

## DOCUMENTATION REQUIREMENTS Open Channel - 582

### I. Reference Materials

The following reference materials will be used for the planning, design, and construction of open channels. Open channels with embankments, berms, side inlets, pipe and straight drops require supporting data as found under Technical Guide, Section IV, under the appropriate practice standard.

- a. Engineering Field Manual (EFM), Chapters 1, 2, 3, 4, 5, and 6
- b. ND Supplement to Engineering Field Manual (NDSEFM), Chapters 2, 3, 4, 14
- c. Technical Release 25, Design of Open Channels
- d. Hydrology Manual for ND
- e. County Soil Survey Report
- f. ND Construction and Material Specifications for Conservation Practices
- g. Technical Release 62, Engineering Layout, Notes, Staking, and Calculations
- h. National Operation and Maintenance Manual
- i. National Engineering Handbook, Section 11, Drop Structures
- j. National Engineering Handbook, Section 19, Construction Inspection
- k. Suitable Computer Software:
  - Hydraulics (e.g. Ohio Program, WSP2, HEC-RAS)
  - Watershed Hydrology (e.g. EFM2, EFH2, TR55)
  - Excel Spreadsheet Hydrology (e.g. ND-ENG-12e)
  - Excel Spreadsheet Yardage (e.g. ND-ENG-1e)
  - Structure Hydraulics (e.g. SITES, others applicable)

### II. Site Investigation/Data Collection

The following information shall be obtained:

- a. Channel size, volume, depth, etc. requirements - as applicable for conditions
- b. Watershed characteristics
  1. Drainage area
  2. Watershed slope, flow length, T<sub>c</sub> (Time of Concentration)
  3. CN (Soil - Cover Complex Number)
  4. Base flow conditions
- c. Job approval authority (NRCS Personnel)
- d. Soils/geologic investigation
  1. Planned by individual with applicable job approval
  2. Conduct a preliminary screening using the county soil survey report
  3. Test hole logs and samples
    - (a) Unified Soil Classification System
    - (b) Excavation centerline and offsets (when necessary)
    - (c) Borrow and Spoil areas
    - (d) Side inlet, stream crossing/road areas (when necessary)
    - (e) Groundwater and water for construction

4. Sedimentation - Consult with geologist when investigation and analysis are necessary
  5. Soil resistivity measurements when needed for the design of cathodic protection for buried metal pipe
- e. Locations of overhead and buried utilities – North Dakota ONE-CALL

### III. Design Surveys

- a. Survey notes shall be kept in loose-leaf or bound field notebooks. The notes will be kept in a format similar to that shown in Technical Release 62, and Chapter 1, Engineering Field Manual. Electronic survey notes will be documented in a format that allows complete checking by others.
- b. Excavation: The excavated (channel) areas will be cross-sectioned at intervals sufficiently close to accurately define the earthwork volumes. In no case will the spacing between cross sections exceed 100 feet. The need and placement of cross sections will be determined by the person having job approval for the design.
- c. Inlet/Outlet/Structures: A profile, cross sections, or topographic survey of the areas will be surveyed as needed to provide necessary design and quantity calculations.
- d. Surveys shall include the locations of all affected utilities (buried or overhead).

### IV. Design Plans and Specifications

- a. The design of open channels will be in accordance with Standard and Specification 582 Open Channel, Section IV, Technical Guide.
- b. Record bench mark; describe and assign elevation, typically mean sea level.

Where reservoir storage volume is considered in the design of the open channel, refer to the user's manual for the SITES computer program, other approved design computer programs, or North Dakota Hydrology Manual, Appendix C.

The following steps shall be followed for the design of open channels where capacity is based on peak inflow (i.e., reservoir storage volume is not considered).

1. Delineate and measure drainage area on USGS Quad map, aerial photo, or other suitable map.
2. Determine runoff curve number (CN) Use Forms ND-ENG-12 or ND-ENG-31 for computations. Specific References:
  - 1) Hydrology Manual for ND, Ch. 2-3
  - 2) EFM, Chapter 2
  - 3) NDSEFM, Chapter 2
3. Determine average watershed slope and flow length from USGS Quad maps or field measurements. Specific References:
  - 1) ND Hydrology Manual, Chapter 5
  - 2) EFM, Chapter 2
4. Determine required design frequencies.  
Specific References:
  - 1) ND Hydrology Manual, Chapter 1, Table 1-7
  - 2) NDSEFM, Chapter 2, Table 2-2
  - 3) Technical Release #25

5. Determine required 24 hr. rainfall depths.  
Specific References: 1) ND Hydrology Manual, Fig.1-2 thru 1-8  
2) NDSEFM, Chapter 2, Table 2-3
6. Determine the required peak discharge rates by the procedures outlined on Forms ND-ENG-8 or ND-ENG-31 or other.  
Specific References: 1) ND Hydrology Manual, Chapter 5  
2) EFM, Chapter 2  
3) NDSEFM, Chapter 2
7. Size the required channel size to pass the design discharge. The velocity in the channel shall not exceed the permissible velocity for the soil and cover types described in Technical Release #25.  
Specific References: 1) Technical Release #25

Record all pertinent data.

#### V. Material and Construction Requirements

At least 3 sets of drawings and specifications will be prepared and distributed to the cooperator, contractor, and NRCS cooperator's file. Site specific drawings and other approved drawings will be used. In addition to drawings and specifications, the cooperator will be provided an O&M Plan.

Items to be included on the drawings:

- a. Location map showing structures, profiles, typical cross sections, borrow and disposal areas, work limits, utilities, and any other necessary information (as needed).
- b. Typical cross sections of structures or embankments (road crossings, etc) showing (typical):
  1. Embankment top width, side slopes, berms, overfill requirements, elevations
  2. Foundation stripping requirements
  3. Cutoff trench bottom width and side slopes
  4. Layout of the drop structures, pipe drops, culverts if space permits. Otherwise, a separate detail of the layout is required, as applicable.
- c. Profile along centerline of the channel, structures or embankments showing:
  1. Original ground line and stationing
  2. Soils logs and groundwater
  3. Locations, elevations, and dimensions of drop structures, pipe drops, culverts
  4. Settled top and any overfill (allowance for settlement)
  5. Requirements for overexcavation and replacement with topsoil
- d. Structural component drawings, descriptions shall include:
  1. Details
    - (a) Type (drop/riser, hood, weir box, etc.)
    - (b) Material (corrugated metal, concrete, plastic, etc.)
    - (c) Dimensions (diameter, height, stub locations, material thickness)
    - (d) Special coatings (polymer coated pipe)
    - (e) Footing/riser base (material, dimensions)
    - (f) Details of pipe(s), culverts
    - (g) Cathodic protection when needed

- e. Construction notes - The drawings will include all notes necessary to clarify construction and material requirements for the job.
- f. Quantities - Estimated quantities based on field surveys and design layout shall be shown on the drawings. All quantities shall be checked by another person.
- g. Job approval - Drawings shall be signed by the designer, checker, and person with required job approval authority (NRCS personnel).
- h. Specifications - Construction and material specifications shall be prepared for all open channels. North Dakota Handbook of Construction and Material Specifications for Conservation Practices or National Engineering Handbook, Section 20, shall be used for more complex sites.
- i. Assist the landowner in completing applications for required State and Federal permits (water rights, 404, etc.).

#### VI. Layout and Installation Procedures

Layout surveys will be recorded in loose-leaf or bound survey books. Survey notes will be kept in the format shown in the Engineering Field Manual, Chapter 1, and Technical Release 62. Centerline and slope stakes will be set for the open channel and structures as needed for construction. Electronic survey notes will be documented in a format to allow complete checking by others.

#### VII. Checkout

Refer to the Engineering Field Manual, Chapter 17, and NEH-19 for guidance on methods of inspection and testing. NEH-19 contains inspection checklists covering all major items of work. Records of all materials and testing will be placed in the cooperator's file. As a minimum, as-built measurements should include:

- a. Channel centerline profile
  - 1. Cross sections as needed (cross sections every 300 ft. as a minimum).
- b. Structures (drop structures, culverts)
  - 1. Location (station)
  - 2. Inlet and outlet elevations
  - 3. Lengths and dimensions as needed. Measurements may include structural items such as weir length and elevations, depth of drop, length of sidewalls and wingwalls, pipe elevations, diameters, etc.
  - 4. Embankment centerline profile, cross sections as needed (at least one)
- c. Miscellaneous
  - 1. Topsoil (area and depth)
  - 2. Seeding (area, species, etc.)
  - 3. Fencing (length, type, post spacing, etc.)

Record as-built measurements and quantities on appropriate drawings. Record statement of compliance on "as-built" plans - that construction is complete according to plans and specifications, and adequacy or status of vegetation and topsoil placement. Date and sign by individual making determination.