Water Conservation FACTSHEET



Order No. 577.100-10 August 2005

DETERMINING ACTUAL ANNUAL WATER USE OF TRICKLE IRRIGATION SYSTEMS

Knowing the actual annual water use of an irrigation system will help to develop an effective irrigation schedule that meets the climate, crop and soil requirements. Some irrigation licences may state a water withdrawal rate; therefore, the actual annual water use must not exceed the licensed amount. The annual water use is based on peak flow rate and annual crop water requirement which vary depending on:

- 1. crop type
- 2. soil type
- 3. rooting depth
- 4. irrigation system efficiency
- 5. climate and field elevation that determine peak ET rates (farms at the bottom of the valleys have higher peak ET rates than those in the same area but at a higher elevation)

The pump curve can be used to estimate the irrigation system flow rate by using the impellor diameter, the number of revolutions per minute (rpm) of the pump, and the system operating pressure. This method is most reliable for pumps that have a steeper pump curve. Contact your pump supplier for pump curve information. It is a good idea to confirm the pump flow rate determined from a pump curve with one of the other methodologies whenever possible.

The **trickle system output flow rate** can be determined using the emitter flow rate and the number of emitters. For farms using more than one type of emitter for different crops or zones, use the zone with the highest flow rate.

Step 1 Actual Peak Flow Rate

The actual system flow rate can be determined using meters, water purveyor restrictions, pump information or sprinkler nozzle output.

A water meter installed on the irrigation system can be used to determine the system flow rate by measuring the amount of water that passes through the meter during a given time period.

Water purveyors supplying irrigation water often allocate a flow rate of the farm based on acreage. Most often, these flow rates are regulated using flow control valves. Contact your water purveyor to find out how much water you are allowed to take if you are on municipal system or an irrigation district.

Step 2 Calculated Annual Water Use

The calculated annual water use is determined using an estimated value of crop water requirements (Table 1) and irrigation system efficiency factors (Table 2). The estimated annual crop water requirement values in Table 1 are based on data collected over the last 40 years. It is accepted that some years are wetter or drier than others and therefore annual water use varies. Regardless, farmers using a well or other water source should adhere to the calculated annual water requirement figures, and should have the annual withdrawal rate stay within the licensed amount.

Table 1 Estimated Annual Crop Water Requirements for B.C. Locations with Average (3 in or 7.5 cm) Maximum Soil Water Deficit

Location	Water		Location	Water		Location	Water	
Location	[in]	[mm]	Location	[in]	[mm]	Location	[in]	[mm]
Abbotsford	9	220	Golden	11	274	Oliver	24	622
Agassiz	4	109	Grand Forks	11	274	100 Mile House	17	439
Alexis Creek	11	274	Grandview Flats	18	457	Osoyoos	25	640
Armstrong	12	311	Grasmere	13	329	Oyster River	6	165
Ashcroft	25	640	Grindrod	7	183	Parksville	10	256
Aspen Grove	13	329	Hazelton	2	55	Pitt Meadows	6	146
Barriere	13	329	Hixon	6	165	Port Alberni	12	292
Baynes Lake	17	420	Норе	9	238	Prince George	10	256
Campbell River	10	256	Invermere	17	439	Princeton	18	457
Canal Flats	14	366	Kamloops	23	585	Quesnel	9	238
Castlegar	21	531	Kelowna	19	475	Radium	12	311
Cawston	25	640	Keremeos	23	585	Riske Creek	16	402
Chase	15	384	Kersley	9	238	Saanichton	10	256
Cherryville	14	348	Kettle Valley	18	457	Salmon Arm	13	329
Chilliwack	5	128	Kimberley	17	439	Smithers	9	220
Clinton	17	439	Ladner	8	201	Spillimacheen	14	348
Cloverdale	7	183	Langley	6	165	Sumas	6	165
Comox	12	292	Lillooet	19	494	Summerland	19	494
Creston	16	402	Lister	16	402	Terrace	9	220
Dawson Creek	7	183	Lumby	15	384	Vancouver	11	274
Douglas Lake	16	402	Lytton	25	640	Vanderhoof	8	201
Duncan	9	220	Malakwa	9	220	Vernon	16	402
Ellison	17	420	Merritt	21	531	Walhachin	20	512
Fort Fraser	8	201	Nanaimo	10	256	Westwold	20	512
Fort Steele	10	256	Natal	10	256	Williams Lake	13	329
Fort St. John	7	183	Notch Hill	14	366			

Note: An irrigation system efficiency needs to be applied to the figures to obtain the gross annual requirements.

Table 2 Application Efficiencies of Irrigation Systems						
Irrigation System Type	Typical Application Efficiency [%]					
Trickle	92					
Drip – Subsurface	95					
Microjet	85					

A **trickle system** irrigates less crop area than a sprinkler system because emitters apply water directly to the root zone. The efficiency of a trickle system is also much higher than that of a sprinkler system which adds to water savings. Table 3 provides factors that can be used to adjust the annual crop water requirement values in Table 1.

Table 3. Crop Adjustment Factors for Trickle Systems						
Crop Type	Adjustment Factor					
Apples, Cherries – Medium Density	0.90					
Apricots, Peaches, Pears – Medium Density	0.80					
Tree Fruits – High Density	1.00					
Grapes	0.70					
Blueberries	0.80					
Raspberries	0.70					
Strawberries	0.75					
Tomatoes	0.90					
Vegetables	0.80					

Step 3 Actual Annual Water Use

The actual annual water use by an irrigation system can be determined using meter data, pumping information or irrigation system operation information.

A water meter provides accurate information on annual water use. Metered systems are usually on municipal or irrigation district water supplies. Trickle irrigation systems often have flow meters to monitor system performance, but these meters do not provide annual data. The meter reading can be converted into annual water use.

The **pump operating hours** may be determined from information on the hydro bill. The amount of energy used can be converted into operating hours and annual water use.

Trickle systems are more efficient than most other irrigation systems. They also operated more frequently than other systems, usually every day or numerous times every week. The annual water use for each zone should be calculated separately, and then added together to determine the total annual use for the irrigation system.

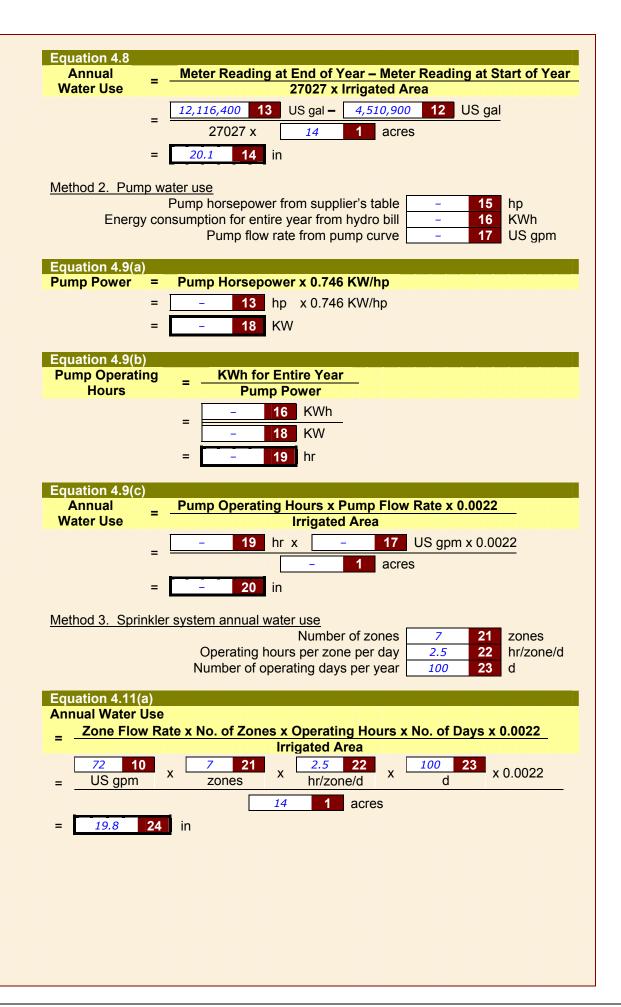
Step 4. Compare Calculated and Actual Annual Water Use

If there is a water licence, do Step 4(a), and then Step 4(b) to double-check. If groundwater is used or water is supplied by a purveyor (i.e., no water licence), follow Step 4(b) only.

- 4(a) To conduct a water licence check, the annual water use calculated in inches must be converted to acre-feet in order to be compared to the licensed volumes. The annual water use in acrefeet should not exceed the amount stated on the water licence.
- **4(b)** Compare the calculated and actual annual water use. The actual value should not exceed the calculated value by 10%. If the farm obtains water from a surface water source under a water licence, the annual use allowed by the licence cannot be exceeded.

An example is shown below on how to determine the actual annual water use for a trickle system. A blank worksheet is provided at the end for self-evaluation.

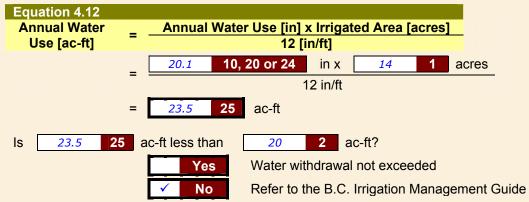
Example 1 Trickle Irrigation in Kelowna Annual Water Use Check - TRICKLE A high density 14-acre apple orchard in Kelowna has a trickle irrigation system with a flow Question: rate of 58 US gpm. The irrigation system consists of seven zones that have similar flow rates. Each zone operates for 2.5 hours per day. The system operates 100 days during the irrigation season. A meter on the system indicates readings of 4,510,900 US gallons at the start of the year, and 12,116,400 US gallons at the end of the year. The water licence states a water withdrawal rate of 20 acre-feet. Does the annual water use meet the licensed amount and/or the calculated annual irrigation water requirement for Kelowna? Information: Irrigated area 14 acres 2 20 Water withdrawal amount on water licence (if applicable) ac-ft 3 Estimated annual crop water requirement from Table 1 19 in Crop adjustment factor from Table 3 1.0 4 Application efficiency from Table 2 92 5 Calculation: Step 1. Determine actual system peak flow rate using one or more of the following methods: Method 1. Water purveyor restriction or measured flow rate using a meter Flow rate measured using a meter or provided by district US gpm 6 Method 2. Pump peak flow rate Irrigation pump peak flow rate from pump curve US gpm Method 3. Determine flow rate using sprinkler nozzles Nozzle flow rate from supplier's tables gph No. of emitters operating at one time 756 emitters Equation 4.4 Trickle System Emitter Flow Rate x No. of Emitters x 0.0167 **Output Flow Rate** = 5.7 gph x *756* emitters x 0.0167 US gpm Determine calculated annual water use. Step 2. Equation 4.7 Crop **Estimated Annual Crop Adjustment Calculated Annual** Water Requirement x 100% **Factor Water Requirement Application Efficiency** in x 1.0 4 x 100% 92 % **11** in 20.7 Step 3. Determine actual annual water use using one or more of the following methods: Method 1. Metered water use Meter reading at start of year US gal 6,089,400 Meter reading at end of year 12,116,400 US gal



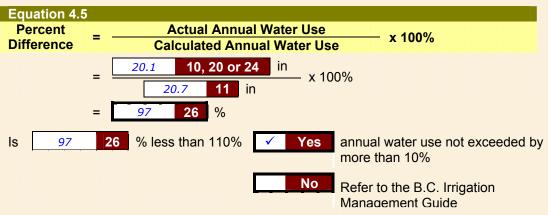
Answer:

If there is a water licence, go to Step 4(a), and do Step 4(b) to double-check. If groundwater is used or water is supplied by a purveyor (no water licence), follow Step 4(b) only.

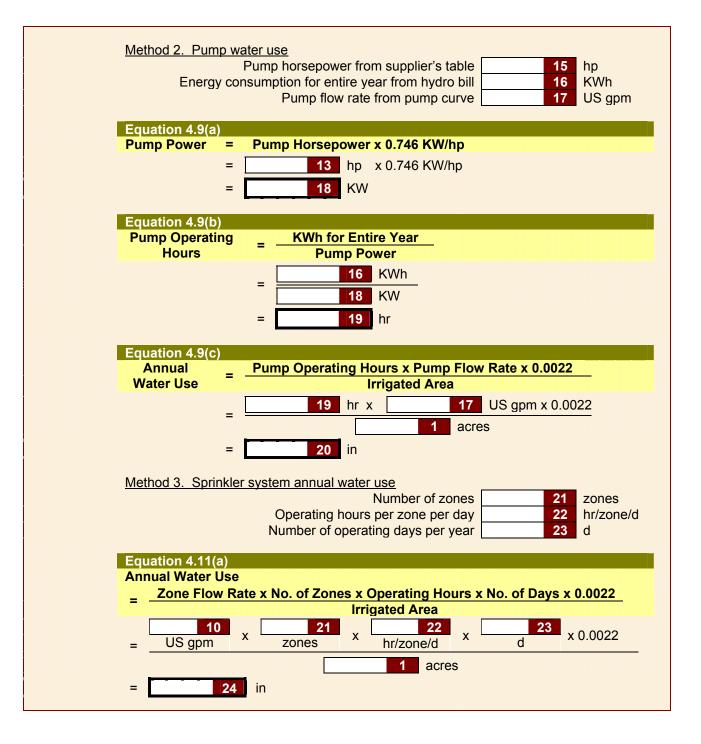
Step 4(a). Calculate the annual water use and compare it with the water licence withdrawal.



Step 4(b). Calculate percent difference of annual water use. Use the metered water use if available because it is the most accurate method.



Annual Water Use Check - TRICKLE Information: Irrigated area acres Water withdrawal amount on water licence (if applicable) 2 ac-ft 3 Estimated annual crop water requirement from Table 1 in Crop adjustment factor from Table 3 4 Application efficiency from Table 2 % 5 Calculation: Determine actual system peak flow rate using one or more of the following methods: Step 1. Method 1. Water purveyor restriction or measured flow rate using a meter Flow rate measured using a meter or provided by district 6 US gpm Method 2. Pump peak flow rate Irrigation pump peak flow rate from pump curve 7 US gpm Method 3. Determine flow rate using sprinkler nozzles Nozzle flow rate from supplier's tables gph No. of emitters operating at one time emitters Equation 4.4 Trickle System Emitter Flow Rate x No. of Emitters x 0.0167 **Output Flow Rate** emitters x 0.0167 gph x US gpm Step 2. Determine calculated annual water use. Equation 4.7 Crop **Estimated Annual Crop Adjustment Calculated Annual** Water Requirement x 100% Water Requirement **Factor Application Efficiency** 3 in x x 100% 5 % 11 in Step 3. Determine actual annual water use using one or more of the following methods: Method 1. Metered water use Meter reading at start of year US gal Meter reading at end of year 13 US gal **Equation 4.8** Annual Meter Reading at End of Year - Meter Reading at Start of Year **Water Use** 27027 x Irrigated Area US gal -12 US gal 27027 x acres 14 in



Answer: If there is a water licence, go to Step 4(a), and do Step 4(b) to double-check. If groundwater is used or water is supplied by a purveyor (no water licence), follow Step 4(b) only. Step 4(a). Calculate the annual water use and compare it with the water licence withdrawal. Equation 4.12 **Annual Water** Annual Water Use [in] x Irrigated Area [acres] Use [ac-ft] 12 [in/ft] 10, 20 or 24 in x acres 12 in/ft 25 ac-ft ls 25 ac-ft less than 2 ac-ft? Water withdrawal not exceeded Yes No Refer to the B.C. Irrigation Management Guide Step 4(b). Calculate percent difference of annual water use. Use the metered water use if available because it is the most accurate method. Equation 4.5 Percent **Actual Annual Water Use** x 100% **Difference Calculated Annual Water Use** 10, 20 or 24 in x 100% 11 in 26 % % less than 110% annual water use not exceeded by ls Yes more than 10%

No

Refer to the B.C. Irrigation Management Guide

Email: Stephanie.Tam@gov.bc.ca

RESOURCE MANAGEMENT BRANCH