directive by section.

7709.56b: The entire Handbook has been revised; refer to the digest for a summary of the revisions.

Zero Code: Makes minor technical and editorial changes, removes obsolete direction and terminology, and updates the coding system by changing from the one-digit to the two-digit coding system.

10: Recodes, reorganizes, and updates direction throughout the chapter. Makes minor technical and editorial changes, removes obsolete directions, and updates the coding system by changing from the one-digit to the two-digit coding system.

11: Recodes, reorganizes, and updates this section in its entirety. Replaces discussion of forest plans, ecosystem management, and least total cost method decisions with subsections on travel analysis and travel management decisions. Updates direction on road management to include direction on Trail Management Objectives and recodes the direction to section 11.3. Reduces scope of direction on alternatives to stay within limits of travel management decisions and the Road and Trail Management Objectives and recodes the direction to section 11.4. Recodes the remainder of the section to new section 11.5 entitled, “Project Development Process.”

13: Sets forth new direction on inspection reports for existing structures and evaluation of load-carrying capacity of existing structures to listing of required design information.

20: Makes minor technical and editorial changes, removes obsolete direction, adds direction to meet Road and Trail Management Objectives, and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter.

23: Adds direction to consider roadway widening needed to accommodate off-tracking of large trucks when curves are constructed close to bridges, to consider construction access to both sides of a stream, and to consider measures needed to maintain existing road traffic when replacing existing bridges.

30: Makes minor technical and editorial changes, removes obsolete direction, and updates the coding system by changing from the one-digit to the two-digit coding throughout the chapter.

34: Revises direction to conform to stream simulation requirements and to reference chapter 60.

35.4: Adds direction for identification of construction staging areas.

40: Makes minor technical and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding throughout the chapter. Removes obsolete direction referencing economic analysis methods and flood insurance.

43.5: Updates direction to allow previously used materials only when they have been inspected, determined to be structurally adequate, economical and approved by the Regional Director of Engineering.

50: Changes chapter caption from “Hydrology” to “Hydrology and Geomorphology” and adds direction to require stream simulation and aquatic organism passage. Makes minor technical

and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding system.

60: Changes chapter caption from “Hydraulics” to “Hydraulics and Watershed Protection” and adds direction to require stream simulation and aquatic organism passage. Makes minor technical and editorial changes and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Removes obsolete direction.

70: Changes chapter caption from “Structural Design” to “Road Bridge Design” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Adds new direction and revises, reorganizes, and recodes direction throughout the entire chapter. Changes various section captions to be applicable for road bridge designs and sets forth new direction throughout the chapter. Removes obsolete direction.

80: Changes chapter caption from “Operations” to “Trail Bridge Design” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Sets forth direction for planning, design, and construction of trail bridges and other engineered trail structures.

90: Changes chapter caption from “Construction” to “Road Bridge Operation” and updates the coding system by changing from the one-digit to the two-digit coding system throughout the chapter. Revises, reorganizes, and recodes entire chapter. Major changes are: 1) removes the distinction and inspection requirements between bridges formerly known as NBIS and non-NBIS (National Bridge Inspection Standards), 2) removes all trail bridge references and guidance and 3) incorporates culvert guidance.

100: Establishes code, chapter “Trail Bridge Operation”, and sets forth direction for maintenance, inventorying, and operation of trail bridges and other engineered trail structures.

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10.2 - Objectives

To prepare and submit environmental documents, feasibility studies, and engineering reports necessary to design bridges and other engineered structures in a timely manner in order to provide road and trail access to meet land and resource management plan objectives.

11 - Preliminary Planning

11.1 - Travel Analysis

Travel analysis assesses the current forest transportation system and identifies issues and assesses benefits, problems, and risks to inform decisions related to identification of the minimum road system per 36 CFR Part 212.5(b)(1); designation of roads, trails and areas for motor vehicle use per 36 CFR Part 212.51; and development of transportation facilities. Travel analysis is done at various scales. It is the Forest Service's process for the identification of issues and concerns involving cumulative effects and connected actions that may be associated with transportation developments.

Travel analysis is documented in a report. The report may contain information on concerns identified in the travel analysis process about cumulative effects and connected actions as well as recommendations for alternative projects to be considered through environmental analysis and decision making to best accomplish management objectives while mitigating concerns.

Bridge engineering expertise may be necessary to conduct a proper travel analysis. This is particularly true in developing costs for stream crossing structures, and where cumulative watershed effects have been identified or where concerns regarding passage of aquatic species have been identified.

Further direction on travel analysis is found in FSM 7712 and FSH 7709.55, chapter 20.

11.2 - Travel Management Decisions

Travel management decisions include adding a route to or removing a route from the forest transportation system, constructing a National Forest System (NFS) road or NFS trail, acquiring an NFS route through a land purchase or exchange, decommissioning a route, approving an area for motor vehicle use, or changing allowed motor vehicle classes or time of year for motor vehicle use. This includes decisions to construct or reconstruct bridges and other structures.

Travel management decisions involve environmental analysis and decision making, including appropriate public comment and involvement. Decisions are documented in accordance with the Forest Service's NEPA regulations at 36 CFR part 220 and NEPA procedures at FSH 1909.15, where applicable.

Professional bridge engineering expertise may be necessary in decision making. The expertise provides advice to decision makers and the public on the relative costs involved in alternatives,

constructability of alternatives, temporary environmental impacts during construction, and long-term environmental impacts and benefits once structures are in place.

Further direction on travel management decisions is found in FSM 7715.

11.3 - Road and Trail Management Objectives

Road and Trail Management Objectives (RMOs and TMOs) document the intended purpose of an individual road or trail in providing access to implement a land and resource management plan as well as decisions about applicable standards for the facility. RMOs and TMOs should be based on management area direction and access management objectives. RMOs and TMOs contain design criteria, operation criteria, and maintenance criteria.

Further direction on RMOs is found in FSM 7714 and FSH 7709.59, chapter 10. Further direction on TMOs is found in FSM 2353.

11.4 - Alternatives

Alternatives for design of a particular bridge or structure must be based on the travel management decision and the applicable RMOs or TMOs. Within the limitations of the decision and applicable RMOs or TMOs, it is appropriate to consider several alternative designs and select the one that best meets the RMOs or TMOs and minimizes costs over the life of the structure.

11.5 - Project Development Process

Each organizational unit having authority to approve structural designs and plans should develop a method for displaying authorities, responsibilities, and the anticipated sequence of activities for each project. The following considerations should be addressed for each project:

1. Establish a timeframe for each sequential phase of the work.
2. Assign coordination responsibilities and approval points, and delegate required authority (FSM 7722.04 and FSM 7723.04).
3. Establish a timeframe for completion and determine the steps required to complete within that timeframe. Document the sequence of activities and time requirements associated with each step. Designate individuals or staffs responsible for completing each step and those who shall provide input or be contacted to coordinate the project work.
4. Give each project an appropriate name and number and determine tentative coordination, field work, and design needs. Establish the project scope by identifying the preferred structure type and estimating the size, cost, and projected completion date.
5. Include Engineering personnel responsible for transportation structure preconstruction work (FSM 7722.04) to provide needed technical input in planning activities.

6. Identify specific work and coordination needed for meeting the following:
- a. Forest Plan requirements (FSM 7712).
 - b. Environmental requirements (FSM 7721.12).
 - c. Requirements of Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) (FSM 7701.4).
 - d. Requirements for Resource Specialist input found in the travel management decision and RMOs/TMOs.
 - e. Requirements of cooperative agreements relative to road jurisdiction and maintenance (FSM 7730).
 - f. Hydraulic (sec. 34 and sec. 60), hydrologic (sec. 50), geotechnical (sec. 31), structural design (secs. 70 and 80), and construction engineering requirements (FSM 7721.3).
 - g. Site surveying requirements (sec. 32).
 - h. Contract administration requirements (FSM 7722.41 and FSM 7723.31).
 - i. Wild and Scenic River requirements (36 CFR part 297).
 - j. U.S. Army, Corps of Engineers 404 general permit requirements (33 CFR part 330).
 - k. U.S. Coast Guard permits for activity in navigable waterways (33 CFR parts 114 and 115).
 - l. Power withdrawals (FSM 5520).
 - m. Fish and wildlife protection (36 CFR part 241 and FSM 2610).
 - n. Biological Evaluations for Threatened and Endangered Species (FSM 2670).
 - o. Archeological and cultural resource preservation requirements (36 CFR 296 and FSM 2360).
 - p. Local and State laws and regulations related to transportation planning (FSM 7712.1).
 - q. Water quality (FSM 2532) and/or water rights (FSM 2541).
 - r. Wilderness protection and management requirements (36 CFR part 293 and FSM 2320).

12 - Project Funding

Ensure that funding for the project has been secured and approved in accordance with Regional procedures for implementing an annual program of work, such as the capital investment program or the timber sale program (36 CFR 212.2(c)).

13 - Required Design Information

The following documents and information should be developed and included with the Project Engineering Report (sec. 14).

1. Topographic map (sec. 32).
2. Road and trail design information (sec. 33).
3. Foundation investigation data (sec. 31.3).
4. Stream channel survey data (sec. 34).
5. Information on existing structures and photographs (sec. 35).
6. Hydrologic data and stream hydraulic analysis (secs. 50 and 60).
7. Inspection reports for existing structures (sec. 81).
8. Evaluation of the load-carrying capacity of existing structures (sec. 83).

14 - Project Engineering Report

The project engineering report should contain the project description and background; the documentation and display of the applicable travel management decisions, documentation, and display of the RMOs/TMOs; project and management requirements; and basic engineering data needed to design the structure.

14.1 - Report Contents

Develop a written report for each project that includes the following:

1. Identify the project name, number, and location.
2. Discuss the preliminary planning process outlined in section 11.
3. Identification of the RMOs/TMOs (sec. 11.3). Include resources to be served, type and amount of traffic, safety, and environmental considerations, whether the road is a public road (FSM 7720.5), and restrictions on road use. Identify environmental or other site-specific constraints.
4. Include design information and documents listed in section 13.

5. Include road design elements and standards (FSM 7720.05 and FSH 7709.56, sec. 42). Include the number of lanes, roadway width, shoulder width, curve widening, clearances, design speed, and sight distance. Also include the road maintenance level (FSH 7709.59, sec. 60) and the vehicle for which the structure is to be designed.
6. Discuss the alternatives to a bridge, culvert, or low-water structure that were considered (sec. 11.4).
7. Recommend structural alternatives that the designer should consider. Display the reasoning and the associated costs such as the following:
 - a. New structure.
 - b. Replacement structure.
 - c. Rehabilitation.
 - d. Reduced design loading.
 - e. Alternative structure types, such as low-water structures.
8. List project management requirements and other information needed by Project Engineers (preconstruction and construction) for preparing the design and contract documents and for administering the construction contract. As a minimum, include the following:
 - a. Identify source of technical assistance for interpretation of the road or trail design and contract plans. Describe coordination between resource management areas if needed.
 - b. Identify timeframe for preconstruction work remaining to be completed. Coordinate with the design office the time requirements for project design and completion of construction plans, specifications, and estimates. Where outside design services are used, include the time needed for contract award and review.
 - c. Determine funding source(s) (sec. 12) and the amount programmed for design, construction, and construction engineering.
 - d. List all other project management concerns that may affect structure design or construction, such as personnel qualified and available to perform construction inspection (FSH 7109.17), environmental constraints, time limitations, provisions of cooperative or cost share agreements, right-of-way acquisition, coordination with the Corps of Engineers, State, county, or other local government officials, and esthetic requirements (color, type of material).
9. List design requirements established for the structure type and size. List all criteria regarding site conditions, such as road alignment, vehicle and pedestrian use, and stream

conditions that will affect the design or construction of the structure. Include the following:

a. Design criteria.

- (1) Design loading and frequency (sec. 72.2).
- (2) Utilities to be incorporated in the structure or to be considered in design.
- (3) Navigation within the stream or clearances for underpasses and overpasses.
- (4) Road template and right-of-way limits. Include curve or slough widening, superelevation or crown, curve radii, fill and cut slope ratios, and so forth.
- (5) Bridge and approach railing (need, type, and finish) (sec. 72.3).
- (6) Sidewalk requirements, if applicable.
- (7) Special signing requirements.
- (8) Availability of material sources, such as aggregate and riprap.
- (9) Foundation conditions (sec. 31.3).
- (10) Hydrology (sec. 50). The report should contain observations, calculations, and recommendations for the site from the Forest Staff Officer for hydrology studies.

The following data are to be included:

- (a) Drainage area used on a U.S. Geological Survey (USGS) map (or copy) along with a terrain description, discussion on soil type(s), vegetative cover, and surface storage.
- (b) Stream flow records including location of gauge(s) date of peak recorded flow, quantity of peak recorded flow, and flood frequency interval of that flow. Discuss the probable cause of the flow (if known), such as snow melt, snow melt and precipitation, precipitation only, or other causes.
- (c) Other historical information, such as performance of existing structures during past flows (state structure length, type, and elevation), water levels observed by markings on the channel banks or eyewitness accounts, debris or ice problems, and scour or deposition problems.
- (d) Calculations supporting the design discharge at the selected frequency. The design discharge frequencies for bridges and major culverts should be the 100- year flood, or as established by Regional guidance (sec. 50).

(11) Hydraulics. See sections 50 and 60 for additional direction. A description of hydraulic conditions should discuss analyses made and the results of the analyses in the form of recommendations. Items to be discussed should include:

(a) Manning's "n" value (channel roughness factor) determined and used in the analysis based on stream characteristics, photographs, and references used for comparison.

(b) Stream gradient, stream cross-section, and velocity used in calculations.

(c) Recommendations should be based on calculations, including high-water elevations for design, desirable stream cross-section, and maximum allowable velocities for limiting fisheries impact and scour potential.

(d) Comments on debris and ice hazards at the site.

(e) Recommendations on scour potential and use of riprap or other measures for protection from scour. Include extent of riprap coverage and class of riprap needed.

(f) Comments relative to fisheries' concerns (maximum velocities, baffles needed, estimated length of time of construction work in stream).

(g) Minimum freeboard for ice and debris.

(12) Recommended bridge deck wearing surface, if any.

(13) Vehicle design speed.

(14) Soil and water corrosion potential.

b. Construction considerations.

(1) Construction seasonal limitations.

(2) Stream access requirements and constraints.

(3) Construction and traffic bypass limitations (location, loading, volume, and speed).

(4) Road access limitations for construction components and equipment (girders and cranes).

14.2 - Report Preparation, Review, and Approval

Prepare the project engineering report to fully display and document the needed project information. The size and complexity of the report will vary with the project scope and complexity. Use project data sheet(s) developed by the Bridge Program Manager for routine data included in the report.

The project engineering report should be signed and dated by the individual assigned responsibility for its completion, and reviewed and approved by the Forest Engineer.

Submit the report to the Regional Bridge Engineer.