2 Peak Flow Rate and Annual Water Requirement

The flow rate potential of a water source should be known or estimated to properly assess whether there is sufficient flow to operate a trickle irrigation system. The water source flow rate will determine:

- the amount of cropped land that can be irrigated
- the maximum zone size that can be operated at one time
- the total run time of the irrigation system.

The maximum operating time for one zone should not exceed 12 hours. This will allow lateral lines to drain during off times which will assist in reducing algae growth. The total system operating time including all zones should not be less than 12 hours and should not exceed 20 hours during peak climatic requirements. Upon design completion if the calculated total operating time is less than 12 hours the flow rates used are higher than they need to be.

Conversely if the total calculated operating time exceeds 20 hours during peak conditions, the area being irrigated may be larger than what can realistically be done. There is a risk that excessive crop stress may develop in subsequent seasons. An allowance must be made for reduced emitter flows over time. A reduction in system flow rate can be made up by increasing the operating time. Initial system designs should take this into account and ensure that at least four hours of extra operating time is available for subsequent years when crops have matured.

For systems that are replaced seasonally, such as line source systems on perennial crops, this is not as much of a concern. For the other system types, if a shortage of water requires system operating times to exceed 20 hours daily during peak conditions a good emitter maintenance program is required to ensure emitters are kept clean and operating properly. Another option is to plant a variety of crops that will allow flexibility in watering schedules.

Make sure that a complete system design is done to assess water availability.

This Chapter provides a methodology of determining peak system flow rates and annual water requirements.

2.1 Determining Peak Flow Rate

An assessment of a water source for trickle irrigation purposes must address the peak flow that can be delivered, annual water use and the water quality. Chapter 12 provides information on water quality. The peak trickle system flow rate can be approximated by using the information provided in Table 2.1 and Table 2.2. The peak evapotranspiration rate that is expected during the season is converted into a flow rate per acre irrigated.

Table 2.1 Peak Evapotranspiration (ET) for Trickle Irrigation Design

Location	Peak ET		Location	Peak ET	
	in/day	mm/day		in/day	mm/day
Abbotsford	.15	3.8	Keremeos	.29	7.4
Agassiz	.15	3.8	Kersley	.22	5.6
Alexis Creek	.15	3.8	Kettle Valley	.27	6.9
Armstrong	.21	5.3	Kimberley	.30	7.6
Ashcroft	.30	7.6	Ladner	.13	3.3
Aspen Grove	.21	5.3	Langley	.14	3.6
Barriere	.20	5.1	Lillooet	.28	7.1
Baynes Lake	.25	6.4	Lister	.21	5.3
Campbell River	.20	5.1	Lytton	.30	7.6
Canal Flats	.26	6.6	Malakwa	.19	4.8
Castlegar	.31	7.9	Merritt	.26	6.6
Cawston	.32	8.1	Nanaimo	.19	4.8
Chase	.21	5.3	Natal	.18	4.6
Cherryville	.21	5.3	Notch Hill	.20	5.1
Chilliwack	.17	4.3	Oliver	.26	6.6
Clinton	.23	5.8	100 Mile House	.23	5.8
Cloverdale	.14	3.6	Osoyoos	.28	7.1
Comox	.20	5.1	Oyster River	.12	3.1
Creston	.18	4.6	Parksville	.16	4.1
Dawson Creek	.18	4.6	Pitt Meadows	.13	3.3
Donald	.14	3.6	Port Alberni	.20	5.1
Douglas Lake	.21	5.3	Prince George	.15	3.8
Duncan	.16	4.1	Princeton	.25	6.4
Ellison	.23	5.8	Quesnel	.26	6.6
Fort Fraser	.19	4.8	Radium	.20	5.1
Fort Steele	.22	5.6	Riske Creek	.28	7.1
Fort St. John	.20	5.1	Saanichton	.16	4.1
Golden	.15	3.8	Salmon Arm	.17	4.3
Grand Forks	.19	4.8	Smithers	.15	3.8
Grandview Flats	.25	6.4	Spillimacheen	.19	4.8
Grasmere	.22	5.6	Sumas	.17	4.3
Grinrod	.14	3.6	Summerland	.26	6.6
Hazelton	.19	4.8	Terrace	.22	5.6
Hixon	.16	4.1	Vancouver	.18	4.6
Hope	.22	5.6	Vanderhoof	.20	5.1
Invermere	.23	5.8	Vavenby	.16	4.1
Joe Rich	.16	4.1	Vernon	.22	5.6
Jura	.22	5.6	Walhachin	.29	7.4
Kamloops	.28	7.1	Westwold	.27	6.9
Kelowna	.24	6.1	Williams Lake	.28	7.1

The flow rate that is calculated using the method shown in Example 2.1 will ensure that the trickle irrigation system can irrigate the entire property daily within 20 hours. Normal operating times will usually be between 14 and 18 hours.

Table 2.2 Determining a Peak Flow Requirement for Trickle System Design

Climate Factor (ET)		Trickle System Flow Rate
in/day	mm/day	gpm (U.S.) / acre
0.14	3.6	3.5
0.16	4.1	4.0
0.18	4.6	4.5
0.20	5.1	5.0
0.22	5.6	5.5
0.24	6.1	6.0
0.26	6.6	6.5
0.28	7.1	7.0
0.30	7.6	7.5

Example 2.1 Peak Flow Rate Requirement – High Density Apple Crop

A grower has 15 acres of high density tree fruits in the Kelowna area. What should be the peak trickle irrigation system flow requirement?

From Table 2.1 – Peak evapotranspiration rate is 0.24 in/day
From Table 2.2 – Peak flow rate is 6.0 gpm/acre

Flow rate required for 15 acres is = 15 acres x 6 gpm (U.S.) / acre
= 90 U.S. gpm

Irrigation District/Water Purveyor Supply

In some regions of the province water is supplied to agriculture through irrigation districts or other water purveyors. Irrigation districts have established water delivery rates on a per acre basis that vary depending on the soil type and location of the district. Table 2.3 provides this information for irrigation districts located within B.C.'s major agricultural areas. Some of these districts have been incorporated into municipalities in the past few years. Table 2.3 uses the historic district names. If the district has been taken over by a municipality the flow rates quoted should be checked to ensure that the values shown are still valid.

The flow rate from an irrigation district is often regulated by means of a flow control valve at the district connection. Delivery flow rates are often rounded to the nearest 5 gpm to match the nearest valve flow control rate.

When designing within an irrigation district the flow rates that are established cannot be exceeded. Also ensure that the zone sizes selected match the delivery flow rate as closely as possible. This will ensure optimum system performance, keep costs down, allow flexibility for system expansion and provide water for other requirements such as crop cooling.

Table 2.3 Water Allotments for Various Irrigation Districts

District[1]	Water Allotment	
	gpm (U.S.) /acre	gpm (Imp.) / acre
Black Mountain	5 to 7	
Cawston	6.6 and 7.7	
Chase	6	
East Creston	4.5	
Ellison	5	
Erickson		2.5
Fairview Heights	6.6 and 7.6	
Glenmore	4 and 6	
Kaleden	6.25	
Keremeos	6 to 8	
Lakeview		5.6
Naramata	5	
North Canyon	3	
Okanagan Falls	6	
Osoyoos	8	
Oyama	6	
Peachland		6
Penticton	5, 6 and 7	
South East Kelowna	5, 6 and 6.5	
South Okanagan Lands (Oliver)	7.75 to 8.25	
St. Mary's Prairie	4.5	
Summerland		6
Vernon	5	
Westbank	5 to 6.5	
Winfield-Okanagan Center	5 to 6.5	
Woods Lake	6.25	
Wynndel	4.45	

[1] Irrigation districts are listed by historic names.

2.2 Annual Irrigation Requirements

Annual irrigation requirements must be determined when applying for a water licence or developing a storage facility. The values that are shown in table 2.4 are optimal for the soil conditions shown. Coarser soils are defined as gravels, sands and sandy loams. Finer soils are classified as loams, clay loams and clays. See Section 3.3 for information on soil texture.

The B.C. Sprinkler Irrigation Manual provides more detailed annual water use information taking into account the crop, rooting depth and soil types. It is recommended that the process outlined in the B.C. Sprinkler Irrigation Manual be used to calculate annual water requirements for licencing purposes. This will ensure that enough water is allocated to the property for all irrigation system types and future cropping patterns.

Table 2.4 can be used for systems that are using groundwater, storage from a reservoir or as a check on an existing water licence or irrigation district allotment.

Example 2.2 Annual Water Requirement – High Density Apple Crop

What is the annual water requirement for a 15 acre high density apple crop in Kelowna on a loam soil?

From Table 2.4 – a loam is considered to be a finer soil, therefore annual use is 20 inches.

Total water requirement is (15 acres x 20 inches) / 12 in/ft = 25 ac -ft

Table 2.4 Annual Water Requirement for Trickle Irrigation Systems

Location	Annual Use (inches)		Location	Annual Use (inches)	
	Coarser Soil	Finer Soil		Coarser Soil	Finer Soil
Abbotsford	12	5	Keremeos	32	26
Agassiz	6	2	Kersley	13	8
Alexis Creek	15	9	Kettle Valley	25	18
Armstrong	17	11	Kimberley	24	17
Ashcroft	35	27	Ladner	11	6
Aspen Grove	18	12	Langley	9	5
Barriere	18	12	Lillooet	27	20
Baynes Lake	23	16	Lister	22	15
Campbell River	14	9	Lytton	35	27
Canal Flats	20	14	Malakwa	12	7
Castlegar	29	21	Merritt	29	21
Cawston	35	27	Nanaimo	14	8
Chase	21	14	Natal	14	8
Cherryville	19	14	Notch Hill	20	14
Chilliwack	7	5	Oliver	34	27
Clinton	24	17	100 Mile House	24	17
Cloverdale	10	5	Osoyoos	35	28
Comox	16	11	Oyster River	9	4
Creston	22	16	Parksville	14	10
Dawson Creek	7	4	Pitt Meadows	8	4
Donald	9	4	Port Alberni	16	10
Douglas Lake	22	16	Prince George	14	9
Duncan	12	8	Princeton	25	20
Ellison	23	17	Quesnel	13	8
Fort Fraser	11	5	Radium	17	10
Fort Steele	14	8	Riske Creek	22	15
Fort St. John	9	5	Saanichton	14	10
Golden	15	11	Salmon Arm	18	12
Grand Forks	15	10	Smithers	12	7
Grandview Flats	25	19	Spillimacheen	19	12
Grasmere	18	12	Sumas	9	4
Grinrod	10	5	Summerland	27	21
Hazelton	3	0	Terrace	12	8
Hixon	9	3	Vancouver	15	10
Hope	13	7	Vanderhoof	11	5
Invermere	24	16	Vavenby	18	12
Joe Rich	16	10	Vernon	22	16
Jura	16	10	Walhachin	28	20
Kamloops	32	26	Westwold	28	22
Kelowna	26	20	Williams Lake	18	12