Irrigation Training Toolbox
Water Management

Measuring The Flow From The Water Source

National Employee Development Center
Natural Resources Conservation Service
Fort Worth, Texas
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LESSON PLAN

COURSE:	IRRIGATION WATER MANAGEMENT
LESSON:	Measuring the Flow from the Water Source
DEVELOPED BY:	Steve Moran
OBJECTIVE:	Participants will: Be acquainted with the various methods of determining the water flow that is available for irrigation.
REFERENCES:	
TRAINING AIDS:	Overheads and blackboard
ARRANGEMENTS:	Overhead projector, screen and blackboard
TIME REQUIRED:	2 Hours

This portion of the program will deal with measuring irrigation water, the variability of the information and various methods of measurement.

Overhead #8
Not Available

How we measure water being delivered to the f field may depend on the source of the water.

The accuracy of the information about the volume of water delivered will vary with the method.

Irrigation water measurement can be achieved two ways.

Instantaneous measurement is a measure of the water being pumped at the time of measurement. Any change in the amount of water being delivered through the season or from year to year will not be known! Later in the class you will learn how 25% variation can affect conclusions and calculations.

Even if the irrigator can tell you his well surges or drops off- By how much? It's a guess and credible recommendation can not come from guess work.

The only option if the discharge fluctuates and your are using instantaneous measurements is to measure the source several times during the season and each year until a pattern can be established.

Overhead #9
Not Available

Cumulative Measurement is a continuous measure of the volume of water pumped. A flowmeter with a 'totalizer' provides a running account of the water that has been pumped. The variability of the source water can be determined with the flowmeter also.

While the cumulative measurement is the best way to measure the "What's going in!" part of our management, not all irrigators are receptive to having an instrument which can tell 'anyone' how much water they pumped - we'll talk about this later.

The instantaneous method may be the only one available.

It is important to know the problems associated with depending on instantaneous readings for seasonal water management.

It's a little like looking at one months salary check stubs to determine annual income. If the income is steady the method is fine, if the income varies with seasons, weather patterns, or whatever - the method won't be very accurate.

Overhead #11
Not Available

Some factors which influence the variability of water delivery are- For surface systems delivering water from canals - How dependable is the water surface elevation in the canal?? New systems can be pretty steady - Older systems can be poor depending on how weed maintenance and silt removal has been done and when.

Where is the user on the system? If they are at the top they may be in good shape for having water delivered. If they're at the tail end - it may be hit and miss.

Is the canal system water source dependable? Is the water allocation limited? This can greatly affect how water should be managed.

Need for advance notice for requesting water.

For irrigation water from a pumped source, the variability can be affected by, the drawdown depth of the aquifer-the lower the elevation of the aquifer, the less water pumped. How much water can the aquifer deliver to the pump? If the pump extracts more water then the aquifer can supply, the pump will surge (pump air) until the aquifer catches up.

If the water being extracted in the 'region' by other wells exceeds the aquifer capacity, the aquifer will be depleted and well capacities reduced.

As a well ages the casings can become plugged and deliver less water to the well.

Always keep in mind that recommendations for improving water management should be based on factual information. If vague information is used to make specific recommendations, how credible are the recommendations?

Could you make specific home budget changes without some pretty concrete information about the household income? When we make specific recommendations to an irrigator using vague information, is he translating that to economic risk?

Overhead #12
Not Available

The next discussion will relate to specific methods to measure water delivered to a field.

Well Driller's Estimate

Overhead #13
Not Available

Probably the most often used and least dependable sources of information.

The probability of accuracy for this method varies with the use of the well- what has happened to the well and surrounding area since the well was drilled.
Age of driller - how experienced was the driller in measuring wells.
Method - how was measurement done? Opinion? Expectations? Meter?
Reason - was well measured to assure quality of installation, relationship to land-owner's expectations, etc.
Type of measurement? Instantaneous
Degree of accuracy expected? Extremely variable

Overhead #14
Not Available

Collin Gage: A method to measure the velocity of water in a pipe. The pipe must be 'flowing' full so accurate calculations can be made. Water must not be turbulent and pipe identification must be accurate.

Overhead #15
Not Available

Type of measurement? Instantaneous
Degree of accuracy expected? High

Overhead #16
Not Available

Sonic Meter: A tool which determines the velocity of water in a pipe by bouncing sound waves off the water moving in the pipe.

Must have full pipe flow
Must know identification of pipe
Must have nonturbulent flow
Type of measurement? Instantaneous
Degree of accuracy expected? High

Discussion how NRD's are using electric hour meter or engine hour meter to calculate total pumping time and using instant measurement calculate total water pumped.

Many irrigation systems in Nebraska do not distribute the water to the field with pipes- it is done with open ditches. While the percentage of this type delivery system is decreasing, we will look at the measurement methods because the potential for management improvement with these systems is large.

Overhead #17 & handout
Not Available

Open pipe horizontal discharge
Ditch delivery systems for water from a pumped source will probably have a open well discharge
This mathematical calculation for capacity can be performed after measuring x and y distance.

Must know pipe diameter
Must have open discharge
Must measure x and y distance

Type of measurement? Intantaneous
Degree of accuracy expected? Moderate-High

(example calculation?)
x= 3.2 y=2.5 d=8" 67 ft

$$Q = \frac{\pi \ .67^2}{4} \left(3.2 \div \frac{5}{32.2}\right)^{.5}$$

Weirs: Measurement of water in open ditch situations is accomplished with weirs.

Irrigation turnouts for canal water have weirs and depth measuring staffs built into the turnout facility. The gate delivering water is adjusted until the weir measures the required volume.

Overhead #19
Not Available

The top sketch shows where the water is measured- if the upstream water surface is variable, the deliver and measurement is also variable.

If the ditch delivery systems has permanent installations, diversion boxes, drops to lower the water to a lower field, concrete ditch, road crossings (culverts) etc.- a weir could be installed permanently.

Otherwise the weir would be a temporary installation.

Review narrative about weirs

Overhead #20

Not Available

Broad Crested Weirs

A broad crested weir is another example of a permanent installation which could measure the flow rate in an open ditch.

Type of measurement with weirs?

Instantaneous

Degree of accuracy if installed properly!

High

Degree of accuracy if not installed properly!

Low-none

It is possible to measure the water delivered to the field by measuring the amount of water delivered to each furrow.

Overhead #21

Not Available

If the system uses open ditches and siphon tubes, the siphon tube discharge can be calculated using the diameter of the siphon tube and difference in elevation between the water surface in the ditch and either the outlet of the tube or the water surface in the furrow.

Another option for measuring furrow flow rates is with furrow flumes.

FLOWMETER

A flowmeter is the only cumulative and instantaneous tool which we have to measure water delivery.

Overhead #22
Not Available

Components:

- Propeller - measures velocity
- Totalizer - cumulates flow
- Vanes

Overhead #23
Not Available

Requirements:

- Full pipe flow
- Non turbulent flow
- Pipe diameter known
- Installed properly

The overhead illustrates where a flowmeter must be installed relative to upstream and downstream elbows and/or reducers. If these guidelines are not followed, the accuracy of the readings are suspect.

Even though flowmeters can be an accurate tool to measure both instantaneous rate and cumulative volume, there is some resistance to using them. The hesitation comes from both irrigators and regulating agencies. Some of the reasons for this hesitation: Irrigators fear they will be taxed on their water conservation. Measurement is first step in process. It has moving parts and will break route maintenance required.

Use the totalizer and your watch to determine flowrate - totalizer is gear driven, needle is magnetic - Do not always treat needle.

The handouts and overhead list the most commonly used units of measurements obtained from other people, it is necessary to know the units and method of measurement.

The units you will be given will most likely

have to be converted to the units you want to use.

For Example: If you were assisting an irrigator to determine how many inches of water where applied to a field, you would determine how much water was being pumped (gpm) for how long (hours) and over how large an area (acres). The handout shows a formula that uses these variables to calculate inches.

The next section of the workshop will deal with water calculations. Surface canal systems deliver water in 'feet'. When a district talks about delivering a foot of water it is 1cfs- .8ft= .8cfs, etc. An irrigation district can talk about inches of water in terms of 'inches over the weir'. Know the units the farmer/irrigator is discussing.