5.0 OPERATIONAL GUIDE (Water Table Management)

Some agencies have recommended a comprehensive water resource management strategy for growing seasons with near average, significantly wetter than average and significantly drier than average precipitation keeping in mind that it is always easier to recover from a temporary lowering of the water table than recovering from a crop flooding injury (Allred et al, 2003, See Fig 5.1 Summary below).

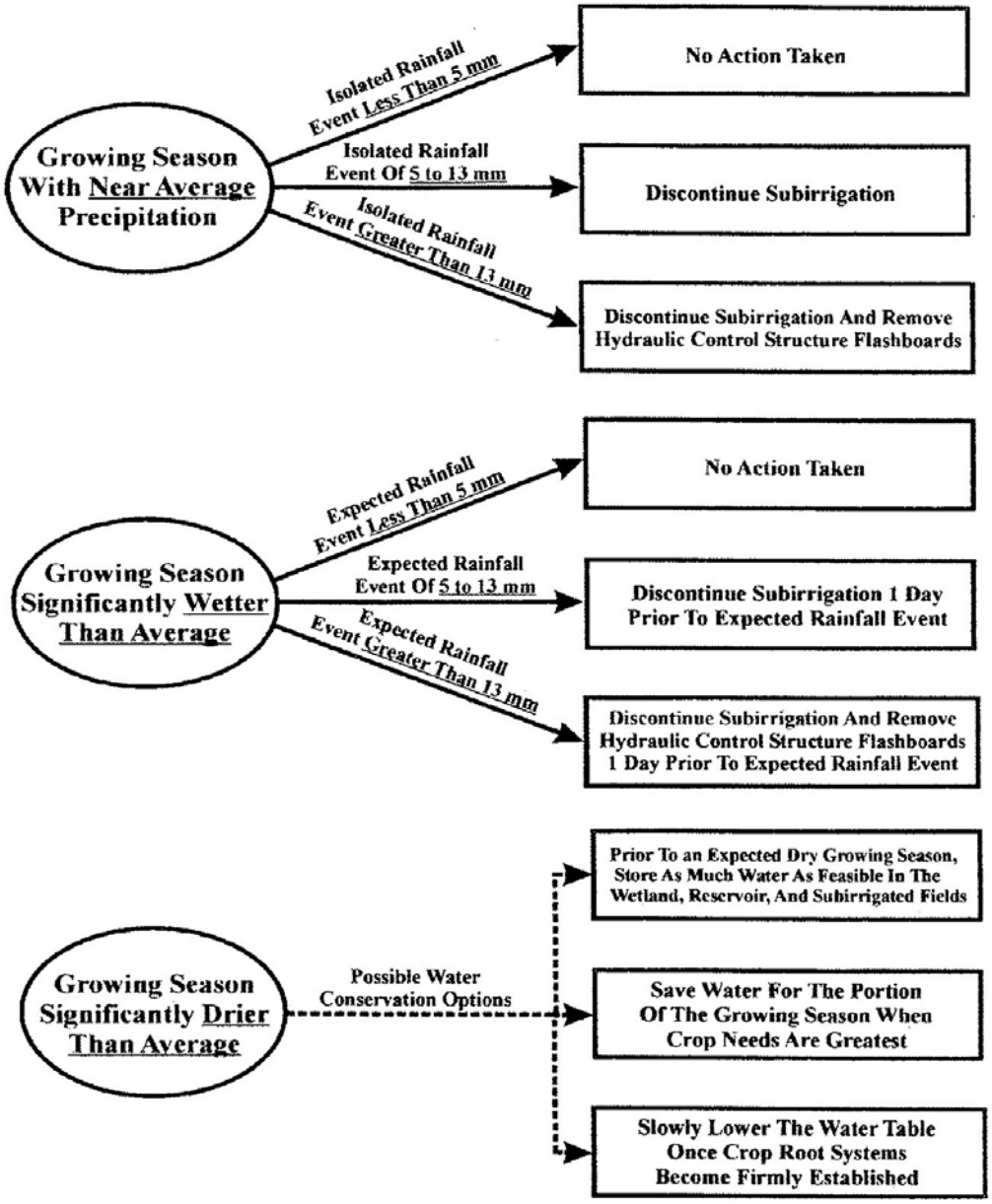


Figure 5.1 Simplified illustration of WRSIS water table management strategies for the growing season (Allred et al., 2003)

5.1 Water Table Management Objectives

Subirrigation will only produce higher more consistent yields of crops with proper water table management. The goal of water table management is to consistently maintain field ground water levels within an optimum range to minimize plant stresses (e.g. droughts or flooding).

- To effectively manage a water table, Allred et al (2003) suggests two important tools, a rain gauge and observation wells. These tools are crucial for determining when to start/stop both subirrigation and drainage.

- Observation wells can be simple enough as a perforated capped PVC pipe and should be located in several locations within the field, particularly at key locations (depressions, midpoints of drain lines).

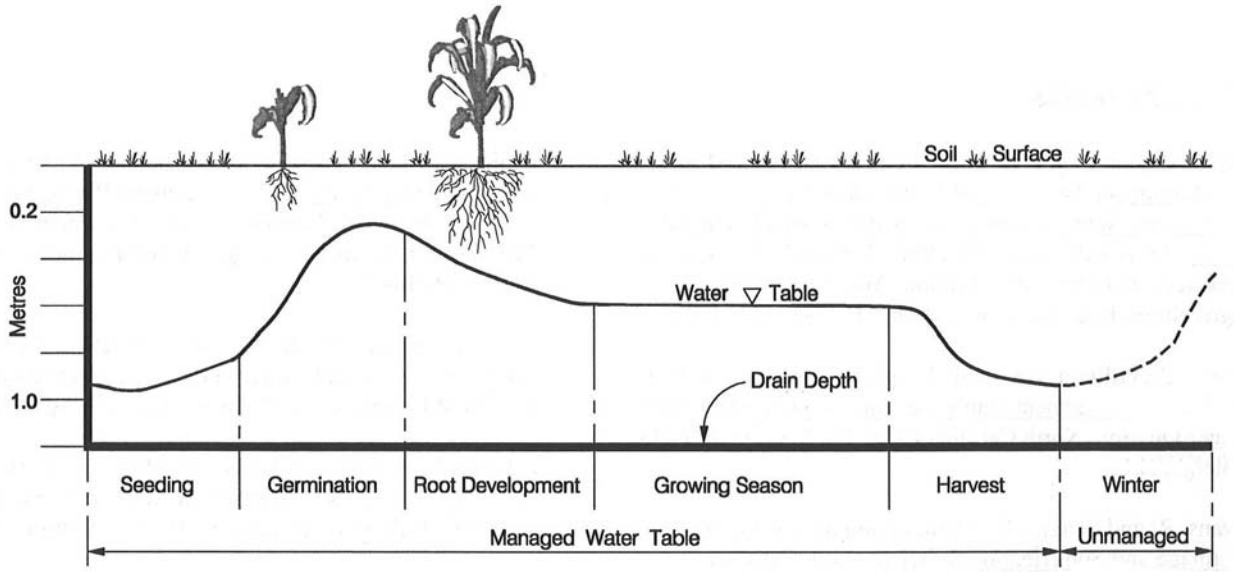
- An important goal in water table management is to keep the subsoil from drying out completely, once the subsoil is dry it is "almost impossible to move the water laterally" (LeCureux, 1995).

- Sub-soils can be kept moist by starting to pump earlier (than when crops require the most water) and a little at a time.

- Water table management can at first be tricky to control and may take several seasons to determine the best settings. Keeping an accurate record of wet stresses, dry stresses and yields for several locations in the field will help determine the best management strategy. Yields directly above the drains should be compared to yields midway between the drains where the greatest stresses should be observed (Evans and Skaggs, 1996).

- A general rule of thumb for managing water tables is that they should be maintained at the greatest depth that will still supply adequate water to the crop. This provides maximum storage potential from efficient use of rainfall events (Evans and Skaggs, 1996).

- Having a deeper water level can reduce the amount of pumped water. For example, test plots showed that weir depths of 30 and 60 cm had similar crop yields (86%) however; there was a 55% reduction in water pumping necessary for the 60 cm weir (Skaggs and Breve, 1995).



***Note:** appropriate depths for specific crops should be calculated.*

Figure 5.2 Managing the water table depth for plant development (*Controlled Drainage / Subirrigation* Factsheet, B.C. Ministry of Agriculture and Food, 1998)

5.2 Seasonal Management Strategy

Allred et al (2003) has recommended the following strategy for management and allocation of stored irrigation water resources to controlled drainage systems for near average, wetter than average and drier than average years (see Fig 5.1). Determining what type of seasonal climate is occurring within a growing season is typically based on rainfall to date and long range forecasts.

5.2.1 Near Average

These are typical conditions that occur based on previous seasonal averages.

1) For rainfall events of less than 5 mm, no changes are required for subirrigation or adjustments to hydraulic control structures.

2) For rainfall events greater than 5 mm, but less than 13 mm, subirrigation should be turned off and remain off for approximately 24 hours, then restarted if no additional rainfall occurs (knowing when to restart the system can be determined using observation wells. No changes should be needed for the hydraulic control structures (i.e. flashboards or weirs).

3) For rainfall events in excess of 13 mm, the subirrigation should be shut off and the hydraulic control structures should be altered to allow unrestricted discharge of subsurface drainage. Hydraulic control structures should remain opened for at least 24 hours and the water table should be observed until it has returned to a desirable level. Once at the desired level, the hydraulic control structure should be restored.

5.2.2 Wetter than Average

During a wetter than average season, water tables have a tendency to remain higher for longer than average or drier seasons, thus management strategies in these scenarios are more of a preventative strategy.

1) For rainfall events of less than 5 mm, no changes are required for subirrigation or adjustments to hydraulic control structures.

2) For rainfall events between 5 and 13 mm, preventative maintenance should be initiated by halting all subirrigation 24 hours prior to expected rainfall.

3) Rainfall events in excess of 13 mm should also be anticipated for and prevented by halting subirrigation 24 hours prior to the expected event and removing flashboards or opening weirs to help prevent crop injury from flooding. Determining when hydraulic controls can be restarted should be done through the use of observation wells.

For both near average and wetter than average seasons, water storage should be kept just above the wetland outlet pipe to establish and continue the vitality of the wetland, thus providing water storage and treatment of inflow and runoff water from storm or overflow events. The reservoir is kept full during these seasons so water is available if needed for subirrigation. These guidelines for water table management can vary depending on the spacing between drains. Closely spaced drains expedite water removal more quickly. Recovering from the lowering of a water table is much easier than the recovery from crops damaged by flooding.

5.2.3 Drier than Average

Water management during a dry season is more problematic and currently no formalized set of guidelines exist. Water table management during these times relies on safety precautions and water conservation as described below:

1) If predictive long term forecasts indicate the possibility of a very dry/drought growing season, water conservation should begin immediately by planting as early as possible and storing as much water as possible as in the reservoir and subirrigation field.

2) Another conservation option would be to conserve water for the portion of the growing season when crop demands are the greatest. Determining when a crops needs are greatest can be done by calculating the yield response factor (Doorenbos et al. 1979), were large yield response factors for a plants development stage reflect the importance of providing adequate water. For example, the yield response factors for corn during a growing season (see table below) indicate that **the most crucial time for corn to require watering is during the flowering stage**.

Table 5.1 Yield Response Factors for Corn

Stage of Development of Corn	Yield Response Factor
Pre Flowering Stage (June)	0.4
Flowering Stage (July)	1.5
Post Flowering Stage (August)	0.5

Any additional water should then be used to water the crop during the next stage of development. During seasons where there is not sufficient water to irrigate all plants, then it is best to fully irrigate, only part of the crop.

3) Another conservation strategy is to slowly lower the water table once roots have become firmly established. This strategy is designed to take advantage of the water moisture typically found in lower soil profiles. By gradually lowering the water table at a rate that downward root growth of the crop can keep pace with plants are able to take advantage of water moisture trapped in the lower soil profile. Calculations suggest that draining the soil profile by 46 cm could theoretically extract 230 m^3 of water per hectare (23 mm). Lowering the water table would also reduce the evaporative effects from soils over the drain lines, thus further conserving water.

4) Crop rotation may also be used to alleviate water shortages if crops are rotated in accordance with water management zones. e.g. irrigate corn rather than soybeans.

5.2.4 Non-Growing Seasons

During non growing seasons controlled drainage-subirrigation, storage ponds systems are typically opened allowing full drainage to enhance the trafficability of the fields for the fall harvest. It is often left open during the spring for tilling the soils, spring planting and post-emergent crop care. Drainage water is restricted from running offsite and is processed in the wetland to remove sediment and nutrients (nitrates, phosphorus).

It is also suggested to raise the water table to the surface between December-March when no work is done on the fields. Raising the water table to the surface would produce anaerobic soil

conditions, thus removing nitrate through denitrification and increased carbon sequestration because of reduced biodegradation (Skaggs and Breve, 1995; Lal et al. 1998). Raising the water table will increase surface runoff.