

Instructions

Variable Flow Tail Water Recovery System Data Sheet

NE-ENG-84

Instructions for use of NE-ENG-84

This form is to be used for the design and documentation and of variable flow tail water recovery systems. Instruction on the use of this form can be found in the National Irrigation Guide (NIG) Chapter 7 within the Nebraska Supplements (Part 652.0710). Blank forms are located in the National Irrigation Guide in Chapter 15.

1. Fill in landowner/operator's name, address, phone number, and legal description. Is the owner/operator interested in cost share?
2. Complete existing field/water supply information.
 - a. Is there an existing pit that will be filled in and be replaced by the VFTWRS? This may effect decision on placement of the inlet.
 - b. Are there wetlands on the farm or near the site of the VFTWRS. If so, the designer needs to insure the VFTWRS does not drain the wetland unless it is part of a wetland/wildlife plan and approved by the appropriate regulatory agencies.
 - c. List availability of electricity to the site or will electricity have to be installed. List voltage and phase. Single phase, 110 volt, pumps are available.
 - d. Enter the information on water source delivery to the field. If information is unknown or does not apply, leave spaces blank. List operating pressure for pumped well system or delivery head for surface water supply if known. This information will be used if the return flow is pumped back into the mainline. Note if information is from a known measurement or estimated.
 - e. Enter critical field elevations for design purposes.
3. Complete the appropriate system layout information.
 - a. Plot plan view and profile layout of VFTWRS and return pipeline. Note and label the following: field(s) that water will be delivered to, field(s) from which runoff is received along with well or water delivery point location, return pipeline location and size, mainline location and size, VFTWRS location, and other information as needed.
 - b. Complete information on where and how runoff tail water is to be used and area to be irrigated. If VFTWRS will deliver to more than one location, make entries and note the fields.
 - c. Complete return pipeline information. If more than one pipeline is used, show all lines and document hydraulically most limiting case (requires the greatest pressure for the given flow capacity). This information will be used to determine pump size and horsepower requirements.
4. Complete the appropriate design elevation/information.
 - a. Top elevation should be set to insure that pump and motors do not become inundated from rainstorm events (minimum 10-year flood event, 25-year flood recommended). Document overflow, culvert, road, etc. elevation to show that this criteria is being met.
 - b. Recommended location of bottom slots/mesh elevation is 0.5 to 1.0 feet lower than field drain invert elevation. If there are other limitations, e.g. wetland water surface requirement, set intake to maintain required water surface.
 - c. Compute VFTWRS bottom elevation.
 - d. If irrigation erosion is expected, a silt trap may be needed. List silt trap bottom elevation (if needed). A separate plan and/or design sheet may be needed to document the layout of the excavated silt trap.

5. Document method used to determine VFTWRS pump capacity. If more than one water source delivers water to the site simultaneously, an accumulative flow rate should be used in determining the VFTWRS pump capacity. Minimum capacity recommended for the VFTWRS is 300 gpm.
6. Document inlet suction pipe size and wall thickness to be used.
7. Compute total dynamic head requirements for the proposed pump capacity.
 - a. Examples of minimum operating pressure at the return pipeline outlet would include: pressure to operate outlet distribution system, e.g. gated pipe at the design flow rate; pressure of mainline at return pipeline connection location (if connected) with mainline flowing and normal flow rate pressure conditions; or no pressure if the outlet free flows into a channel or structure open to the atmosphere.
 - b. Friction loss and minor losses shall be computed from a design or analysis of the return pipeline.
 - c. Elevation differences will be measured to the elevation of the center of the pump. Elevation difference is positive (+) if uphill or negative (-) if downhill.
 - d. Vertical Suction Lift – elevation difference between the pump elevation and low level water surface.
 - e. Friction and minor losses in pump column. See Charts “Suction Intake Pipe Losses” behind these instructions.
 - f. Plot the required system hydraulic grade line on the pipe profile.
8. Compute Net Positive Suction Head Available (NPSH_{available}).
 - ◆ NPSH_{available} is the pressure available at the pump suction to push the fluid into the pump. For a water source below the pump, the NPSH_{available} is equal to the atmospheric pressure minus static lift minus friction losses in the suction pipe minus the vapor pressure of the water. NPSH_{available} is dependent on the system layout and must always be equal to or larger than the Net Positive Suction Head Required (NPSH_{required}.)
 - ◆ The NPSH_{required} is the loss from the suction connection to the point in the pump at which energy is added, generally through the impeller vanes. It is determined by testing and is dependent on pump design, pump size, and operating conditions. NPSH_{required} can be obtained from the pump characteristic curves.
 - a. Determine atmospheric pressure for the given mean sea level elevation from the charts.
 - b. Vertical suction lift, friction, and minor losses in the pump column same as above.
 - c. Determine vapor pressure for the given water temperature. If temperature unknown, use 75 degrees Fahrenheit.
 - d. Use factor of safety in determining NPSH_{available}. Recommend 2 feet minimum.
9. Determine Net Positive Suction Head Required from the pump characteristic curves. NPSH_{available} must always be equal to or larger than the Net Positive Suction Head Required NPSH_{required}. If not, select a different pump or inlet suction pipe until the requirement is satisfied.
10. Compute brake horsepower for computed total dynamic head (TDH) for the required flow rate.
 - a. $Eff = \text{pump efficiency} \times \text{drive efficiency}$. Use pump characteristic curve to derive the pump efficiency. Attach copy of pump curve to documentation. Assume direct drive connection from electric motor to pump (100% drive efficiency).
 - b. If pump curve is unavailable, use a value between 65% to 75%. Compare assumed efficiency to the manufacturer-supplied pump when pump curve is obtained. See pages NE7-64 thru NE7-66 for Aermotor Pump Curves.
11. Compute motor horsepower requirement.
 - a. For electric motor sizes from 5 to 250 hp, the motor efficiencies vary from 83% to 94%. If pump efficiency is unknown, use 88% motor efficiency.
 - b. Ensure that for the maximum probable flow rate, the rated motor horsepower is not exceeded by the “computed” system required horsepower.
12. Appurtenances
 - a. Fill in needed appurtenances for the VFTWRS and/or return pipeline and/or distribution system. Appurtenances needed and documented should include pump and motor, pressure relief valve, combination valve, totalizing flow measurement device, and others as needed.

13. Comments. This section is for any other comments that may be pertinent to the project.

Support References

NEH – Part 652 National Irrigation Guide

<http://www.wsi.nrcs.usda.gov/products/W2Q/downloads/Irrigation/National%20Irrigation%20Guide.pdf>

NE Supplements

http://efotg.nrcs.usda.gov/references/public/NE/NE_Irrig_Guide_Index.pdf

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