

**October, 2013****USDA Natural Resources Conservation Service (NRCS)**

Landowner \_\_\_\_\_

**Sound water management begins with knowing flow rates and volumes.****WHY MEASURE?**

Accurately measuring irrigation flow rates is integral to proper irrigation water management. The flow rate not only defines hardware features such as pumping plant efficiency and pipeline sizes, but also establishes such management criteria as timing of irrigation sets, irrigation frequency, and return intervals. When incorporated into an overall irrigation water management plan, water losses are kept to a minimum.

**WHEN TO MEASURE?**

Ideally, flow rate should be checked every time irrigation water is applied to a field. This is only feasible with a permanently installed flow meter. Pump discharge can fluctuate due to a variety of circumstances. Changes in aquifer water levels during an irrigation water application and throughout the irrigation season can have a severe impact on flow rates. Changes in motor speed for internal combustion engines used to drive pumping plants will also change flows. Fluctuating flow rates may also be an indication of problems with pumping plant or drive motor.

As a minimum, flow rates should be checked at the beginning of the irrigation season and at least once during the season. Checks should be made under full operating conditions where practical.

**TYPES OF FLOWMETERS**

There are many types of commercial flow meters available for water measurement. The specific type chosen will depend on the individual's needs and goals as well as the type of delivery system on which the flow meter will be used. Where pipelines are used as the delivery system, the most common type of flow meter is a propeller type that is permanently

installed. Portable propeller type units are also available for periodic flow rate checks. However, this requires that the delivery system be disassembled for the installation of the meter. A non-intrusive ultrasonic type flow meter is now available for making instantaneous flow measurements under operating conditions.

**PERMANENT INSTALLATIONS**

This job sheet is not intended to restrict users to any particular style, configuration, or manufacturer; however, meters of all types shall meet the requirements below. A list of approved models can be found on the Oklahoma Pre-Approved Structures, Components, and Appurtenances list found in Section IV of the Field Office Technical Guide.

1. Accuracy – The water meter shall be calibrated at the factory and shall be warranted to register within  $\pm$  5 percent of the actual volume of water passing the meter. This requirement shall be met throughout the normal operating range of the meter.
2. Meter Body – The meter body shall be durable, of sound construction, and of suitable strength and rigidity to maintain its shape and integrity under all normal field conditions. The style of meter shall be suitable for the flow conditions anticipated. Propeller type meters are preferred when water is clean and free of debris. Where metals are used that are subject to rust or corrosion (cast iron, steel, etc.), the entire meter body surface shall be protected with an impervious coating applied by the manufacturer. The meter size, serial number, and direction of flow shall be clearly stamped on the body of the meter. The inside pipe diameter for which the meter has been calibrated shall be clearly shown on the meter to the nearest one-thousandth (0.001) of an inch.

3. Register and Indicator – The meter shall be equipped to provide direct totalizing and rate of flow and be tamper resistant. The totalizing register shall provide direct readings in acre-feet, acre-inches, or gallons. The rate of flow indicator shall be either a direct display of rate of flow in gallons per minute or a center sweep hand indicating acre-feet, acre-inches, or gallons per revolution. Where applicable, the dial face shall clearly indicate the units measured. The register assembly shall be designed to be interchangeable in the field without altering the accuracy of the meter.

4. Installation – The meter shall be installed according to the manufacturer's recommendations and in such a manner to insure full pipe flow at all times while water is being pumped. Full pipe flow may be obtained by using butterfly valves or by raising the pipe beyond the meter to a point above the level of the water. Unless otherwise specified by the manufacturer, the meter shall be placed in a section of line free from obstructions such as valves or elbow for a length of at least 10 pipe diameters upstream and 5 pipe diameters downstream.

#### Propeller Meters

In addition to the basic requirements for all water meters, propeller type meters shall meet the following criteria:

The propeller shall be constructed from corrosion resistant material (plastic, stainless steel, etc.) of a rigid but resilient nature. The diameter of the propeller shall be no less than one-half the diameter of the pipe in which the meter is installed. The propeller shall be mounted on a non-corrosive shaft and with a bearing assembly designed to withstand all shocks and thrusts which can reasonably be expected in the proposed use. The propeller and bearing assembly shall be designed to prevent sand and entrained debris from adversely affecting the operation and accuracy of the meter.

#### **ULTRA-SONIC FLOWMETERS**

This type of meter uses sound waves to determine the velocity of the flowing liquid. From the velocity, the flow rate is determined based on the pipeline characteristics (size, material, and wall thickness). Ultra-sonic flow meters are ideal for making instantaneous checks of wells under operating conditions and many systems can be evaluated in a relatively short period of time. However, they are

limited when it comes to long duration use or total volume measurements. The ultra-sonic type flow meter is also a great tool for checking the accuracy of permanently installed meters. Checks of permanently installed meters are recommended at least annually.

#### **WHAT TO DO WITH FLOW MEASUREMENTS**

Basic irrigation water management begins with knowing four key items: (1) area to be irrigated, (2) depth of water to apply, (3) time of system operation, and (4) flow rate. The relationship is:

$$QT = DA$$

where:

Q = flow rate in cubic feet per second

T = time in hours

D = depth in inches

A = area in acres

Accurately knowing the flow rate (Q), the time (T) of an irrigation set can be adjusted to apply the appropriate depth (D) over the desired area (A). Similarly, the area or depth could be varied to match a particular irrigation time-set for a particular flow rate. Of course adjustments in depths are needed due to inherent inefficiencies of the delivery or application system.

Accurate flow rates are also valuable in the design of the most efficient irrigation system. Properly sized delivery components and properly designed application systems will not only save water but also energy and money.

#### **FOR ADDITIONAL ASSISTANCE**

Contact your local NRCS or conservation district office for additional information relating to flow measurement, detailed irrigation designs, and irrigation scheduling.

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