

National Engineering Manual

Part 541 – Drafting and Drawings

541.0 General

- A. Engineering designs are normally described, displayed, and documented with construction drawings. These drawings provide details of the location, content, and dimensions of the components needed to complete the work.
- B. Drawings need to communicate information clearly and effectively among designers, reviewers, owners, and contractors at different locations. This requires uniformity and consistency in drawing layout and style.
- C. Drawings reflect the professional quality of NRCS engineering services to the owner, contractor, and general public. Drawings should be legible, accurate, complete, and should have a consistent appearance throughout the agency.

541.1 Media

- A. Drawings can be developed by manual drafting techniques and/or computer aided design (CAD) methods.
- B. Paper is appropriate for most NRCS conservation work. More durable medium such as vellum or mylar should be considered for standard drawings that will be reused repeatedly, or for drawings that need to be retained for many years.
- C. CAD files should be saved on media appropriate for retention period shown in NRCS Records Management Guide. Permanent record files should be upgraded to newer, more durable media as technology evolves.

541.2 Sheet Size

- A. Drawing sheet size should be appropriate for presentation of required information in a neat and uncluttered manner.
- B. Standard size sheets for NRCS work will be as follows:
 - (1) Full size, 22 inches by 34 inches, ANSI D size.
 - (2) Half size, 11 inches by 17 inches, ANSI B size.
 - (3) Page size, 8.5 inches by 11 inches, ANSI A size.

- C. Normally, full size sheets should be used for projects involving large land areas or complex structures. Half size sheets should be used for smaller, simpler work. Page size sheets should be limited to simple details.
- D. Other size paper may be used for NRCS work as needed to facilitate local paper supply availability and special plotting, copying, or reproduction equipment limitations.

541.3 Title Blocks

- A. Each sheet in a set of construction drawings shall have a title block to identify the drawing and provide other information about the drawing. Location data including State, County, Township, Section or similar information shall be included in each title block.
- B. Full and half size drawing sheets shall have a vertical title block on the right side of the sheet. Page size sheets shall have horizontal title blocks across the bottom of the sheet.
- C. The standard title blocks for NRCS work shown in Sections 541.7 through 541.10 shall be used for all new drawings or drawing forms prepared by NRCS.
- D. Alternative title blocks can be used or added for work prepared by other agencies, local organizations, or private firms. Such alternate title blocks shall contain at least the same drawing identity and other information as contained on the NRCS standard title block.

541.4 Cover Sheet

- A. Each set of construction drawings consisting of more than five sheets shall have a cover sheet showing the name and location of the project, the names of the sponsoring agencies or owners, an index of the drawings, space for approval signatures, and professional seals as appropriate.
- B. The cover sheet for major, long lasting NRCS work such as dams and channels may also include a location map, general notes, and project data.

541.5 Orientation

- A. Maps should be drawn with north toward the top of the sheet. If this orientation is not feasible, the map should be drawn with north toward the left. A north arrow shall be shown on all maps.
- B. Layout drawings (plan view) should be drawn so that the direction of flow is from left to right or bottom to top of the sheet. A north arrow and flow arrow indicating direction of flow shall be shown.
- C. Cross section and elevation views of structures representing surfaces essentially parallel to the direction of the stream flow should be drawn so that flow is from left to right.
- D. Cross section and elevation views representing surfaces essentially normal to flow should be drawn so that they are viewed looking downstream. If such orientation makes the drawing

unclear, it may be changed and the orientation labeled on the drawing. For example, orientation could be labeled as “Looking Upstream.”

E. Stationing on open channels can be stationed upstream or downstream, depending on local practice, design software, or existing drawings.

F. Multiple cross sections on a sheet should be arranged sequentially according to stationing.

G. Orientation of views and directions of stationing shall be consistent throughout the drawing set.

541.6 Style and Content

A. Drawings should present as much related information as reasonable on the same sheet for efficiency and clarity. If possible, details should be drawn on the same sheet as the work to which they apply. If details are shown on a separate sheet, appropriate sheet references should be noted. Dimensions and sizes of components should be shown on the drawings rather than referenced to the specifications.

B. Drawings shall follow agency and industry standards for content, appearance, details, and symbols to best communicate requirements to reviewers, contractors, and the building trades. Standards include:

(1) American Concrete Institute (ACI)

- ACI 315 – Details and Detailing of Concrete Reinforcement
- ACI 315R – Manual of Engineering and Placing Drawings for Reinforced Concrete Structures

(2) American Institute of Steel Construction (AISC)

- AISC – Manual of Steel Construction

(3) American Society of Mechanical Engineers (ASME)

- ASME Y14.1 to Y14.5 – Drawings, Dimensions, etc.

(4) Natural Resources Conservation Service (NRCS)

- National Digital Geospatial Map Symbols Handbook, Title 170, Part 601

(5) National Institute of Building Sciences (NIBS)

- U.S. National CAD Standard, Version 2.0

C. Scales for drawings should be selected carefully to assure clarity of details and accommodate reduced size reproductions. Bar scales are preferred for maps and plan views and are necessary for any drawings that will be reduced for contracting.

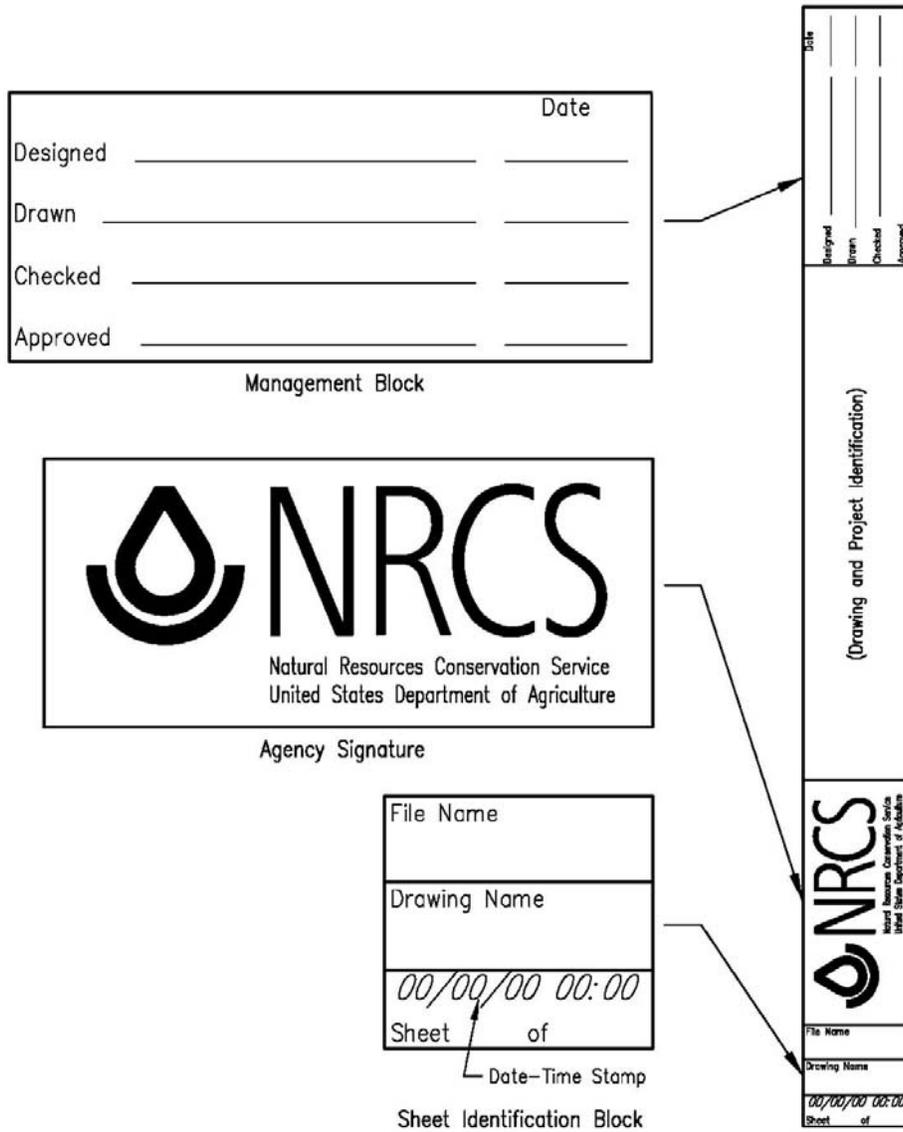
D. The minimum scale for structural drawings should be: ¼ inch equals 1 foot for layout sheets, ⅜ inch equals 1 foot for reinforcing steel sheets, and ½ inch equals 1 foot for any sheets that will be reduced. Drawings that will be reduced shall include bar or graphic scales, or each reduced sheet shall bear a prominent warning note stating that the drawing is a reduced size and the indicated scales are not accurate.

- E. Notes on the drawings should be limited to those required for complete and accurate description of the drawings and those required to supplement the contract specifications.
- F. All lines and letters must be clear, sharp, and dense to ensure clear reproductions and one-half scale reductions. Manually drafted letters shall be single stroke type.
- G. Drawings should include geographic location information. Routine work should show at least a simple location map containing readily identifiable landmarks. Major work should include structure reference lines and right-of-way limits referenced to fixed and readily identifiable geographical points.
- H. Drawings should include geologic and soils information where available. Boring numbers, station and offset of borings, waterline depth and date of waterline, and soil classification at various depths can be displayed on cross section and profile views.
- I. Drawings should include survey information, i.e. benchmark location, data and datum used, where available.

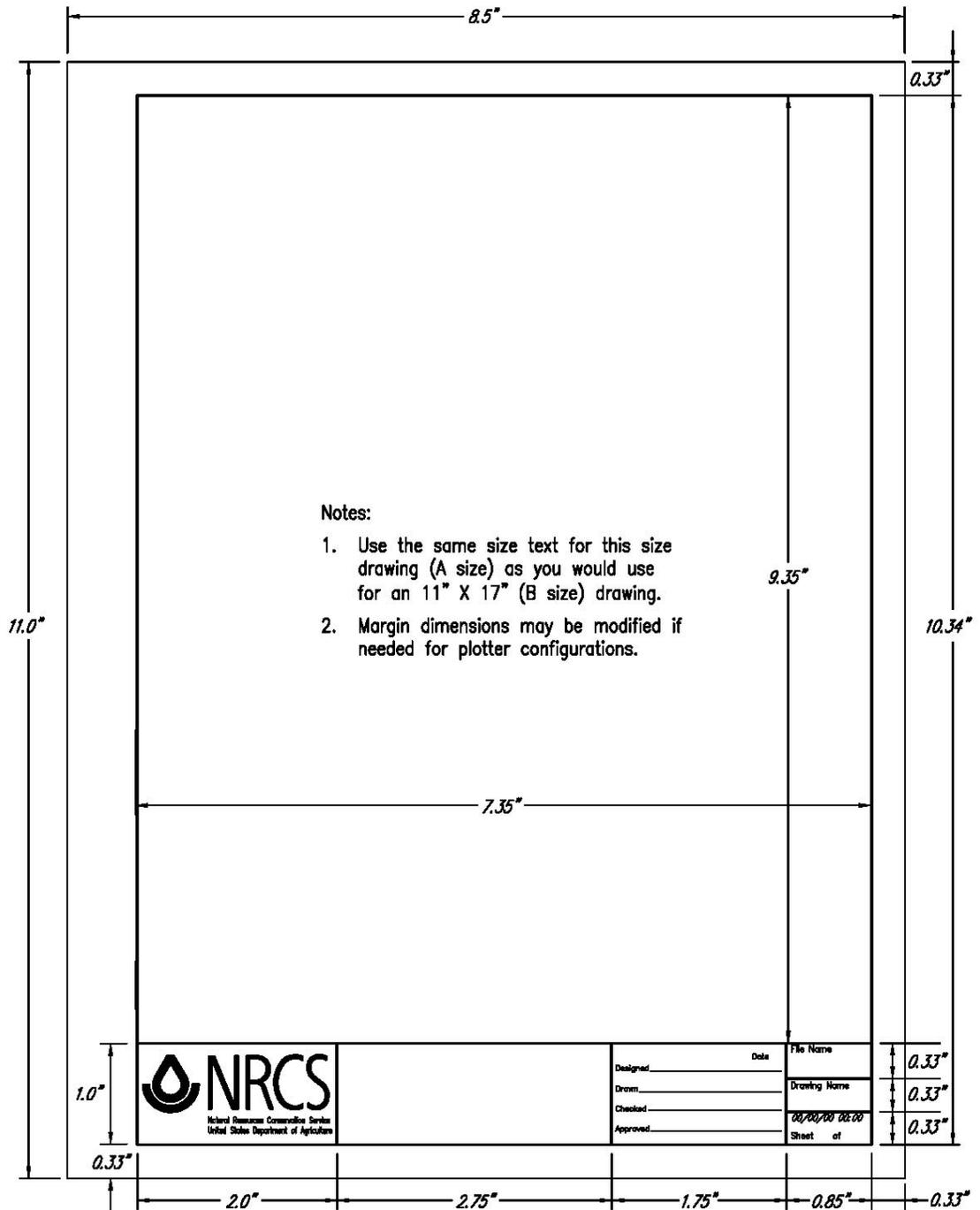
541.7 Standard Title Block for ANSI A (8.5x11) Sheet

| | | | | |
|--|--|----------------|------------|--------------------|
|  NRCS Natural Resources Conservation Service United States Department of Agriculture | | Designed _____ | Date _____ | File Name _____ |
| | | Drawn _____ | | Drawing Name _____ |
| | | Checked _____ | | 00/00/00 00:00 |
| | | Approved _____ | | Sheet of _____ |

541.8 Standard Title Block for ANSI B (11x17) and ANSI D (22x34) Sheets



541.9 Standard ANSI A (8.5x11) Sheets



541.10 Standard ANSI D (22x34) and ANSI B (11x17) Sheets

