DOCUMENTATION REQUIREMENTS
Spring Development - 574

I. Reference Materials

The following is a partial list of reference materials that might be used in spring development design and construction.

a. North Dakota Technical Guide, Section IV, Practice Standards 574, 516, and 614
b. Engineering Field Manual, Chapter 3 and 12
c. North Dakota Handbook of Construction and Material Specifications for Conservation Practices
d. Supplement to Engineering Field Manual, Chapter 3, (Hydraulics)
e. ASTM and AWWA Standards
f. King's Handbook
g. ACI Building Code
h. National Range Handbook, Section 803.3, Livestock Water Facilities
i. Suitable Computer Software:

Ohio Program (e.g. Hydraulics)
Excel Spreadsheet Yardage (e.g. ND-ENG-1e)
Pipeline Design (e.g. PipeDesign, Agpipe)

II. Site Investigation/Data Collection

The following is a list of items to be checked in the field to ensure a viable site.

a. Check for buried or overhead utilities or other hazards. Use ND ONE-CALL.
b. Is the site accessible by construction equipment, or do roads to the site or working platforms need to be built and figured in the cost of the project?
c. If the site has to be cleared and grubbed, where will the debris be placed or buried?
d. Does the site require intense investigation? (e.g. Wetland, Cultural, Endangered)
e. Determine approximate flow of the spring area. This can be done by several simple methods.
    1. Container method - Excavate a trench by shovel to an overflow area where the flows can be caught in a container. Determine the volume of the container and measure the time to fill.
    2. Channel method - Where water is flowing in a small uniform channel, the flow can be determined by measuring the velocity and the cross-sectional area of the channel. Measure the velocity by timing a small floating object to travel a predetermined distance. Measure the average cross-sectional area of flow in square feet. Calculate the flow rate from the following formula:

$$Q = 448.8 \sqrt{A}$$

where: Q = Flow in GPM
V = Velocity in ft./sec.
A = Area in square feet

    3. Weir method - Chapter 3 of the Engineering Field Manual describes several methods of measuring flows with weirs.

f. Take soil boring samples along the collection trench to locate water bearing stratum, impermeable layers and geologic formation producing the spring. Record data on ND-ENG-41e, Log Sheet for Earth Borings.

g. Determine the proposed locations of the collection trench, spring box, tank, and end of outflow pipe. Run preliminary survey to check adequacy of grades for the system.

h. Determine the volume of livestock and other water needs.

If any of the above steps rule the site unacceptable, inform the cooperator and look for a different site or alternative (stock pond, well, dam, pipeline, etc.)

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 I, Engineering Field Manual. Electronic survey notes will be documented in a format that allows complete checking by others.

b. The surveyor will use sound professional judgement in gathering information for the design and construction of the spring development. Information will be used to determine collector, spring box, outlet pipeline grades and estimated quantities.

(1) Establish a bench mark(s) in a location that will not be destroyed.

(2) Determine the elevations and locations of soil borings and present water table levels.

(3) Survey ground profiles of collection pipe trench, outflow pipe trench, and overflow pipe trench locations. Additional surveys may be required on a site by site basis.

(4) Determine the ground elevation at the proposed tank site.

IV. Design Plans and Specifications

The design of a spring development will be in accordance with Standard and Specification 574, Spring Development -Section IV, Technical Guide.

The steps in the design are as follows:

a. Complete the plan view of spring development on appropriate sized sheets; grid, clear, or plan/profile.

b. Plot profiles of the collection trench, outflow pipe trench, tank and overflow pipe trench on the appropriate sheets.

c. Locate water table elevations, impermeable and water bearing stratum elevations on the profiles.

d. Set bottom elevation of collection trench relative to the water table and the impermeable layers to ensure proper flow into the collection line.

e. When a perforated pipe is used for the collection line, it should be a minimum of 4" in diameter. The pipe shall be laid with the bell facing upstream and with the perforations on the bottom of each pipe section.

f. If sediments are expected from the collection drain, a spring box may be used. Place bottom of spring box a minimum of 6" below both the inflow and outflow pipe openings.

g. Draw the proposed grade of the collection pipe (collection drain to spring box), spring box, the proposed outflow pipe (spring box to tank), the tank and the overflow pipe. Set the water elevation in the tank 3" below the top of the tank. Determine the grade of the outflow pipe and the head on the outflow pipe. The size of the outflow pipe can then be determined either by using the minimum sizes based on grades in the practice standard, or by following the example shown in the Engineering Field Manual, page 12-15, figure 12-11, using exhibit 12-1 on pages 12-43 through 12-45. The pipe shall not be sized less than the minimums shown in Standard 574 unless analyzed by an Engineer.

h. The size of the overflow pipe may be determined in the same manner as the outflow pipe. Chart 1, exhibit 12-1, Engineering Field Manual, can be used to determine entrance head losses for the overflow pipe when required. The entrance head loss is subtracted from the water surface elevation in the tank to arrive at the maximum entrance elevation of the overflow pipe.

i. If the outflow and overflow pipes cannot be placed deep enough to prevent freezing, other means such as bypass lines, drains, valves, insulating, steep grades, etc., may be needed to prevent freezing.

If the spring is to be used in the winter, the following should be considered:

Place the outflow and overflow pipes deep enough to prevent freezing. Other means such as bypass lines, drains, valves, insulating, or steepness of grade, should be considered to prevent freezing. Consideration should be given to keep the pipe from freezing, even if the spring will not have winter use, to prevent broken pipe and connections.

j. Consider a valve to control inflow to tanks on high output springs.

k. Complete ND-ENG-20e - Spring Development Data Sheet. Computer printout showing all input and output, is required, if used.

l. Determine all earth work, material, and seeding quantities. The volume of work in cubic yards will be determined by the method of average cross sectional end area or trenching on the per foot basis, dependent on the project complexity. These computations will be shown, or computer printout of all input and output.

m. Job approval (NRCS personnel) and signature is required.

V. Material and Construction Requirements

The cooperator, cooperator's file, and the contractor will be provided a set of plans and specifications for the spring development construction. The plans can be drawn on appropriately sized sheets. The plans should contain, as a minimum, the following:

a. Overall plan view showing all stationing and identifying all key components of the spring development.

b. Profiles of the original ground lines of the proposed collection trench, outflow line, and the overflow line. Superimposed on those profiles will be the design grades of the collection line, outflow line, overflow line, and tank. Also superimposed on the profiles will be the spring box, if used.

c. Details of the spring box and tank showing inlet and outlet pipes.

d. Other details such as bypass line connections, drains, insulation, etc.

e. Construction notes - Sufficient notes should be provided on the plans to clarify details or furnish direction in construction of the spring development.

f. Estimated quantities.

g. Job approval.

Construction specifications are to be provided with each set of plans. The North Dakota Construction and Material Specification for Conservation Practices shall be used for each item of work and materials, as applicable or available. Additional specifications may need to be written to provide full material and installation instructions. A cover sheet and list of specifications is to be provided with the specifications.

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. Electronic survey notes will be documented in a format to allow complete checking by others.

Record the following minimum information:

a. Cut stakes will be set at suitable intervals for grade control on all pipe trenches to be installed.

b. Reference stakes should be set at spring box and tank locations indicating bottom elevations and the inlet and outlet pipe elevations.

c. Centerline and slope stakes will be set for structural excavations.

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.

a. Compliance checking - record in field notes

1. Inspect all pipelines all suitable intervals before the trenches are backfilled. If high spots are found, they will be lowered to grade before backfilling.

2. Record the following shots and elevations:
   (a) Top and bottom elevations of the spring box
   (b) Collection pipe invert at the spring box
   (c) Outflow pipe invert at the spring box
   (d) Water elevation in the spring box

3. Measure and record all material type, lengths, and diameters. Document certifications on materials such as pipe.

4. Check all quantities.

5. Statement of compliance on "as-built" plans - state the construction is completed according to plans and specifications. Date and sign by individual making the determinations.

b. "As-Built" Plans

"As-Built" plans are a record of constructed facilities. Changes from the design are to be superimposed in another color on the official file copy of the plans. On the "as-built" plans show:

1. Significant design changes
2. Significant changes in linear measurements
3. Final quantities
4. Identify "as-built" on plans