RICE AND FURROW IRRIGATION MANAGEMENT

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Rice Water Management

Water use on rice fields has been monitored by the SCS since 1987. Three rice fields were monitored during the summer of 1989 to determine how well water was managed on each. A total of 7 fields have been monitored which resulted in usable information. These results are summarized below. LL indicates the field had been precision leveled. P indicates permanent pads around the field borders. The amounts shown below do not include flushes.

Table 1: Summary of Rice Water Measurement

	Irrg	Rain	Total Input	Runoff
1987				
field 1 LL,P	17.6"	14.6"	32.2"	17"
field 2	29.8"	13.8"	43.6"	12"
1988				
field 3 LL	32.0"	6.4"	38.4"	0.9"
field 4	25.6"	9.7"	35.3"	4.2"
field 5 LL,P	40.6"	11.0"	51.6"	11.5"
1989				
field 6 LL,P	3.6"	25.7"	29.3"	5.9"
field 7 LL	26.6"	11.2"	37.8"	13.8"

Field 3 and field 7 had permanent pads at the top and sides of the fields while field 4 had permanent pads on the top and one side of the field. A measure of seepage losses from 5200 ft of pull-up exterior levee in 1988 indicated a seepage loss of 2,500 gallons of seepage per foot of levee during the flood season.

In 1989, field 1 took 4.3" to flood. Information for fields 1 and 2 was collected that included flushes and initial flood. Data for 1987 can be broken down as follows:

Table 2: 1987 Rice Water Use Itemized

	Field 1	Field 2
1st Flush	2.29"	3.40"
2nd Flush	1.93"	1.77" (rain)
Est. Flood	2.11" (short)	2.98"
Main. Flood	17.60"	29.84"
Total	23.9"	38.0"

Infiltration 0.035 in/day

The infiltration amount was the measured loss from an infiltration ring in the rice field during the growing season. This measurement was made on a heavy clay soil (Alligator). Infiltration losses made be higher on a lighter soil such as a Forestdale.

1989 Studies

In 1989, field 6 was approximately 25 acres in size. The field had been precision leveled and had straight levees. The perimeter of the field consisted of a pad allowing access to the entire perimeter of the field and eliminating water seepage. Water was supplied to the field through a 12" underground irrigation line from a groundwater well. The field drained through two 10" pipes equipped with slotted board risers to control the water level in the field. The field was planted for foundation seed production and, therefore, could be expected to be intensively managed.

Water management of the field, however, was relatively simple. When replenishing the flood, the top cuts were filled and when the next to last cut began to receive water from the cut above, the well was shut off. Water from the top cuts would continue flowing to the lower cuts until filled. The well could be shut off sooner or allowed to run longer the next time the field was filled based on observation of the success of the previous irrigation. The technique is simple but effective in eliminating irrigation runoff.

This process also provides that only brief periods will exist where all cuts are totally filled. Turning off the pumps and allowing water levels to decrease in the cuts also provides the ability to capture any rainfall that may occur. This past year with its high rainfall provided ample opportunity for the capture of rainfall. This field captured its fair share. The flood season water level in the bottom cut is shown in figures 1 and 2, for fields 6 and 7, respectively, along with irrigation, rainfall, and total (irrigation plus rainfall) input amounts.

At season's end the field was allowed to dry down considerably before the outlet was opened providing maximum beneficial use of the water in the field after the last irrigation. More water would have left the field during draining normally, but the farmer was trying to delay ripening of the field, thus extending the flood season depleted the water left in the field. If a field would normally be drained 14 days before harvest, cut off water 7 to 10 days before that. There should be enough water stored in the cut to keep the soil saturated until the gates are pulled for final drydown.

Field 7 was approximately 80 acres in size with a center levee dividing the field into two 40 acre blocks. The entire field was watered from one 12" riser supplied by a 12" underground irrigation line which was connected to a groundwater well. The field had been precision leveled and had straight levees.

The field perimeter was an elevated farm road, except on the bottom of the field. The bottom rice levee was some 10' from the road, thereby providing a drainage way to connect the several pipe outlets (not equipped with slotted board risers). This allowed seepage through the bottom rice levee into the drainage way. Since the water level in the drainage way was held artificially high for runoff measurement purposes, seepage was probably minimal.

The well for this field was electric, and water was controlled by sequencing the pump on and off. However, as the plot of the outflow water level indicates, off times were not long enough (or conversely on times were too long). It must be pointed out that all the runoff from this field was not waste. The farmer used this runoff as a surface water supply downstream on another field. This field did not have the same opportunity to capture as much rainfall as field 6 since the cuts were normally full. The management of field 6 was intended to take advantage of rainfall whenever possible.

Recommendations For Improved Water Management Efficiency

Field Size - A field size of 40 acres or less appears to be desirable to those rice farmers who are trying to implement water conservation practices. However, with proper management inputs, any size field could be irrigated efficiently.

Precision Leveled Fields and Pads - Those farmers who are cutting down field sizes while in the process of landleveling (to help control and conserve water) should also design and build pads around the exterior of the field and as an outlet install an overfall pipe with slotted board riser to control outlet elevation and allow the field to be flooded in winter for waterfowl habitat (including set-aside land). Cost-sharing varies from county to county on these practices.

Cycling Water - The primary key to reducing water use on rice is to shut the water supply off at periods to allow the water level to decrease, then to apply water and have a plan on when to shut the water off so the last cut is filled without overfilling. Stakes in the field, timing inflow, cutting off when water reaches a specific cut are some ways this might be implemented.

Tailwater Recovery - One of the best ways to conserve water and improve irrigation efficiencies is to install a tailwater recovery system. A tailwater recovery system is an on-farm system that captures tailwater from fields on the farm. Complexity and cost may vary widely from installation to installation.

The simplest and least expensive situation is where the runoff from the bottom of one field can be picked up and pumped to the top of an adjoining field (the well on that field would run less hours than it normally would). This is normally possible in rice production where floods are maintained during the growing season. A true tailwater recovery system must reduce the groundwater initially pumped to meet its conservation goal and be using tailwater from that farm.

A tailwater storage reservoir provides the ability to accumulate and store tailwater until ready for use. These reservoirs must be excavated unless a natural catchment area exists. An acre-foot of storage will require 1,613 cubic yards of excavation ($1050 per acre-foot of storage based on $0.65 per cubic yard excavation cost). Normally a 3 to 5 acre-foot storage reservoir will be required. Pumps and a transport system will be required to deliver the tailwater to where it is needed for irrigation purposes.

At the current time, it appears no structure may be installed in a drainage district ditch that would pond water above its design grade line for the purpose of establishing a pool to utilize surface water present in the ditch.

To utilize water from a drainage district ditch, a sump can be dug in the bottom (below grade) to collect water and allow for pump depth or an eye can be dug to the side of the channel and below grade to allow for installation of a pump without hindering the operation of the channel. Drainage district permission would be required. These types of systems would also require continued maintenance to clear sedimentation. Utilizing surface water from a public water supply (drainage district ditch) is considered surface water pumping (not tailwater recovery) and requires a pump permit.

Cost-sharing for tailwater recovery systems is available in most ASCS districts. Benefits include higher irrigation efficiency, lower pumping costs, increased engine life, less potential polluting runoff.

Compliance With 1985 Food Security Act And 404 Regulations

All water management activities undertaken should conform to the rules and regulations of the 1985 Farm Bill, especially in regards to the SWAMPBUSTER provisions, and wetland regulations in regards to 404 permitting procedures and any applicable state law.

Furrow Irrigation Scheduling And Infiltration

In 1989, furrow irrigation evaluation and infiltration measurements were made on one cotton field. The field was approximately 31 acres in size. The field was irrigated using polypipe with approximately 3/4" punched holes. The rows were approximately 850' long on 40" centers. The polypipe had a total of 237 holes punched in it. The field was approximately 1600' across. Only every other middle was irrigated to prevent the entire field from becoming saturated especially in the case of rainfall.

The soil profiles began to show depletion in the surface 6" and the next 6" around July 24. However, there was plenty of soil moisture below 12"(see figures 3 and 4). Rooting depth at this time would have been expected to be 30". There was no evidence of extraction at deeper depths. However, examination of several tap roots from plants pulled up in the field revealed that the tap root barely extended to 12". Oxygen deprivation at deeper depths and an abundance of soil moisture in the surface layer early in the year probably contributed to this. However, the onslaught of hot, dry weather could put the plants in a situation of not being able to have root development keep pace with evaporative demand and soil moisture depletion. Therefore, the farmer decided to irrigate while the profile still had high moisture levels below 12".

While the data from the neutron probe showed a relatively full profile below 12", it was decided that only a very light irrigation would be required to replenish the moisture in the top 12". It was also decided that once the water reached the ends of the rows the water could be shut off, with the recession stream completing the irrigation since the bottom of the field did not require as much irrigation as the top of the field (neutron readings showed consistently higher moisture levels at the bottom of the field).

The first irrigation was begun at 1000 hours on August 10, 1989, (day 222). The holes in the polypipe had flowrates that were measured between 7.4 and 6.4 gpm. The total well output was measured as approximately 1700 gpm. The rate of advance in one furrow was measured at the 0', 100', 200', 400', and 600' points in the furrow. The advance times were 1032 hours (when hole was punched for this furrow), 1050 hours, 1110 hours, 1207 hours, and 1330 hours, respectively.

By 1400 hours, approximately 75% of the furrows were out. Irrigation continued until 1930 hours when approximately the next 20% of the furrows were out. The irrigation total was 1.07" for 31 acres. Since every other row was irrigated it could be considered to have been a 2.14" irrigation in those furrows. Even as short as this irrigation time was, there was still considerable runoff as evidenced by 75% of the furrows having runoff for over 5 hours.

Another irrigation was applied on August 16, 1989, (day 228). The second irrigation applied slightly less water than the first irrigation. In each case the depth of infiltration was so shallow (less than 10") that the soil moisture probe barely discerned the irrigations. These irrigation replenished the soil moisture in the top foot of soil only.

Furrow Infiltration

The most important factor to consider in furrow irrigation is the ability of the soil to absorb irrigation water. Estimating the rate and the amount of water the soil will absorb is important in designing irrigation systems.

When the irrigations were made, a measurement of the infiltration was also made. The inflow from an actual furrow gate was measured using the furrow evaluation inflow box. The sump box was set 100' down the row. The sump pump then pumped the water into the furrow to continue the irrigation of the furrow. In this case, the infiltration was measured over 100' of furrow for the entire irrigation set time. The infiltration was determined over a period of 6.4 hours. The intake in the 100' section was 4.17" for an average intake over the period of 0.65" per hour. This soil was an Askew sandy loam which should have a higher intake than siltier soils. Infiltration did not exceed 10" vertically and reached only 38" horizontally. These measurements are consistent with previous years' measurements.

Summary

Furrow irrigation requires a high level of labor input to schedule and operate. Observations and measurements indicate that on most Mississippi delta cotton land, intake rates decrease after an initial rate to a lower rate. Long opportunity (soak) times contribute more to runoff than soil moisture. It would appear advisable to use high furrow rates (15 gpm for 1320' rows, and lower rates, 7 gpm, for shorter rows, 800') to push water to the end of the furrows, get a majority of rows out, then shut off the water and move to another set. This may mean one more irrigation during the course of a season.

Irrigating every other middle would appear to be advisable to prevent waterlogging the soil if hit by thunderstorms after irrigating. This would necessitate more irrigations which may be unfeasible if gated pipe needs to be moved. Moving pipe causes one to schedule irrigations by the ability to move pipe rather than the needs or capabilities of the soil or plant.

The use of flowmeters can help to determine furrow stream sizes and number of gates to open. Tailwater recovery pits are also a possibility if runoff from large irrigated areas can be captured.

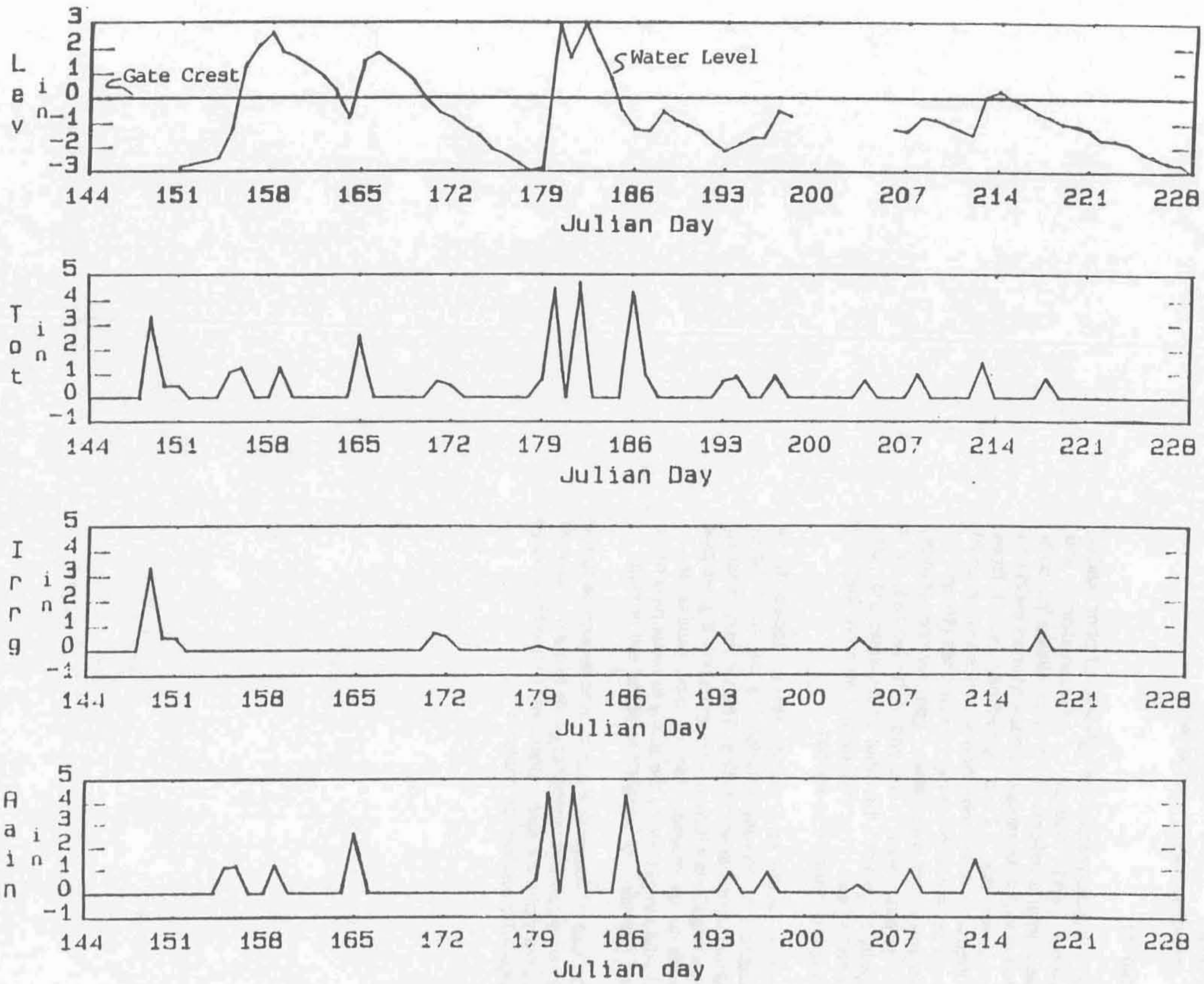

Figure 1. Field 6. Outflow

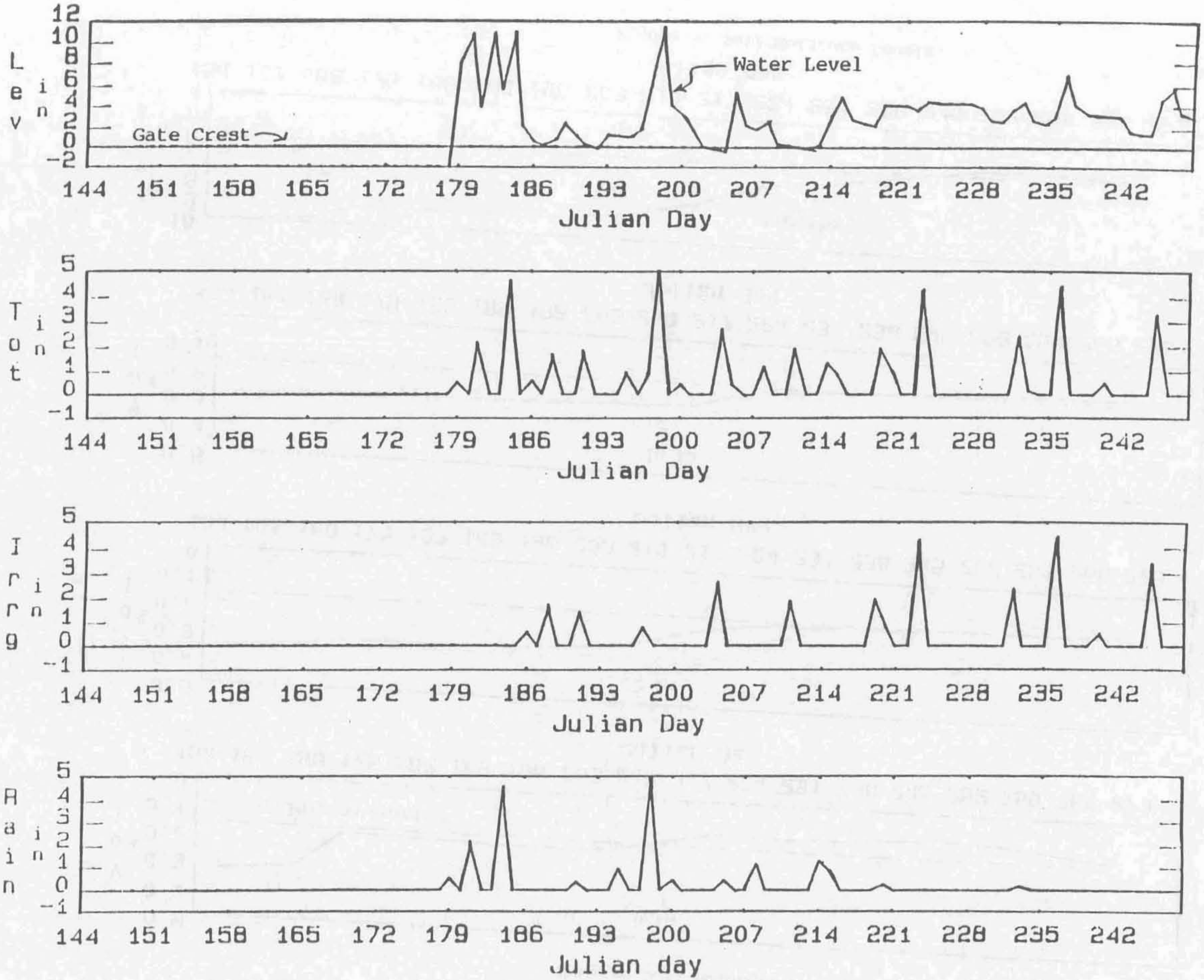

Figure 2. Field 7. Outflow

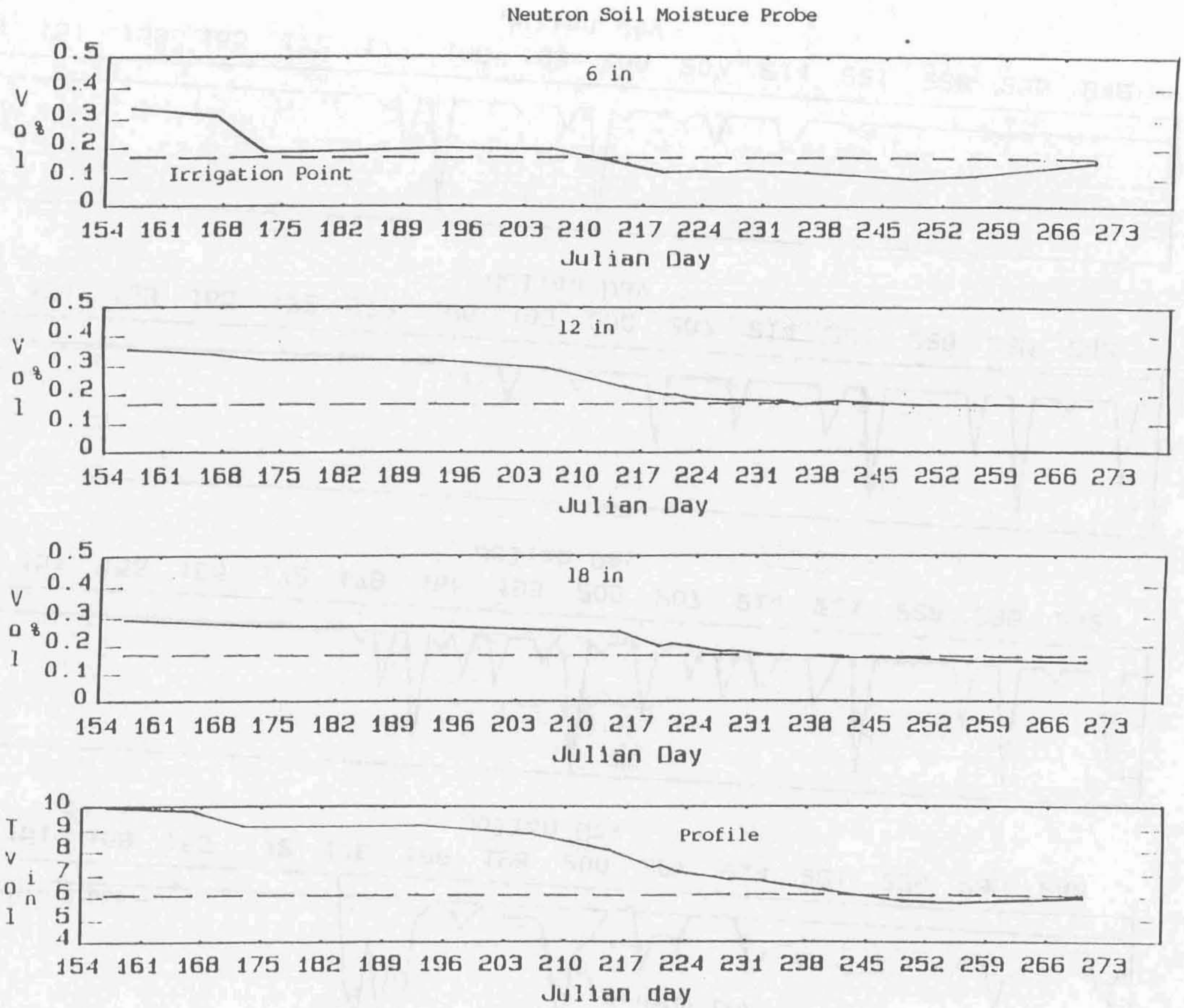

Figure 3. Soil Moisture Levels.

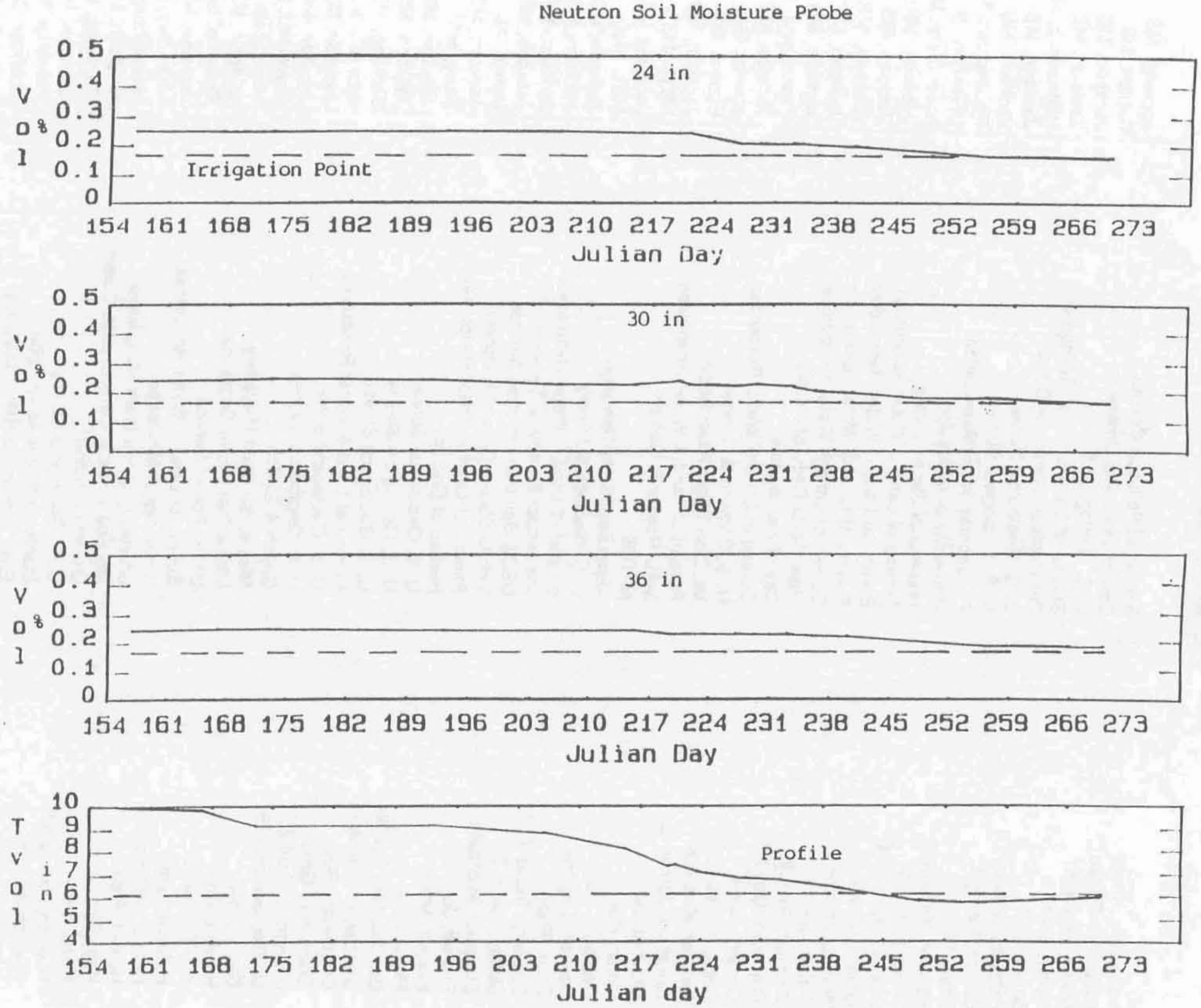

Figure 4. Soil Moisture Levels.