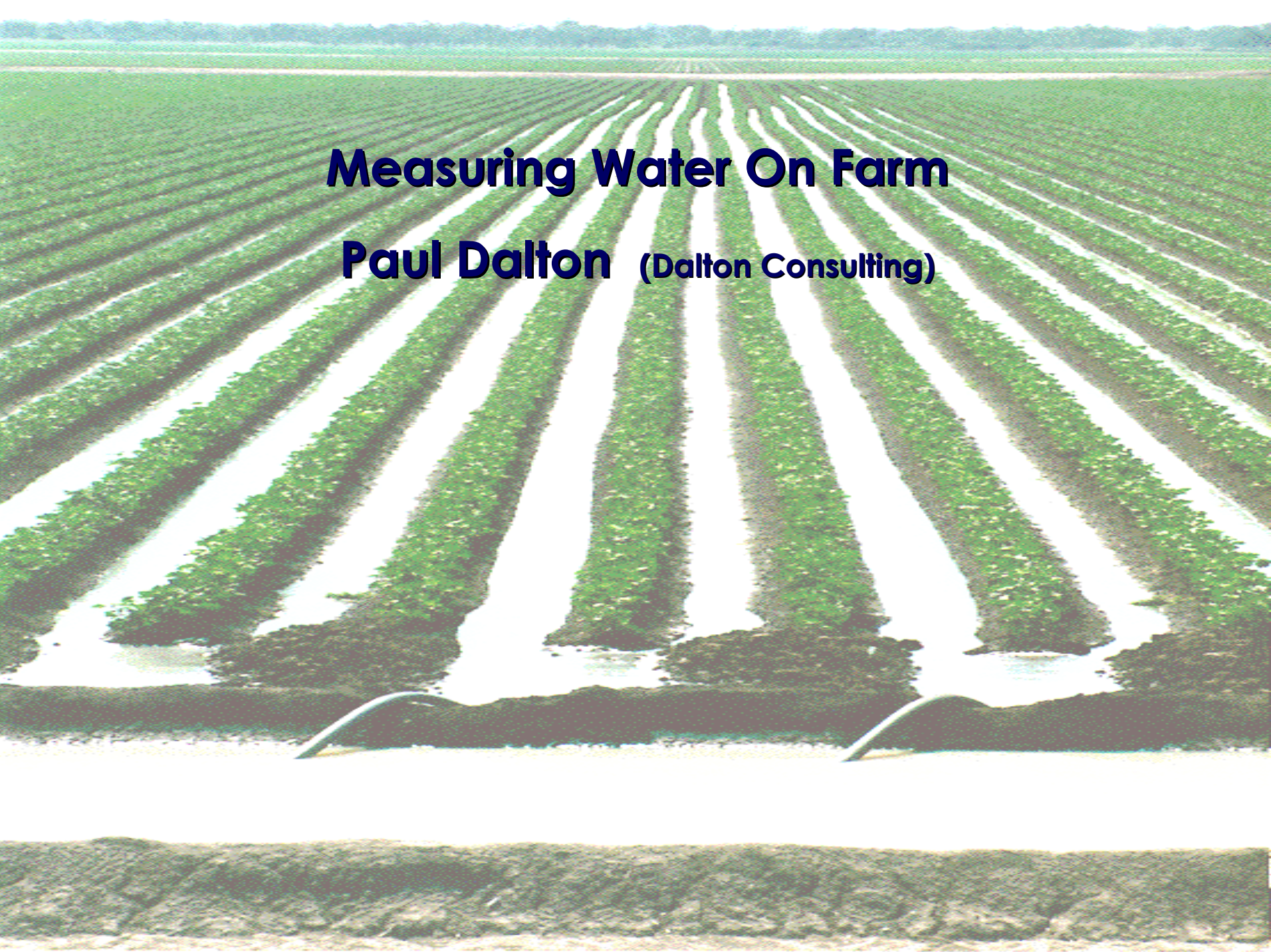
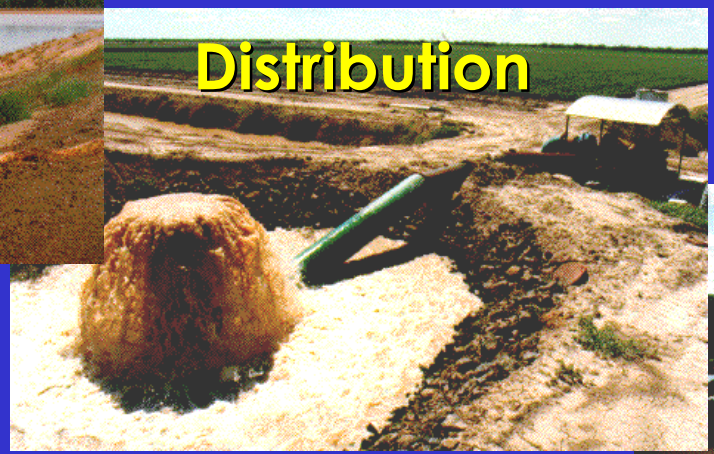


Measuring Water On Farm

Paul Dalton (Dalton Consulting)

Surface Irrigated Cotton Systems



Irrigation Efficiency - Performance Indicators

Efficiency = ratio of Outputs from Inputs

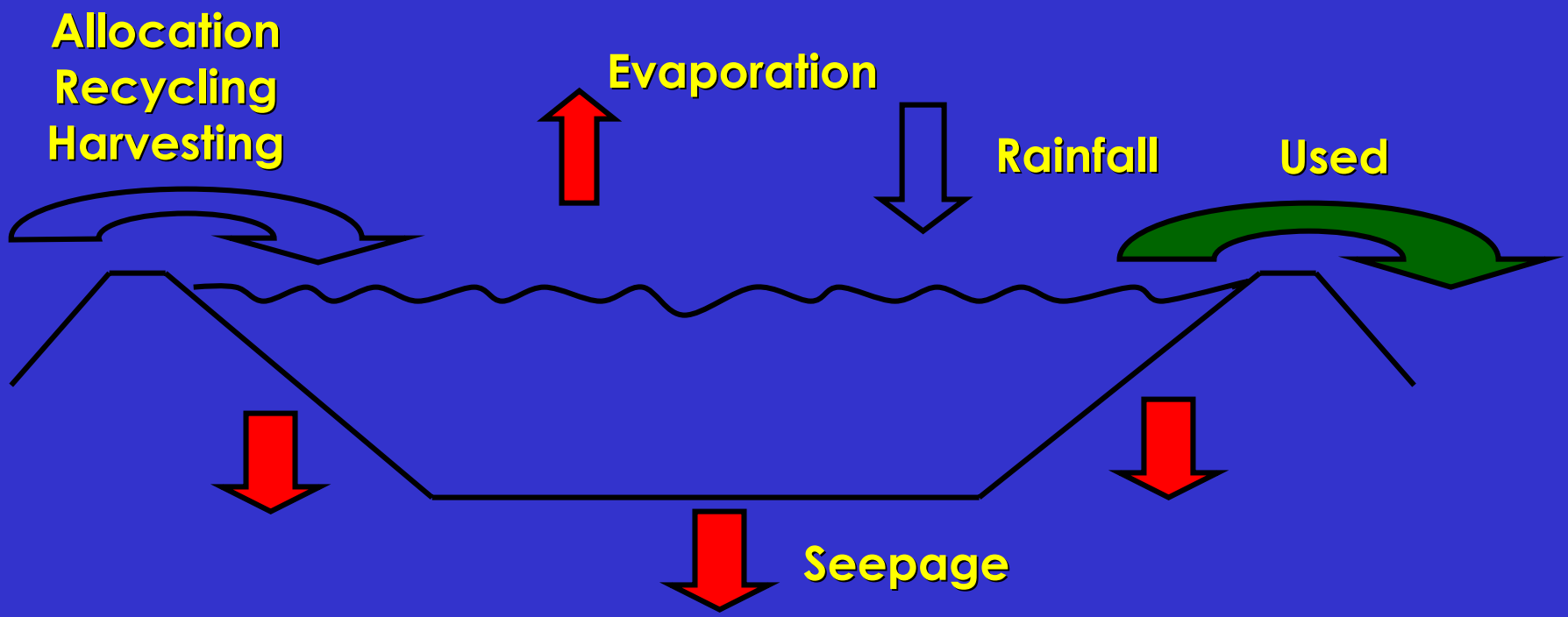
- Economic Efficiency = $/ML
  - optimise economics
- Agronomic Efficiency = bales/ML
  - optimise production
- Volumetric Efficiency = ML/ML or %
  - optimise water use

$$\text{Vol. Effic. (\%)} = \frac{\text{volume into root zone}}{\text{total distributed/applied}}$$

WATER STORAGES

Efficiency

$$\text{Storage Efficiency} = \frac{\text{Volume used}}{\text{Volume Stored}}$$



Measuring Storage Efficiency

- Water Level (1mm)
- Depth / Volume Relationship
- Evaporation
- Weather Station
- Rain gauge
- Seepage during static periods

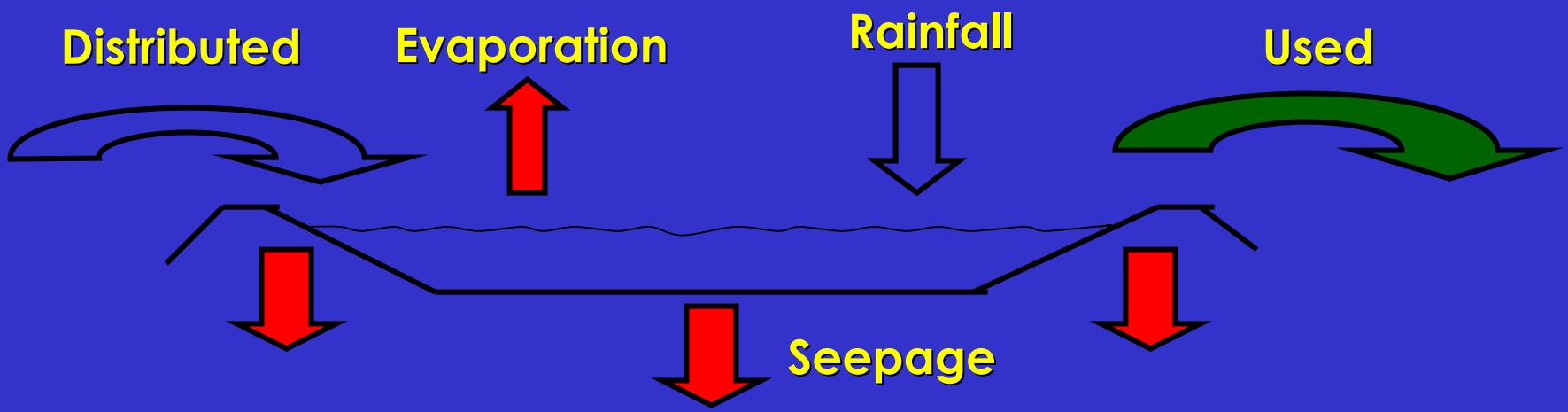
Results - Storage Efficiency

Storage Description	Storage Period	Stored Water (ML)	Used (ML)	Seepage (ML)	Evaporation (ML)	Storage Efficiency
Farm A 4m max depth 1800 ML	27/11/98 to 28/12/98	1272	1082 (85%)	14 (1.1%)	177 (13.9%)	85%
Farm A 4m max depth 2500 ML	27/11/98 to 5/7/99	2388	1313 (55%)	255 (10.6%)	930 (39%)	55%
Farm B 3m max depth 500ML	2/12/98 to 5/5/99	729	581 (79.7%)	34 (4.7%)	121 (16.6%)	79.7%
Farm E 4m max depth 1800ML	13/8/99 to 16/2/2000	3649	2776 (76.1%)	180 (4.9%)	701 (19.2%)	76.1%

DISTRIBUTION CHANNELS

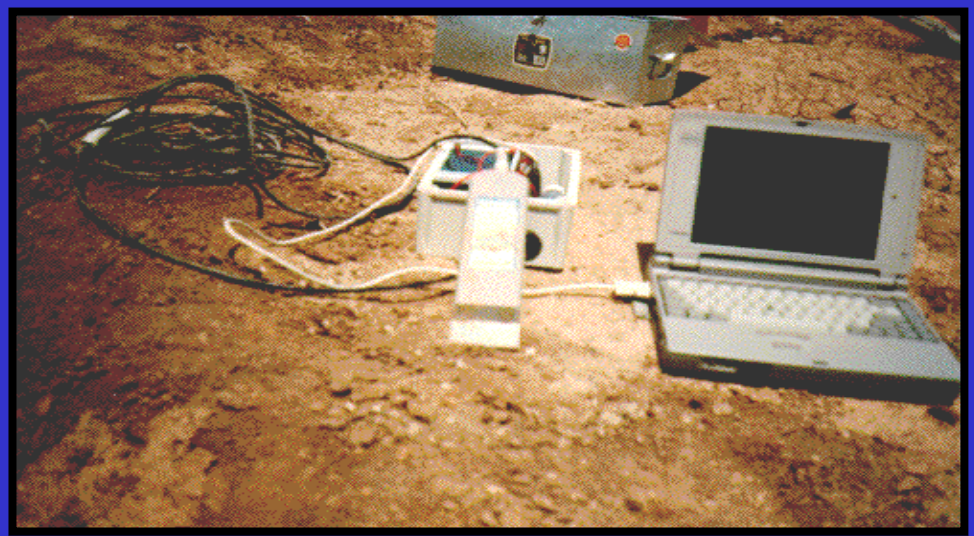
Distribution Channel Efficiency

$$\text{Distribution Efficiency} = \frac{\text{Volume used}}{\text{Volume Distributed}}$$



Measuring Distribution Volumes

- Versatile Doppler velocity / flow sensors
- Velocity, depth and cross-sectional area of flow
- Works on ultrasonic Doppler shift principle



Measuring Losses

- Channel Height - Depth sensor
- Evaporation - pan
- Seepage - volume balance of ponded channel sections

Results - Channel Losses

Site	Average Daily Loss for period (mm/day)	Average Daily Evaporation for period (mm/day)	Resultant Seepage
Farm A main supply channel	14.6	13.6	1.0 mm/day
Farm A TW channel	34	10.8	23.0 mm/day
Farm B TW channel	31.2	12	19.2 mm/day
Farm E head ditch	13.0	8.4	4.6 mm/day
Farm E head ditch	11.9	8.4	3.5 mm/day
Farm E TW channel	18.2	9.3	8.9 mm/day

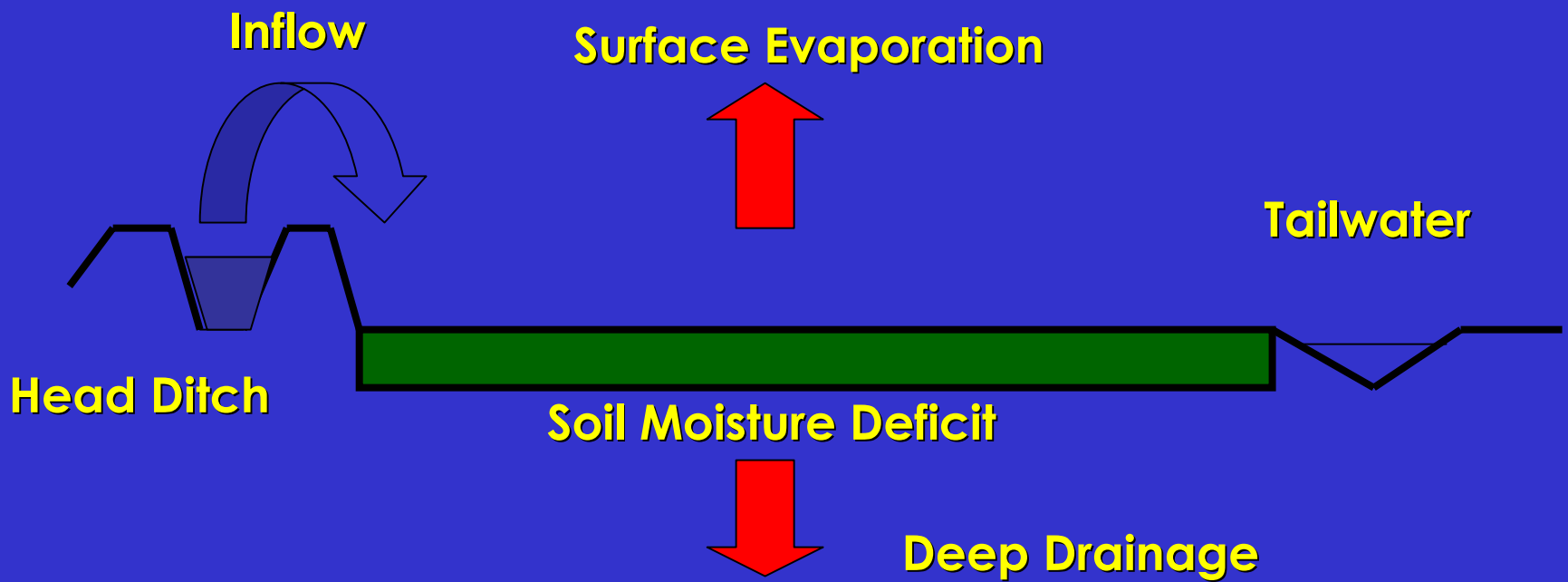
Results - Distribution Efficiency

Site	Distributed (ML)	Evaporation ML (%)	Seepage ML (%)	Distribution Efficiency (%)
Farm A	5000	130 (3%)	270 (6%)	91 %
Farm B	1300	68 (5%)	109 (8.4%)	86 %
Farm E	4800	94 (2%)	90 (1.8%)	96 %

APPLICATION- FIELD / FURROW

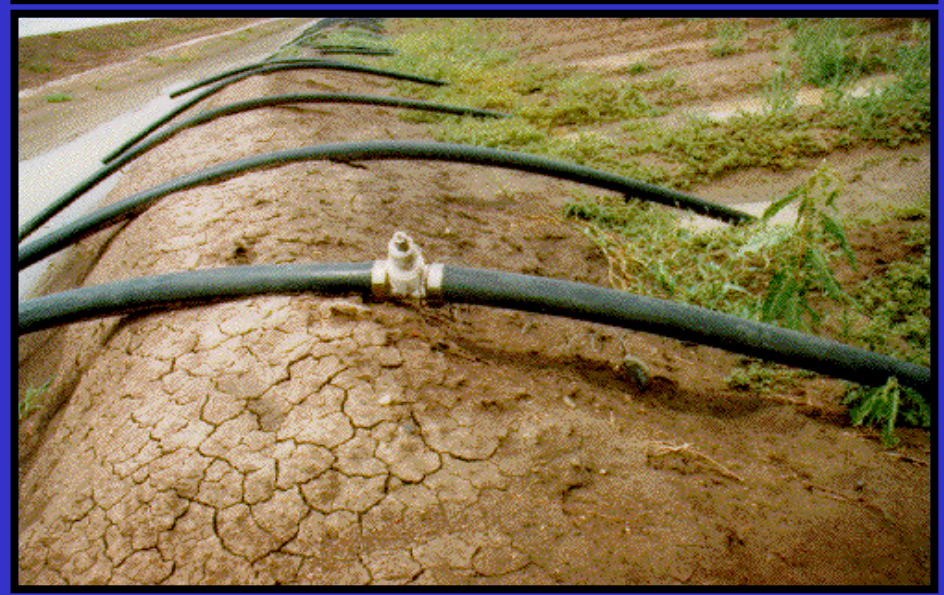
Application Efficiency

Application Efficiency = $\frac{\text{Volume applied to Deficit}}{\text{Volume Applied to Field}}$



Application Rate

- GLI tee mount flow sensors in siphons
- Measures siphon flow rate and the total volume applied (mm)



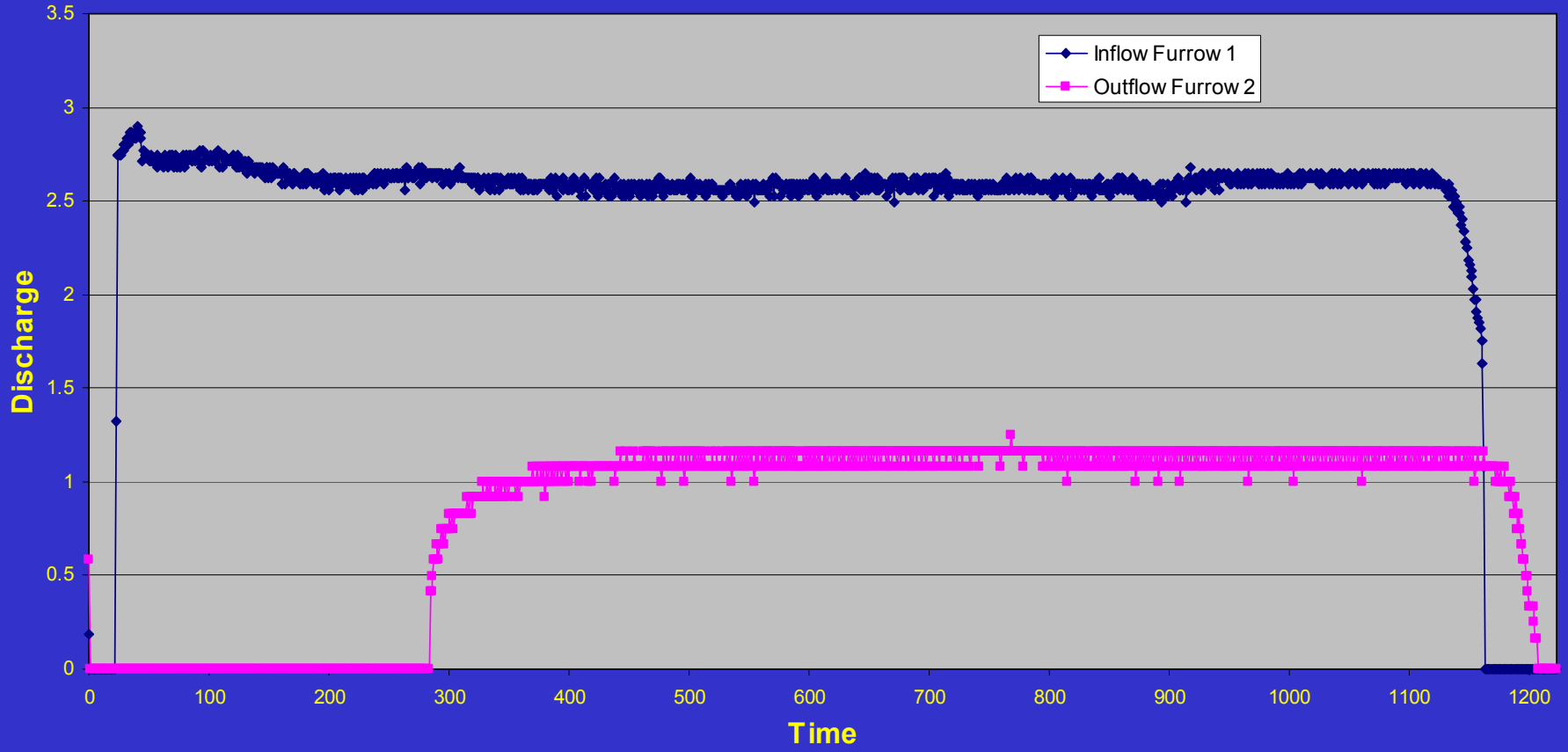
Outflow Data

- PVC dam
- GLI tee mount flow sensor
- Measures the tailwater flowrate and volume (mm)

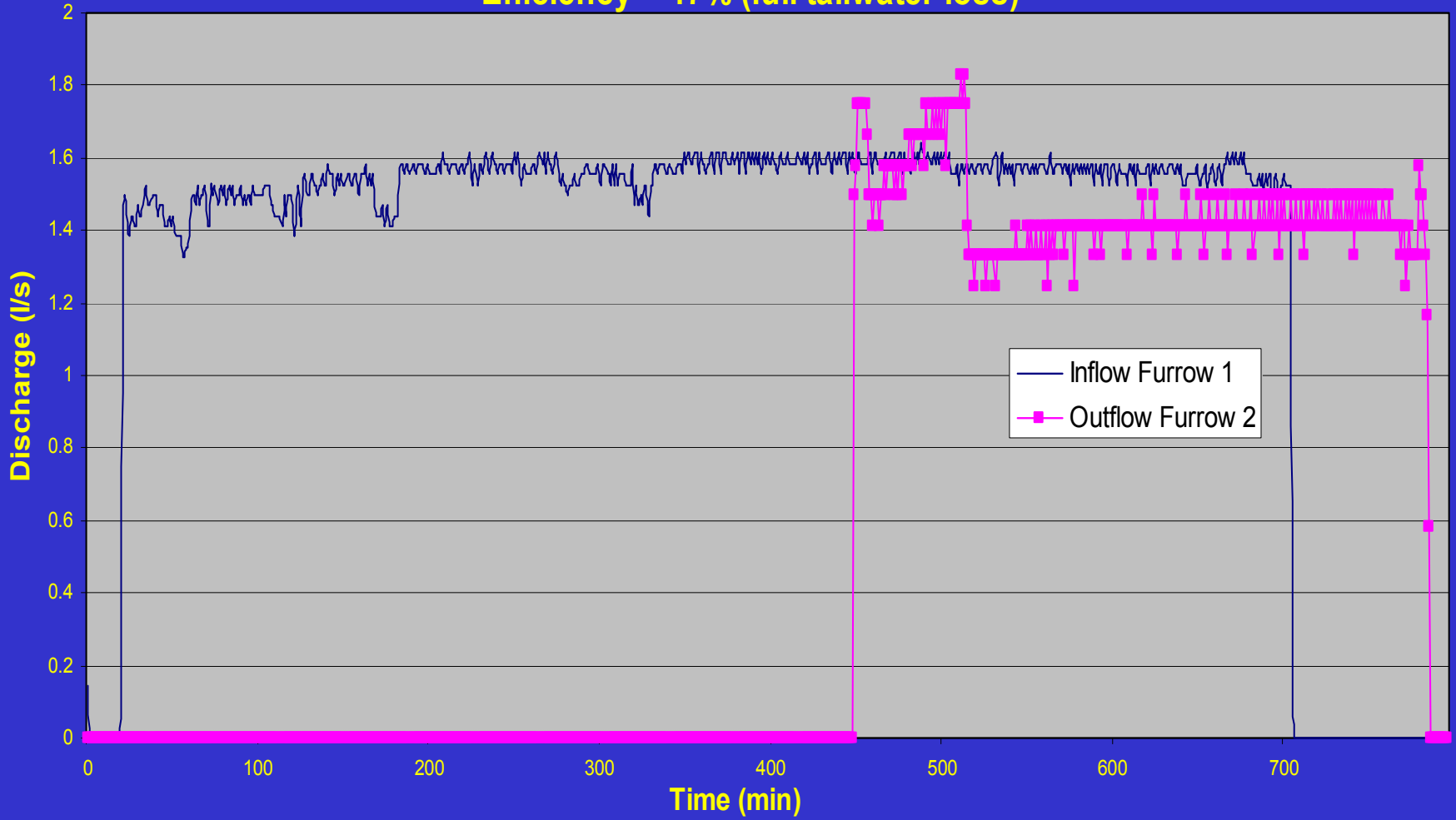
Soil Moisture Deficit

- Neutron Probe
- amount of water applied to the soil profile

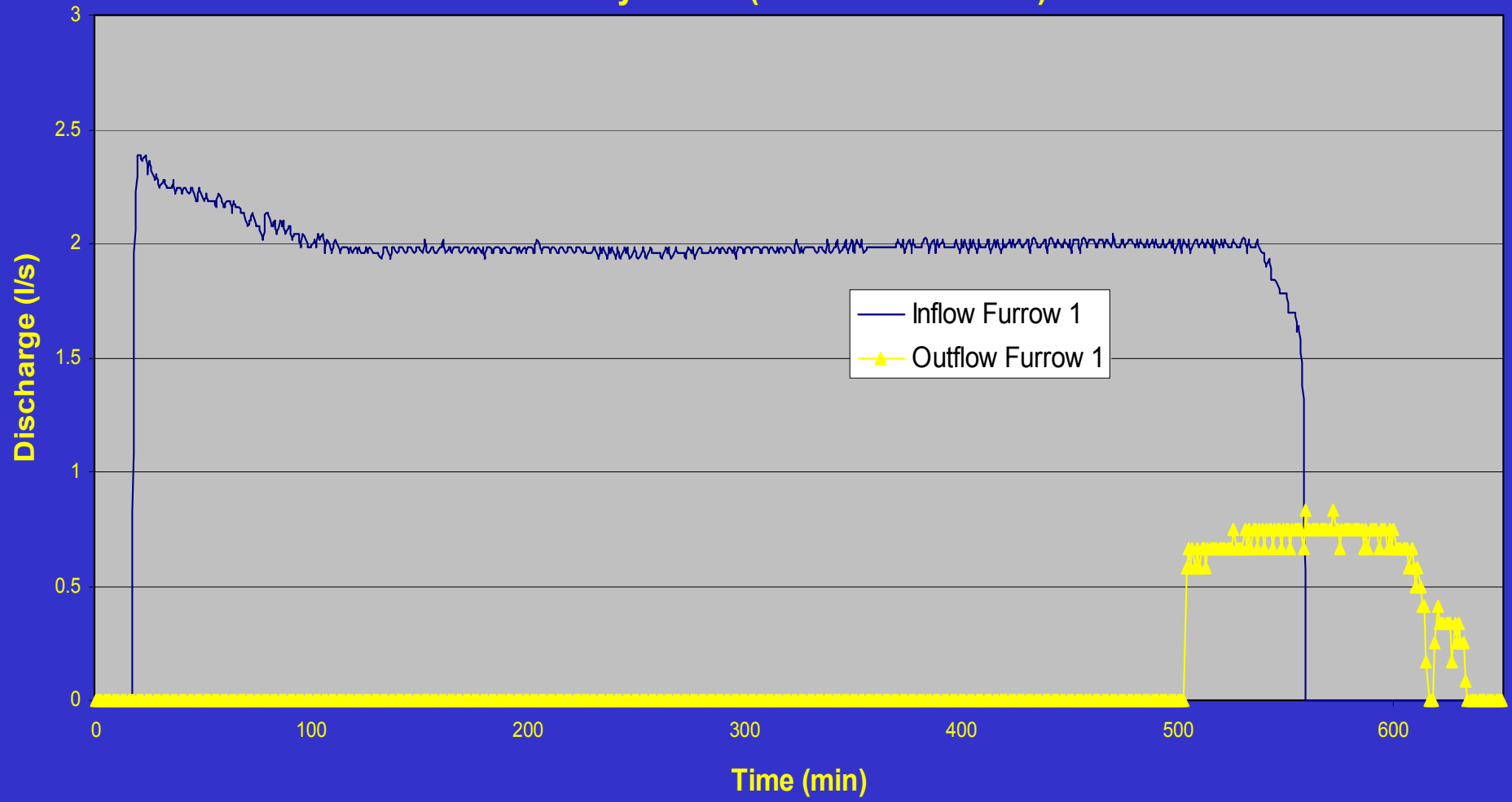
Applied = 355mm
Deficit = 120mm
Tailwater = 120mm
Deep Drainage = 115mm
Efficiency = 33% (full TW losses)
Efficiency = 51% (no TW loss)



Application = 85mm
Deficit (applied to fill soil profile) = 40mm
Tailwater = 40mm
Deep Drainage = 5mm
Efficiency = 93 % (no Tailwater losses)
Efficiency = 47% (full tailwater loss)



Application = 87 mm
Deficit (applied to fill soil profile) = 78 mm
Tailwater = 7 mm
Deep Drainage = 2mm
Efficiency = 97% (no Tailwater losses)
Efficiency = 90% (full Tailwater loss)



Seasonal Application Data

APPLIED				TAILWATER	DEFICIT	TOTAL INFILTRATION	DEEP DRAINAGE (=error & "other losses")	EFFICIENCY	
Irrigation No. and Date	**Av. Furrow Application Rate (l/s/fur)**	**Application Time (min)**	**Application to Furrow (mm)**	**Runoff Tailwater Furrow (mm)**	**Added to Soil Moisture Defecit (mm)**	**Total Infiltrated (mm)**	**Deep Drainage (mm)**	**Application Efficiency (TW recycling) %**	**Application Efficiency (no TW recyc) %**
3 – 10/12/98	1.25	719	89.8	21.7	35.5	68.1	32.6	63.7	39.5
4 – 21/12/98	1.34	1216	130.0		50.2				38.6
6 – 7/1/99 Low Head	1.55	685	84.9	39.1	39.9	45.9	6.0	93	47.0
High Head	1.94	650	100.9	23.9	39.9	77.1	37.2	63.2	39.5
7 – 17/1/99 Low Head	1.58	818	103.6	18.4	84	85.2	1.2	98.8	81.1
High Head	2.01	540	86.7	6.5	78	80.2	2.2	97.5	90.0
8 – 15/2/99 Low Head	1.52	973	118.6	7.8	99.3	110.9	11.6	90.3	83.7
High Head	2.34	648	105	8.5	89	96.5	7.5	92.8	84.8
Total			**750mm** *	**100mm** #	**545mm** @	**650mm** !	**105mm**	**86%**	**73%**
%			**100%**	**13%**	**73%**		**14%**	**86%**	**73%**

(* assumes averages between measured applications when more than one is recorded and that initial two unmeasured irrigations were 70mm and irrigation 5 was 100mm)
(# assumes tailwaters of 10mm per irrigation on irrigations that were not recorded)
(@ assumes deficits of 50 mm in irrigations 1,2 and 5)
(! assumes infiltration of 80mm in irrigations 1,2,4 and 5)

Seasonal Application Data

APPLIED				TAILWATER	DEFICIT	TOTAL INFILTRATION	DEEP DRAINAGE (+error and "other losses")	EFFICIENCY	
Irrigation No. and Date	**Av. Furrow Application Rate (l/s/fur)**	**Application Time (min)**	**Application to Furrow (mm)**	**Runoff Tailwater Furrow (mm)**	**Added to Soil Moisture Defecit (mm)**	**Total Infiltrated (mm)**	**Deep Drainage (mm)**	**Application Efficiency (no TW loss) %**	**Application Efficiency (full TW loss) %**
1 – 16/10/98	1.53	632	96.6		50				52
2 – 09/12/98 High Head	1.94	550	106.7	7	43	100	57	47	40
Low Head	1.35	474	64.4	7	43	57	15	77	66
3 – 23/12/98	2.34	549	128.6	7.7	71	121	50	62	55
4 – 07/01/99	2.16	345	74.7	0.4	54	74		73	73
5 – 19/01/99	2.25	495	111.9		85				76
7 – 11/02/99	1.88	359	67.7	1	53	67	14	80	79
8 – 22/02/99	2.16	556	120.4	1.41	87	119	32	73	72
Total			**685mm**	**27mm #**	**443mm**	**640mm @**	**197mm**	**71%**	**67%**
%			**100%**	**4%**	**65%**		**29%**	**71%**	**67%**

(# assumes average tailwaters per irrigation on irrigations that were not recorded)
(@ assumes infiltration of 80mm in irrigation 1 and 100mm on irrigation 5)

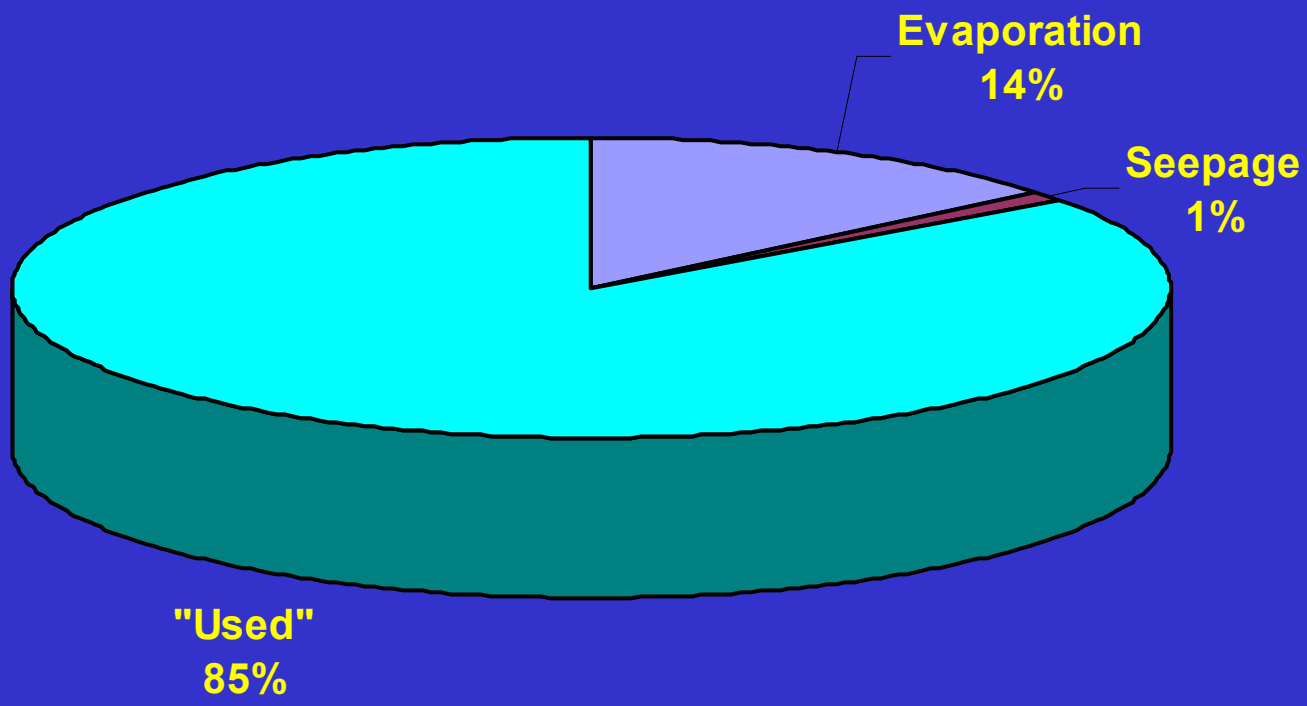
Seasonal Application Data

Application Efficiency and Volume Balance Data at Farm E Field 2

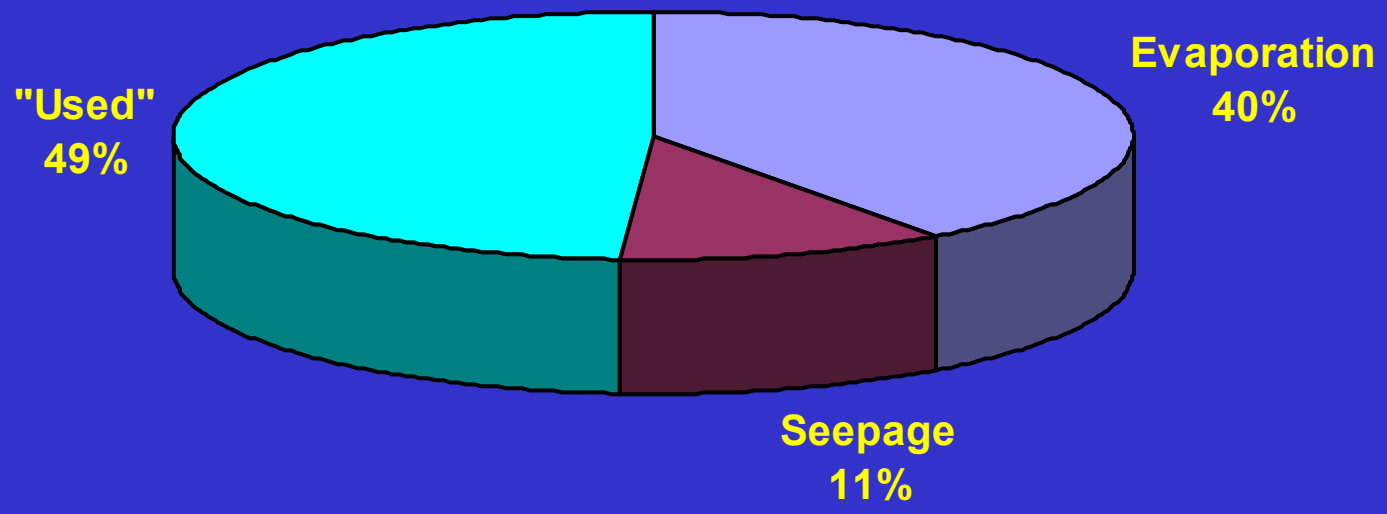
Irrigation No. and Date	I (mm)	TW (mm)	Defecit (mm)	Surface Evap' (mm)	Deep Drainage (mm)	Ea (no TW loss) %	Ea (full TW loss) %	DU %	Er (%)
1 – 01/10/99	116	21	80	8	8	86.4	68.6	94	100
2 – 04/12/99	113	8	54	7	44	55	48	86	100
3 – 26/12/99	127	20	69	8	30	70	54	93	100
4 – 11/01/00	90	21	65	0	4	95	72	90	95
5 – 20/01/00	61	6.4	64	0	0	100	89	83	84
6 – 31/01/00	84	22	85	0	0	100	74	97	74
7 – 08/02/00	83	15	80	0	0	100	82	91	85
8 – 25/02/00	93	9.3	76	0	7	92	82	93	100
TOTAL	767mm	123mm	573mm	23mm	88mm	91%	75%		

BENCHMARKING

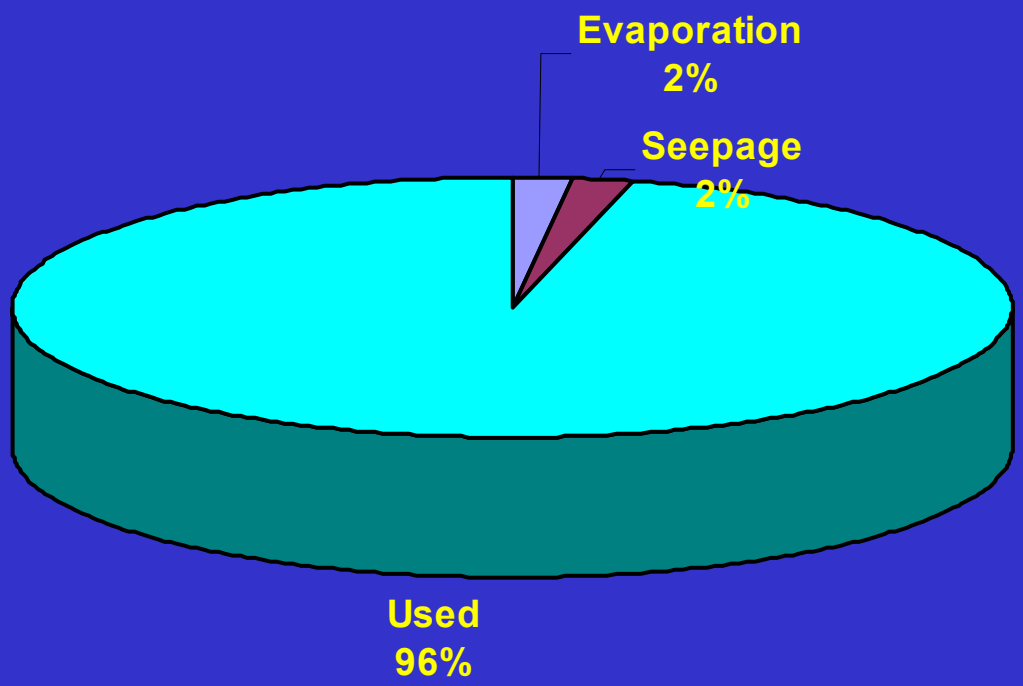
Storage Efficiency (best case)



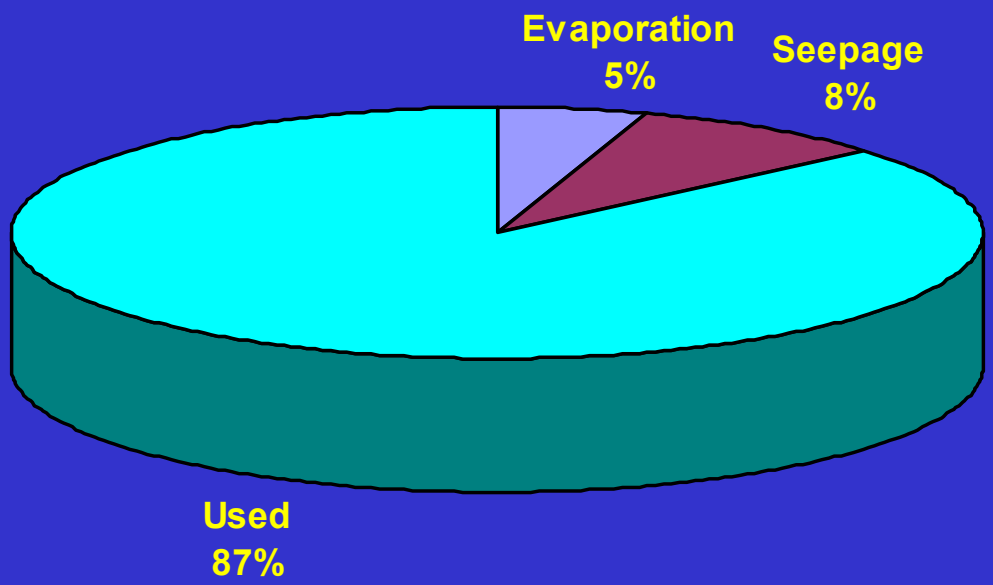
Storage Efficiency (worst case)



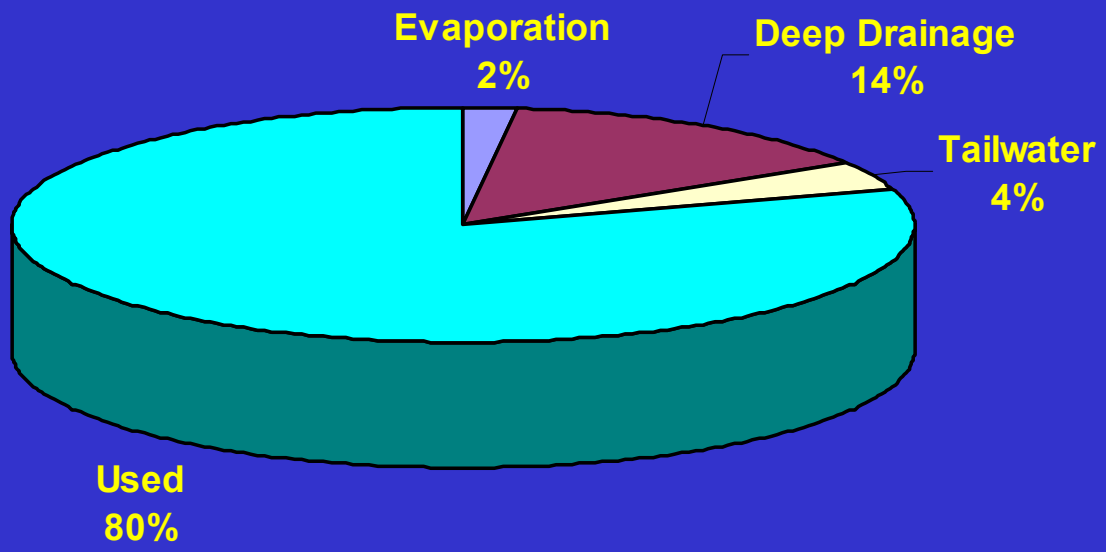
Distribution Efficiency (best case)



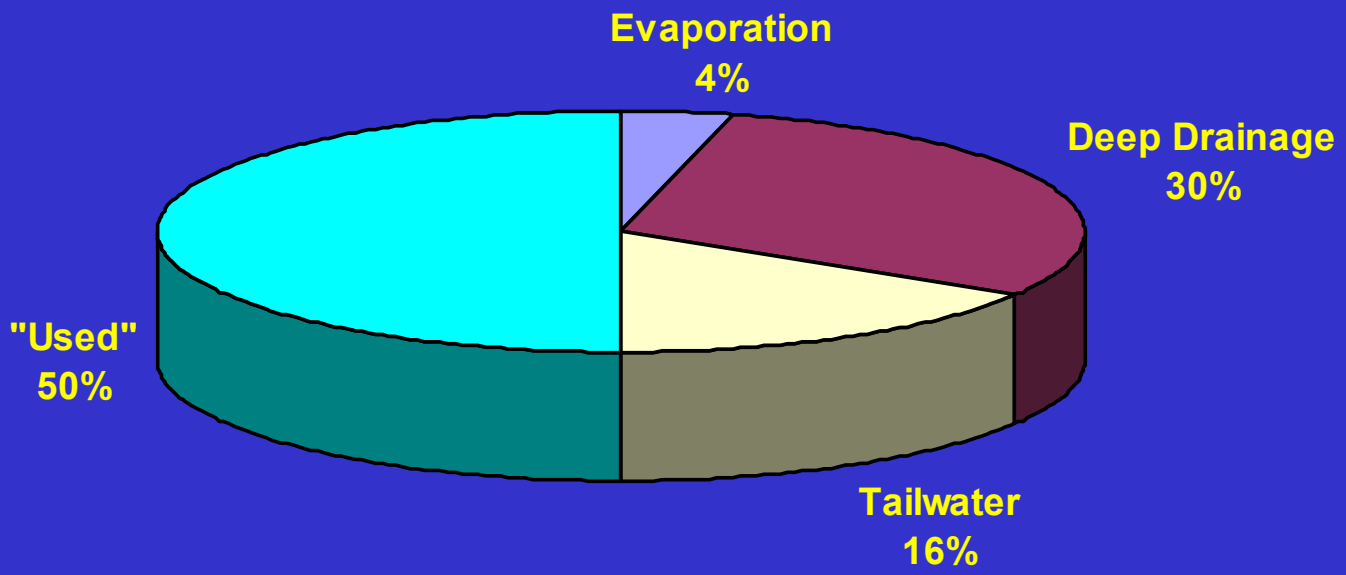
Distribution Efficiency (worst case)



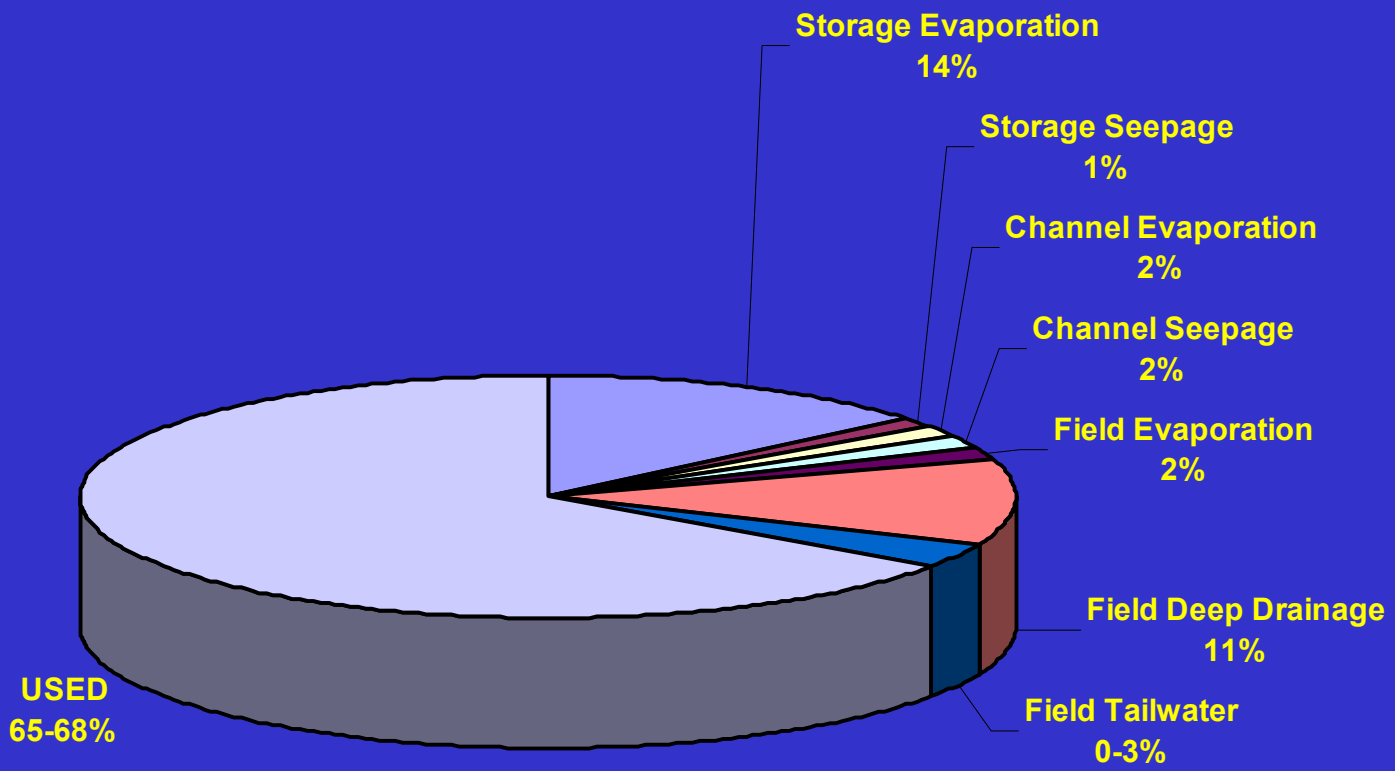
Application Efficiency (best case)



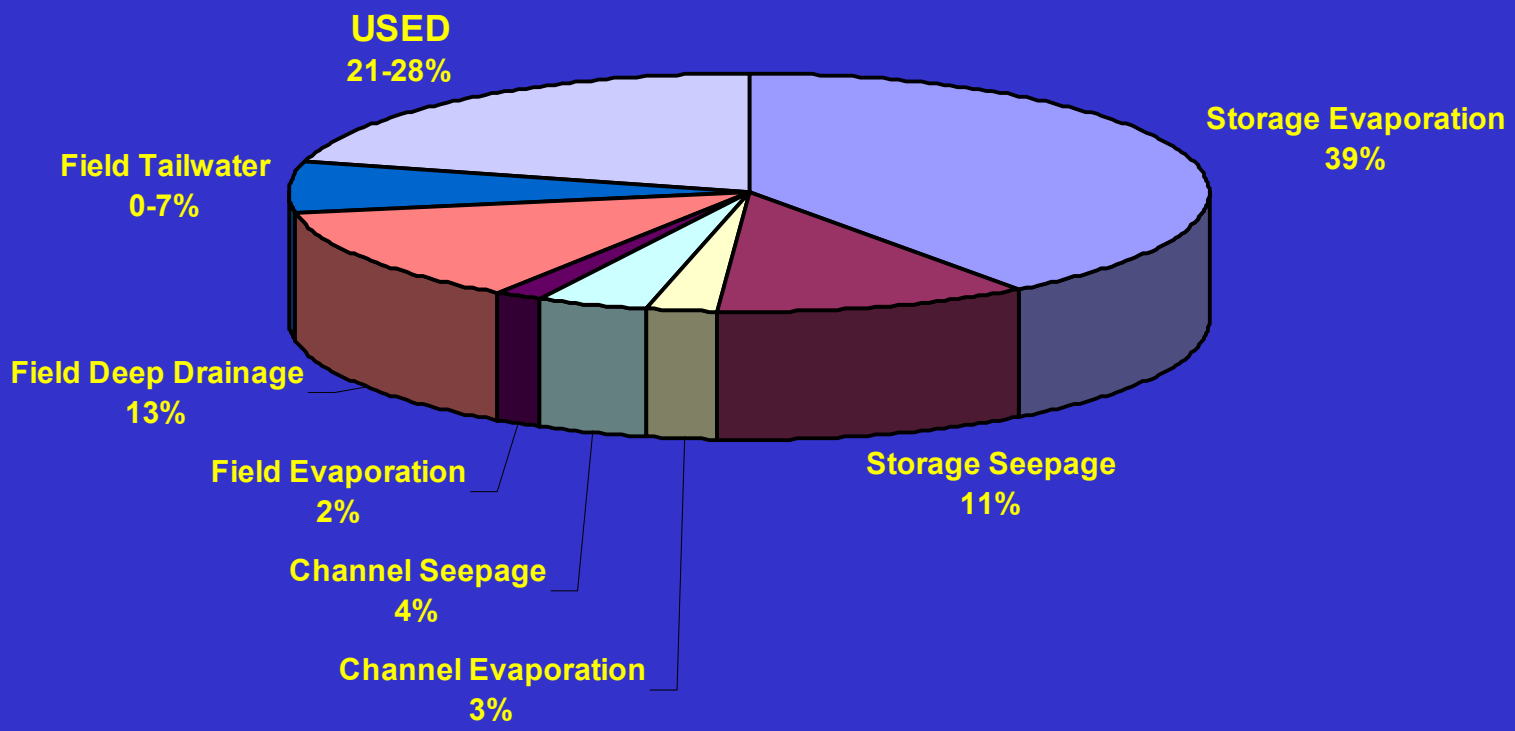
Application Efficiency (worst case)



WHOLE FARM WATER USE EFFICIENCY (best case)



WHOLE FARM WATER USE EFFICIENCY (worst case)



IMPROVING EFFICIENCY

THE MAIN GAINS

- Storage Evaporation Mitigation - "the Holy Grail"
  - covers
  - deepening storages - decreasing surface area/volume ratio
  - $$$$$$
- In some cases Storage Seepage
  - $$$??

Cost/Benefit of Deepening Storages

Water Storage Design Comparisons for a 3500ML storage at Goondiwindi

Wall Height (m)	5	7.5	7.5	10
Water depth (m)	4.2	8.7	8.7	12.4
Shape	Square	Square	Round	Round
Area (ha)	76	42	44	28
Earthworks (m^3)	349,600	654,887	592,876	888,483
Earthworks unit cost ($/$m^3$)	1.00	1.33	1.3	1.25
Earthworks cost ($)	$349,600	$871,000	$770,739	$1,110,604
Av. Evaporation on Yearly basis (m)	1.8			
ML lost to Evap.	1521	734	736	516
% Evap Loss	43%	21%	21%	15%
Extra ha of crop production (@ 6ML/ha)	0	131	131	167
Extra $ (@ $1976/ha gross margin)	0	$258,856	$258,856	$329,992
Years to pay back extra investment	-	2.01	1.62	2.3

THE MAIN GAINS

- IN FIELD IRRIGATION APPLICATION
  - Deep drainage
  - Tailwater
  - HOW? - low cost simple management changes

Managing Applications

- Siphon Application Rate
- Siphon cut-off time
- Matching Applied volume to Soil Moisture Deficit

Measure it to manage it!!

Evaluate and Improve

- APPLIED (mm) = RATE x TIME
- 1 mm = 1 litre over 1 sq. m
- 1000000 litres over 1ha = 100mm (4 inches)
- Manage and Optimise Irrigation
  - Manage Siphon Application Rate
  - Manage Siphon cut-off time
  - Applied (mm) = Required Soil Deficit (mm)
- ARE YOU OVER OR UNDER IRRIGATING?
- Could you grow more crop with the same water

FIRST EVALUATE

IRRIMATE

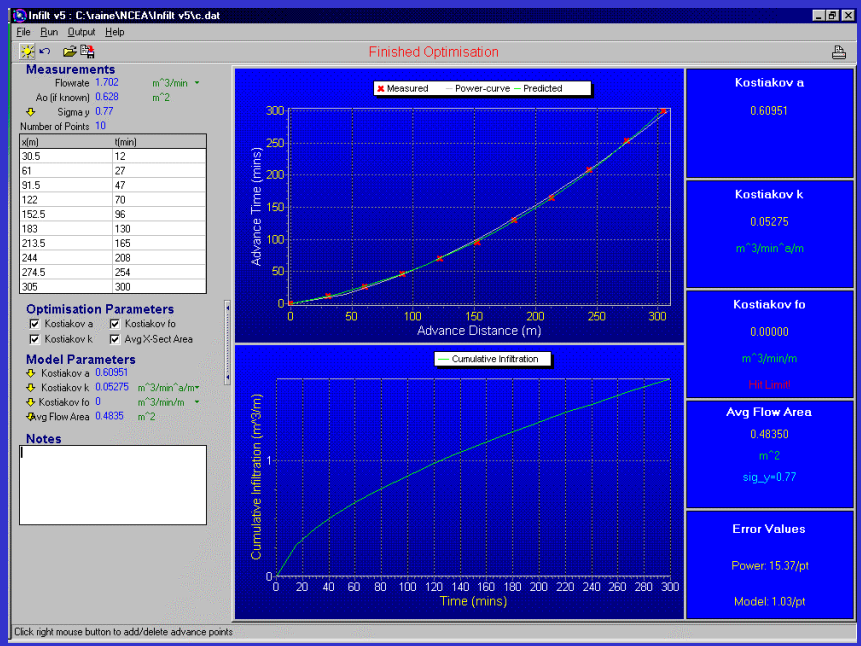
Surface Irrigation Monitoring Tools

Irrimate Siphon Flow Sensor

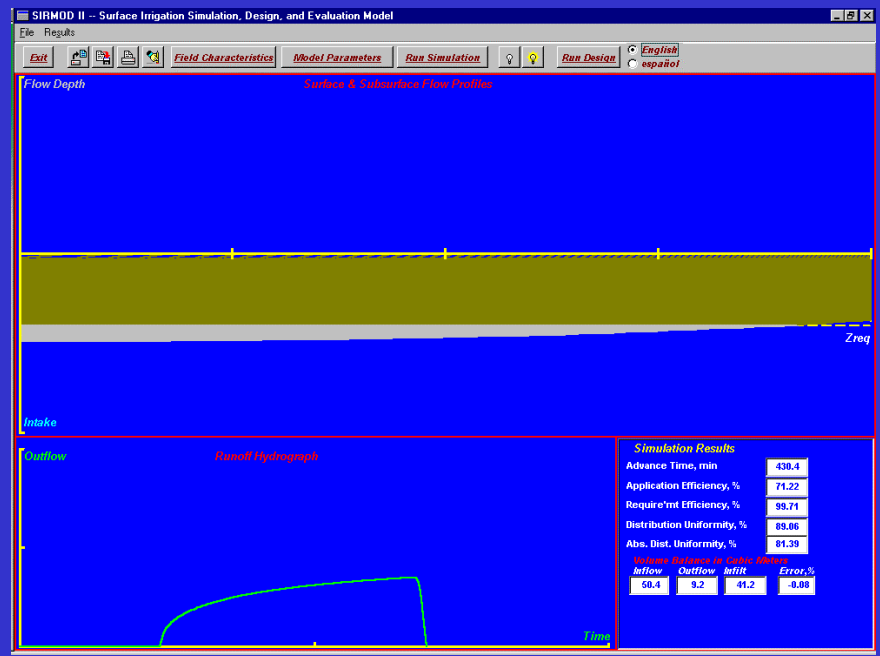
Irrimate Advance Sensor and Palmtop Computer

SIRMOD

Simulation Modelling of Surface Irrigation



"Infilt" - Infiltration Characterisation



"Sirmod" - Surface Irrigation Model

Current Practice

- Field Length - 1000m
- Slope 1:800
- Alternate furrow irrigation
- Soil Moisture Deficit - 70mm
- Application rate = 4l/s (63mm siphon at 350mm head)
- Cut-off time - when reaches the end or after - approx 16 hrs

CURRENT PRACTICE

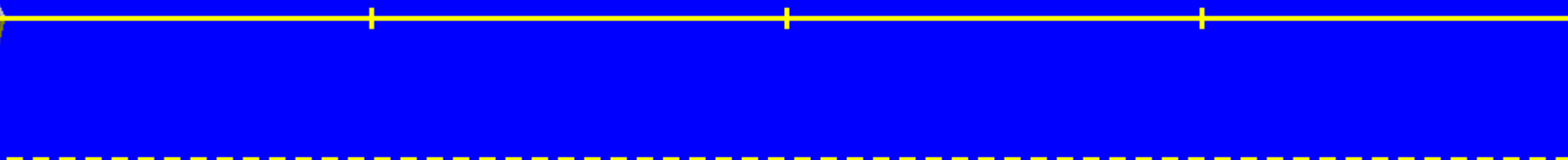
EG……

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

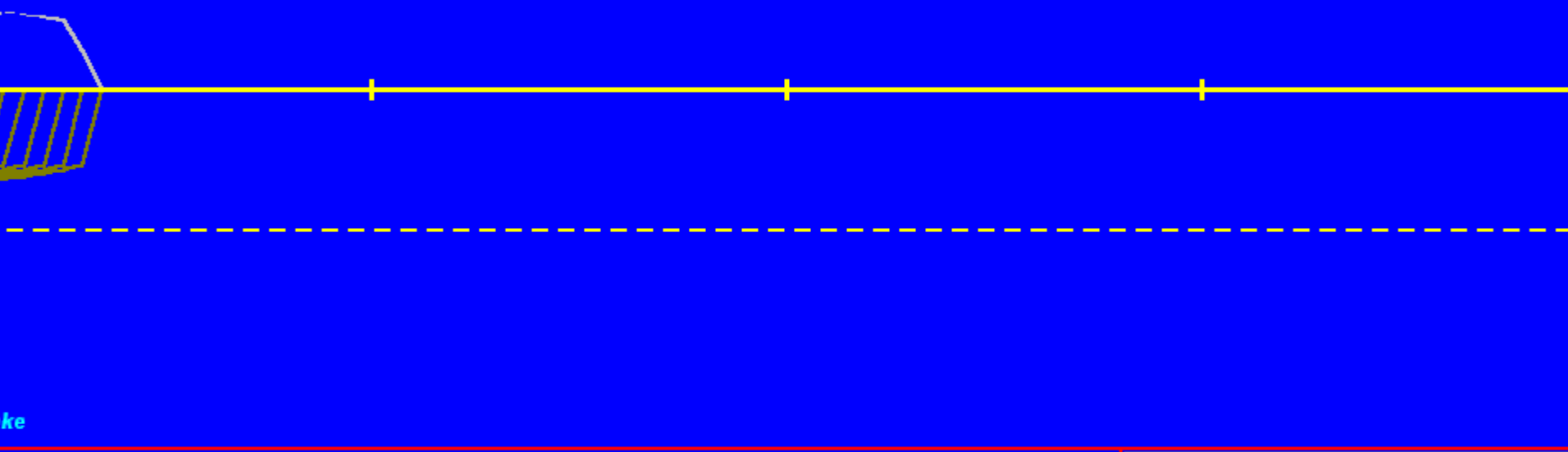
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

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Application Efficiency, %	0.00
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Distribution Uniformity, %	0.00
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Volume Balance in Cubic Meters

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Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

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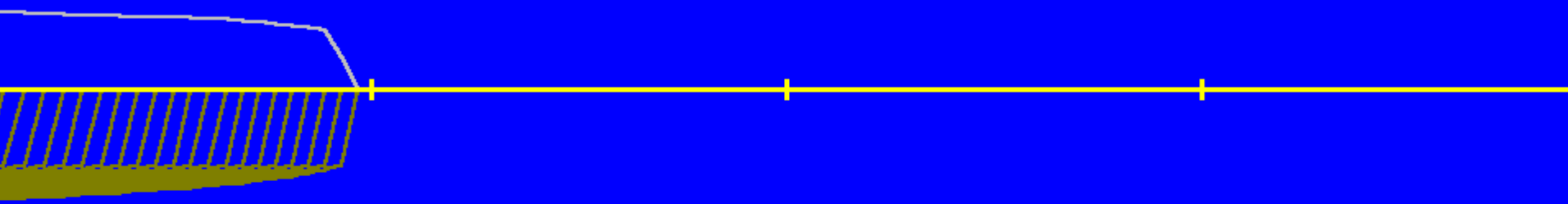

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flow

Runoff Hydrograph

Simulation Results

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Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

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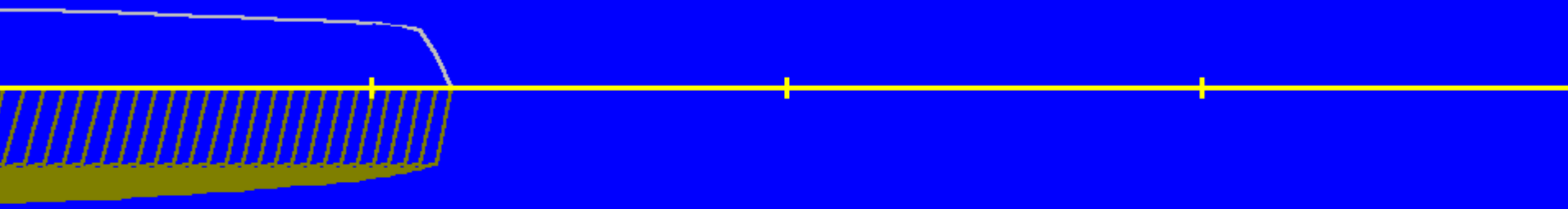
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

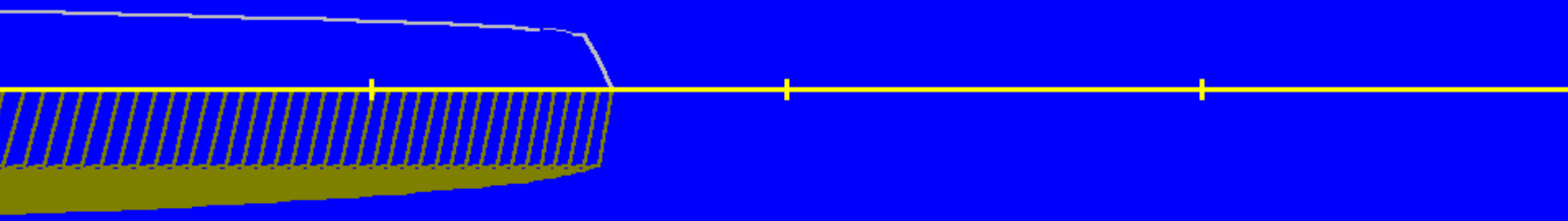
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
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Volume Balance in Cubic Meters

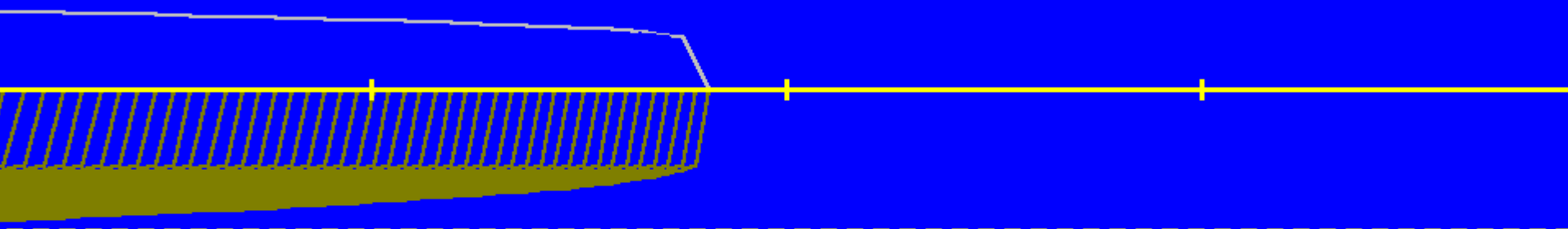
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

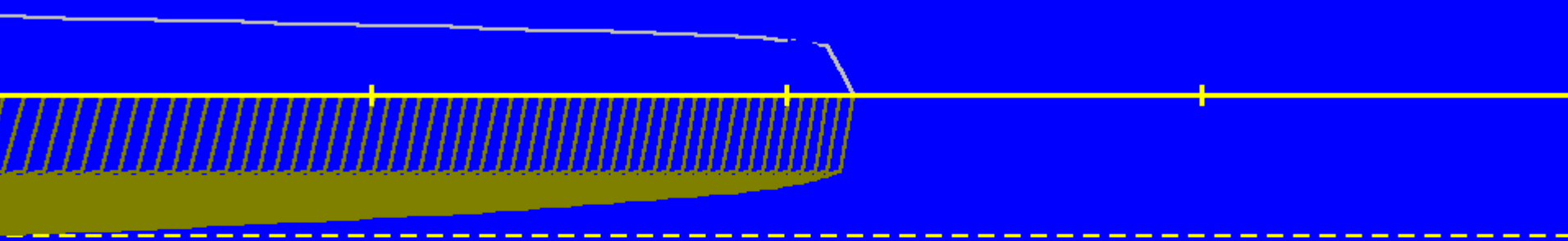
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

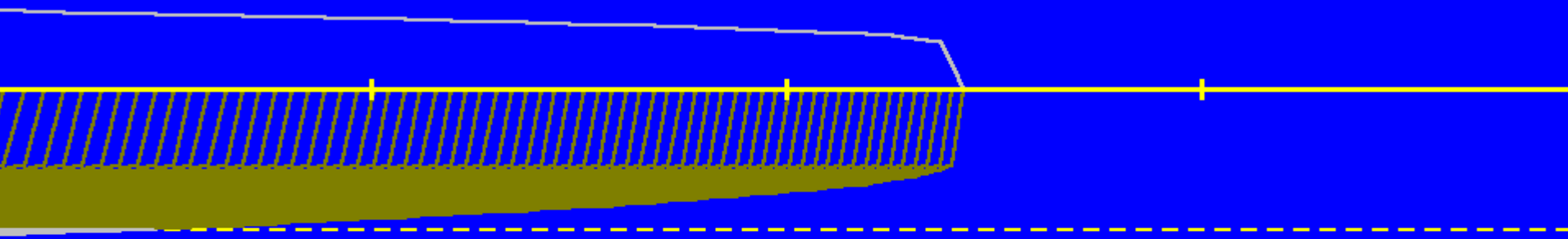
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

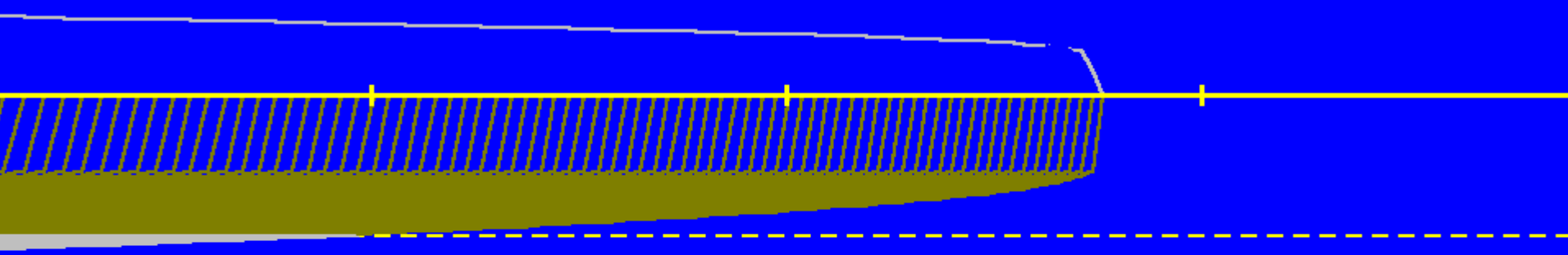
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

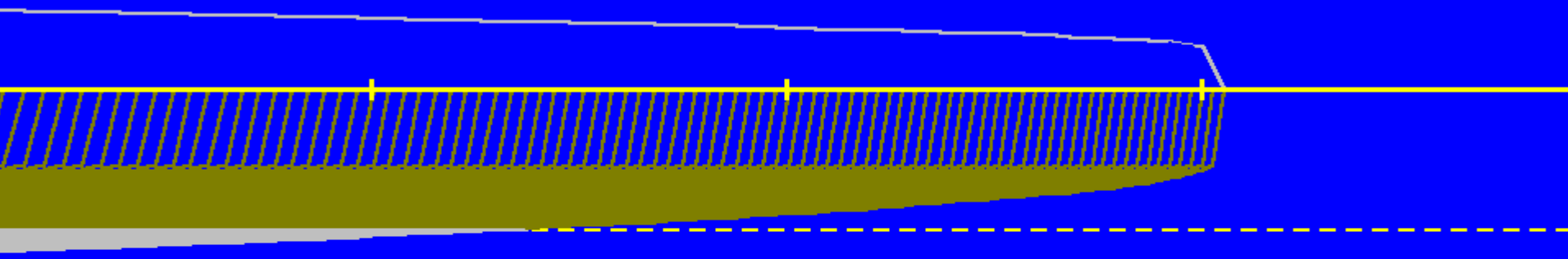
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

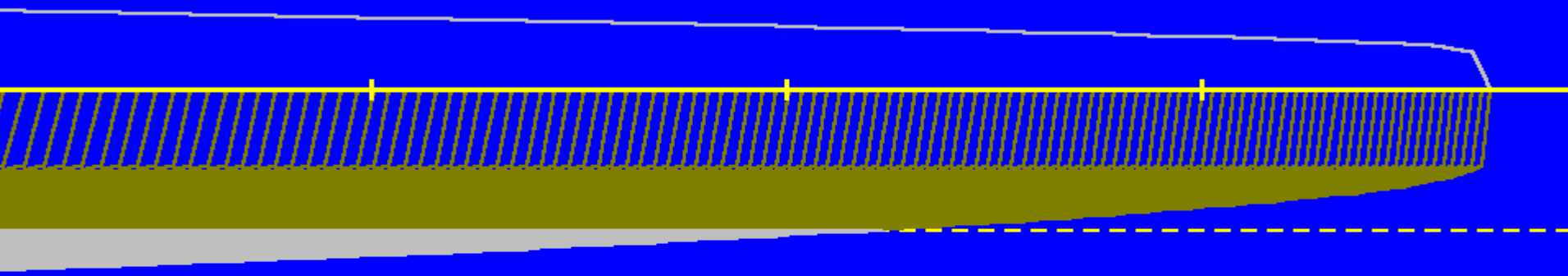
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

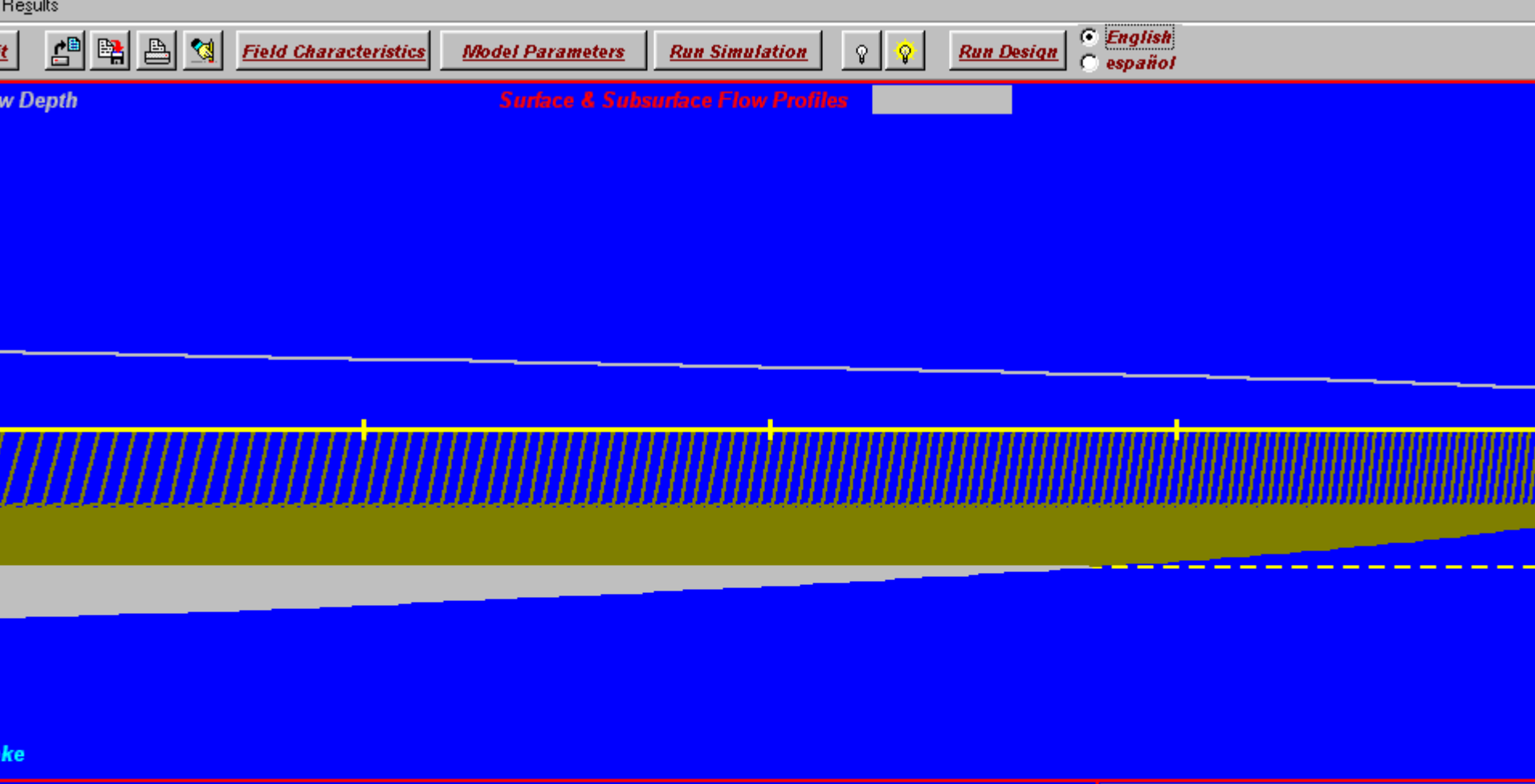
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

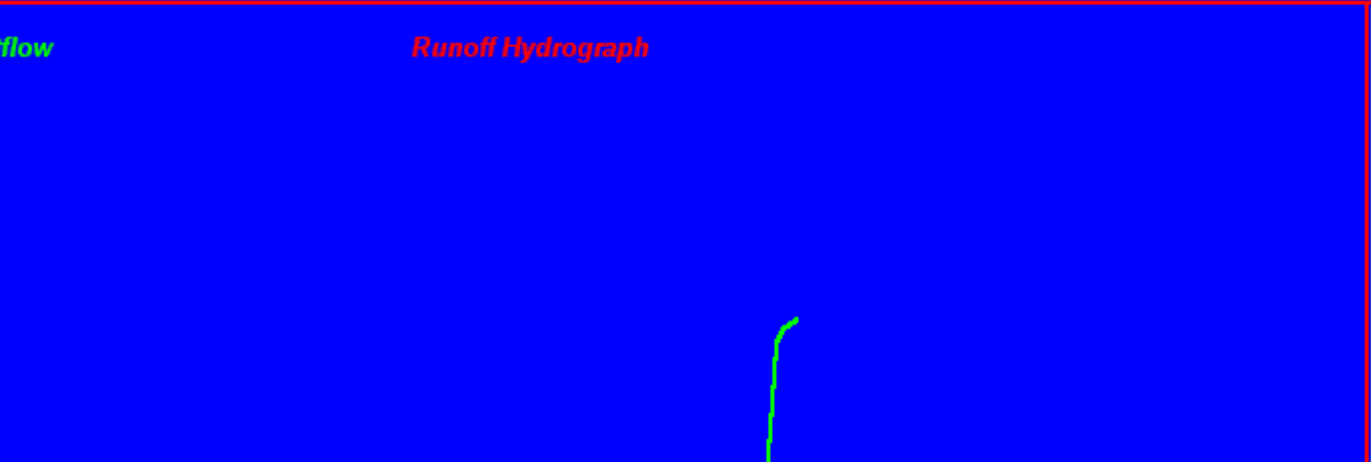
Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph



Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

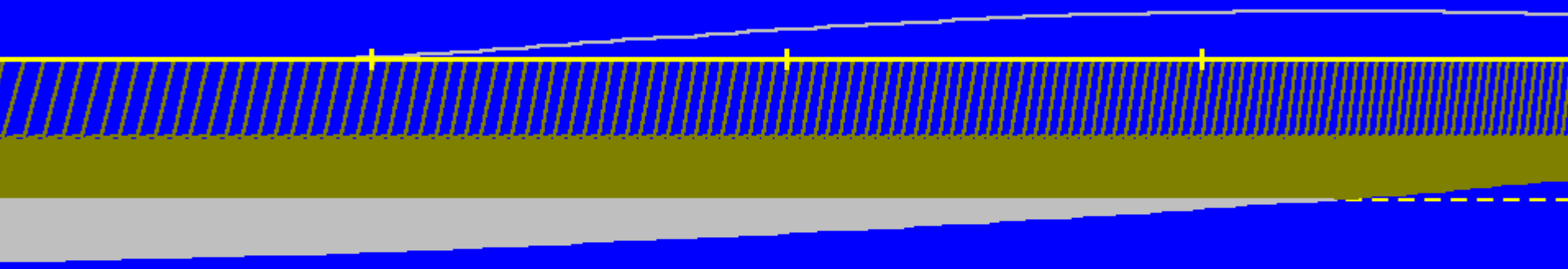
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

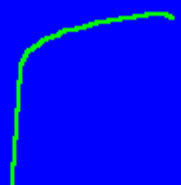
Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph



Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

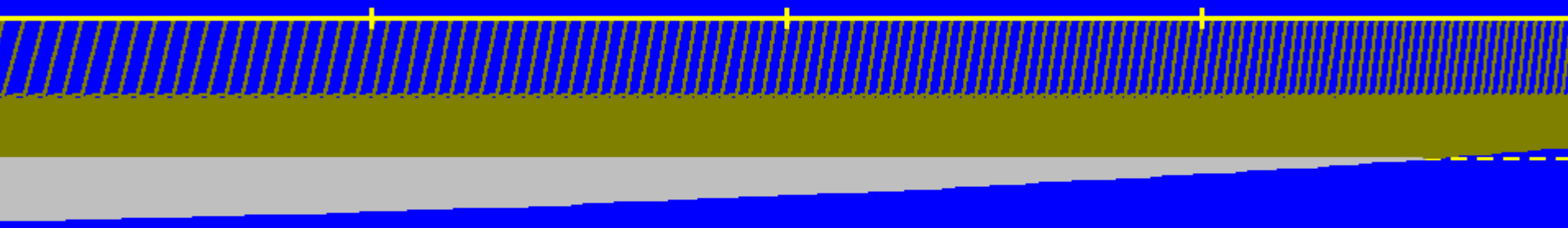
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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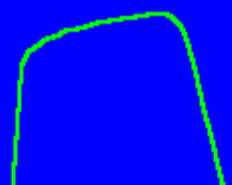
flow

Runoff Hydrograph

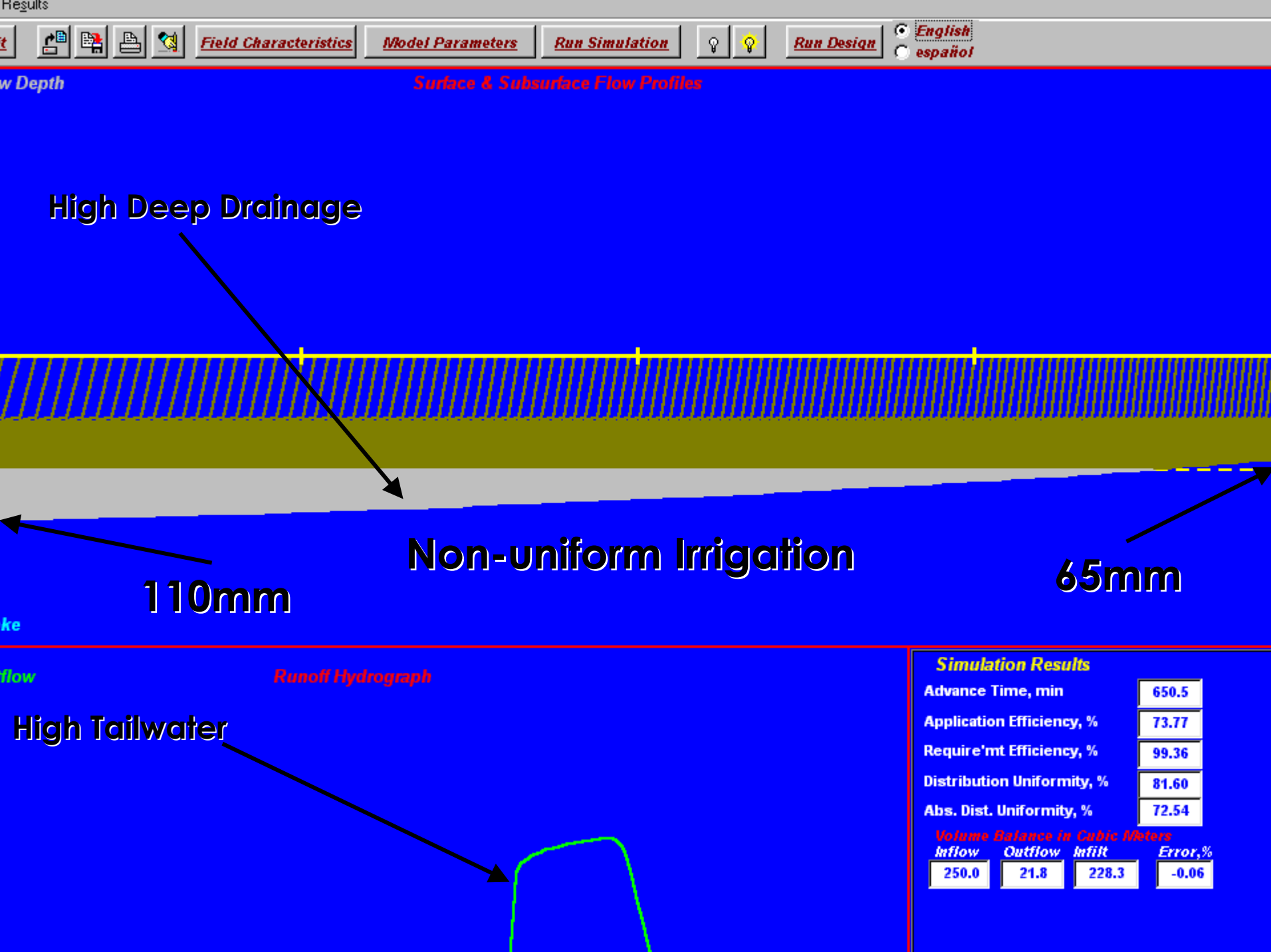


Simulation Results

Advance Time, min	650.5
Application Efficiency, %	73.77
Require'mt Efficiency, %	99.36
Distribution Uniformity, %	81.60
Abs. Dist. Uniformity, %	72.54

Volume Balance in Cubic Meters

Inflow	Outflow	Infilt	Error,%
250.0	21.8	228.3	-0.06


Results
Field Characteristics
Model Parameters
Run Simulation
Run Design
English
español
w Depth
Surface & Subsurface Flow Profiles
High Deep Drainage
Non-uniform Irrigation
110mm
65mm
ke
flow
Runoff Hydrograph
High Tailwater
Simulation Results
Advance Time, min
650.5
Application Efficiency, %
73.77
Require'mt Efficiency, %
99.36
Distribution Uniformity, %
81.60
Abs. Dist. Uniformity, %
72.54
Volume Balance in Cubic Meters
Inflow
Outflow
Infilt
Error,%
250.0
21.8
228.3
-0.06

THEN IMPROVE

Optimise The Irrigation Application

- MATCH APPLIED (mm) WITH REQUIRED (mm)
- Measure Irrigation using IRRIMATE
- Simulate Irrigation using SIRMOD
- OPTIMUM APPLICATION RATE
- OPTIMUM IRRIGATION TIME

OPTIMISED IRRIGATION

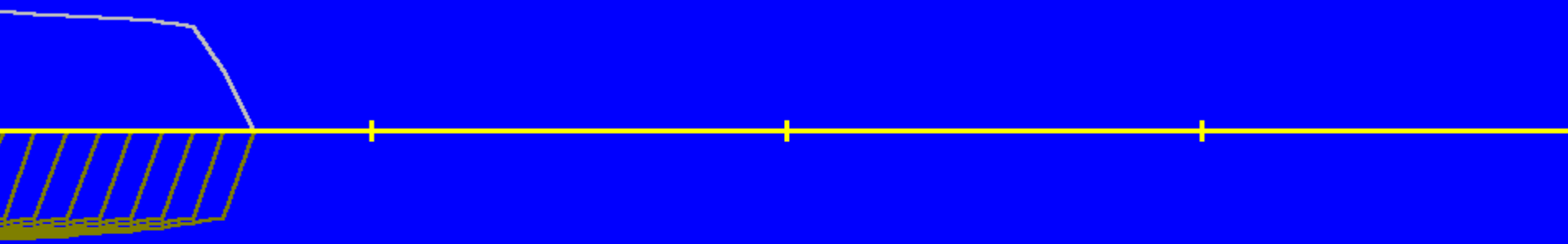
EG……

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

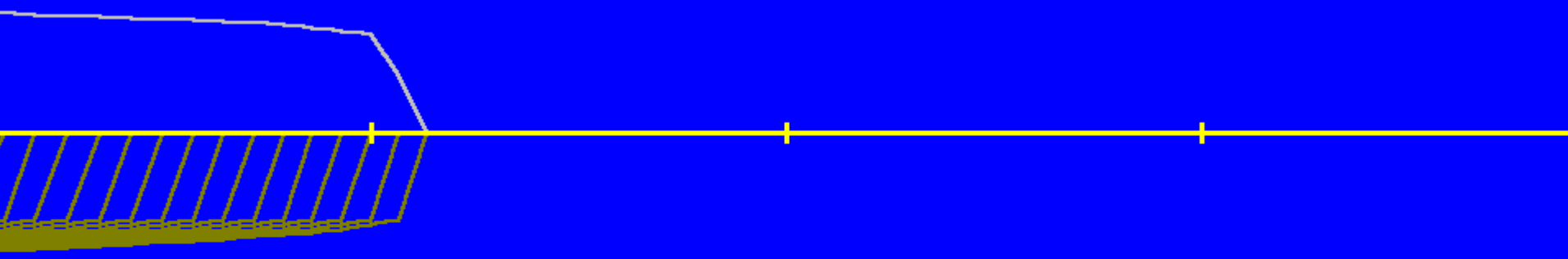
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

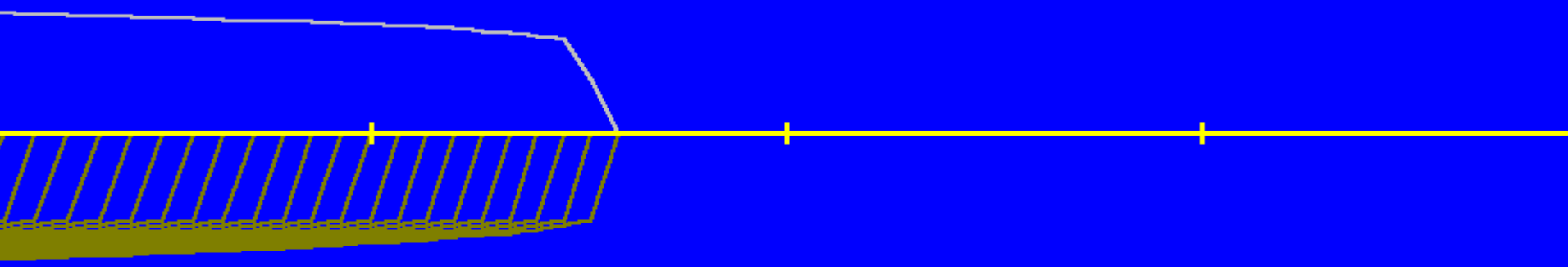
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

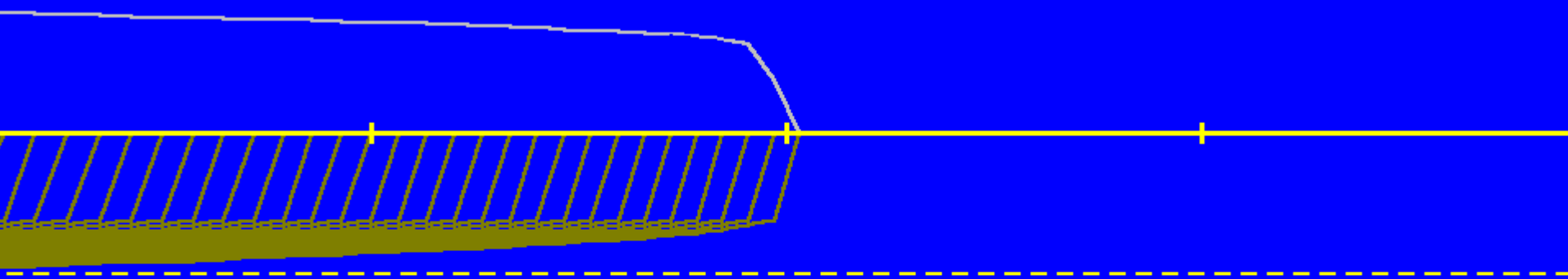
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

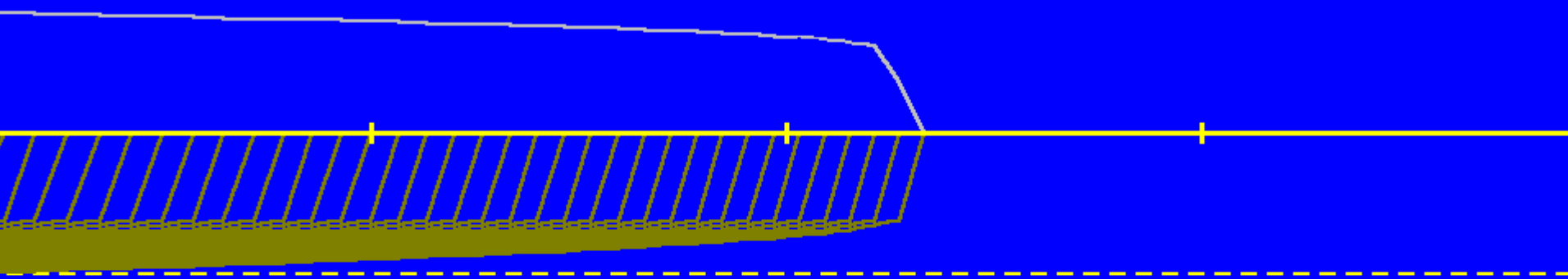
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

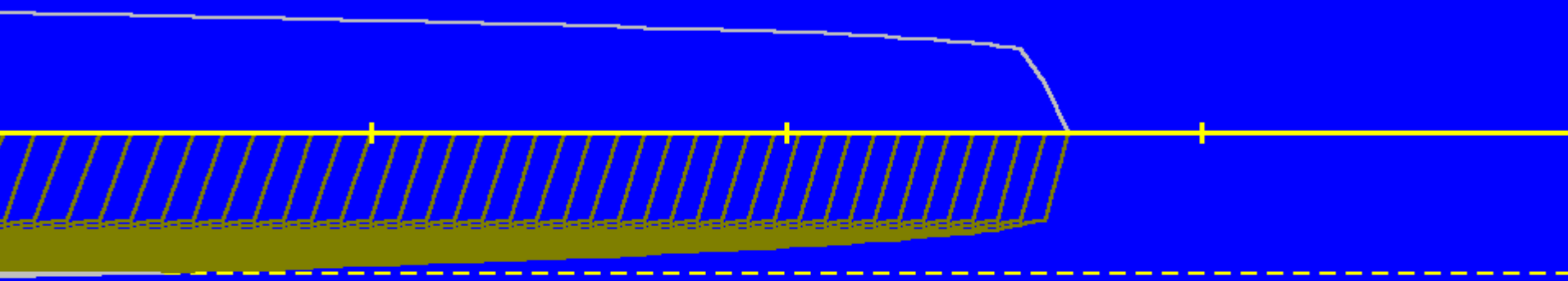
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

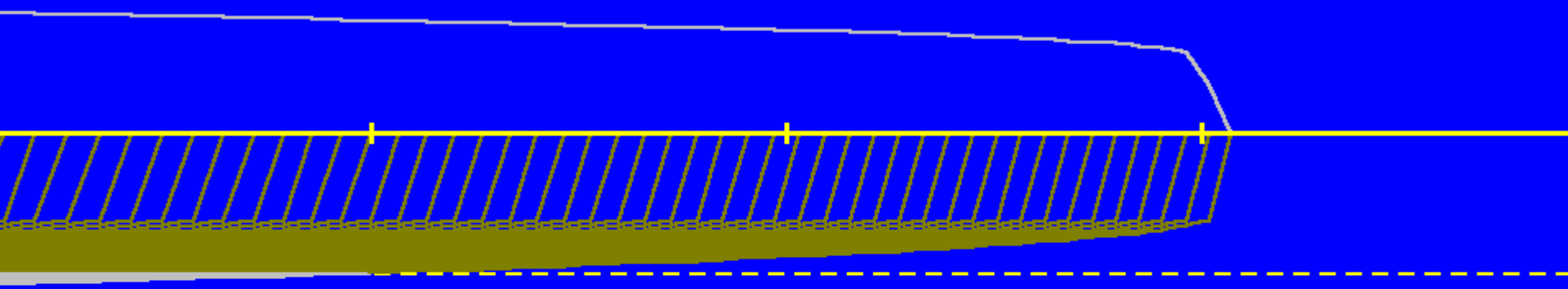
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

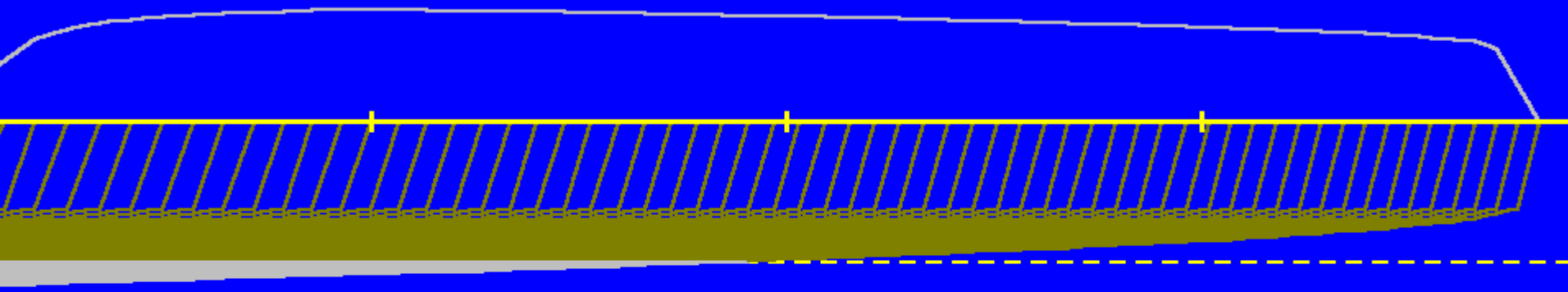
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



ke

flow

Runoff Hydrograph

Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

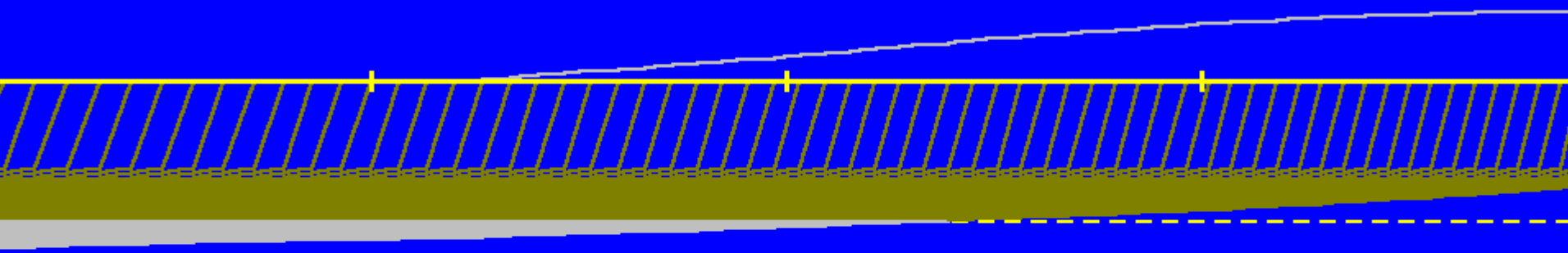
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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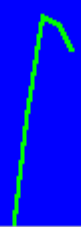
flow

Runoff Hydrograph



Simulation Results

Advance Time, min	0.0
Application Efficiency, %	0.00
Require'mt Efficiency, %	0.00
Distribution Uniformity, %	0.00
Abs. Dist. Uniformity, %	0.00

Volume Balance in Cubic Meters

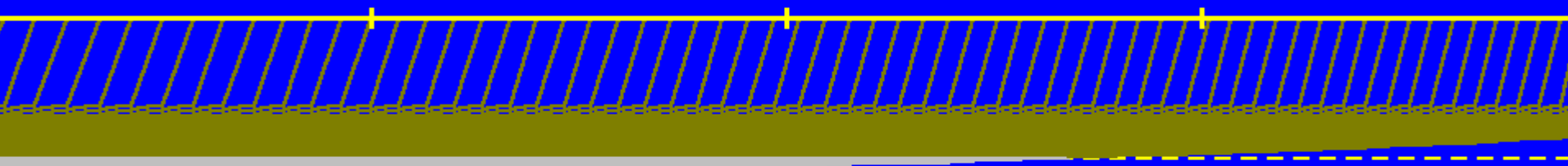
Inflow	Outflow	Infilt	Error,%
0.0	0.0	0.0	0.00

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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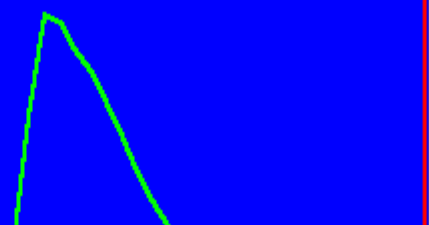
flow

Runoff Hydrograph



Simulation Results

Advance Time, min	323.4
Application Efficiency, %	88.06
Require'mt Efficiency, %	97.60
Distribution Uniformity, %	86.74
Abs. Dist. Uniformity, %	79.86

Volume Balance in Cubic Meters

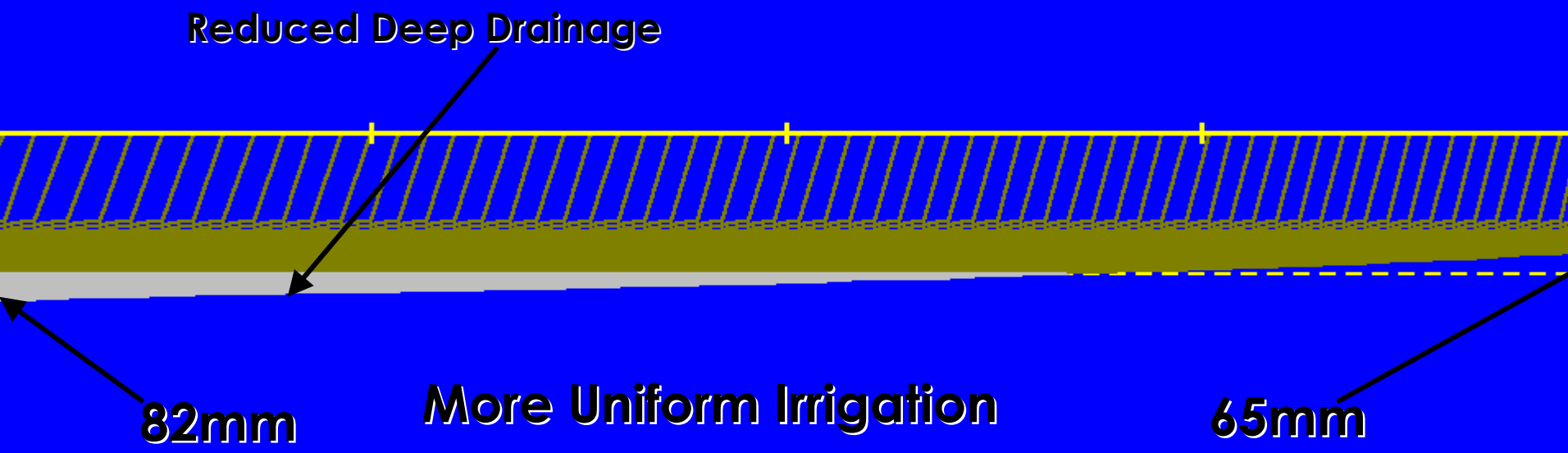
Inflow	Outflow	Infilt	Error,%
180.0	10.2	170.1	-0.18

Results

Field Characteristics | Model Parameters | Run Simulation | Run Design | English | español

w Depth

Surface & Subsurface Flow Profiles



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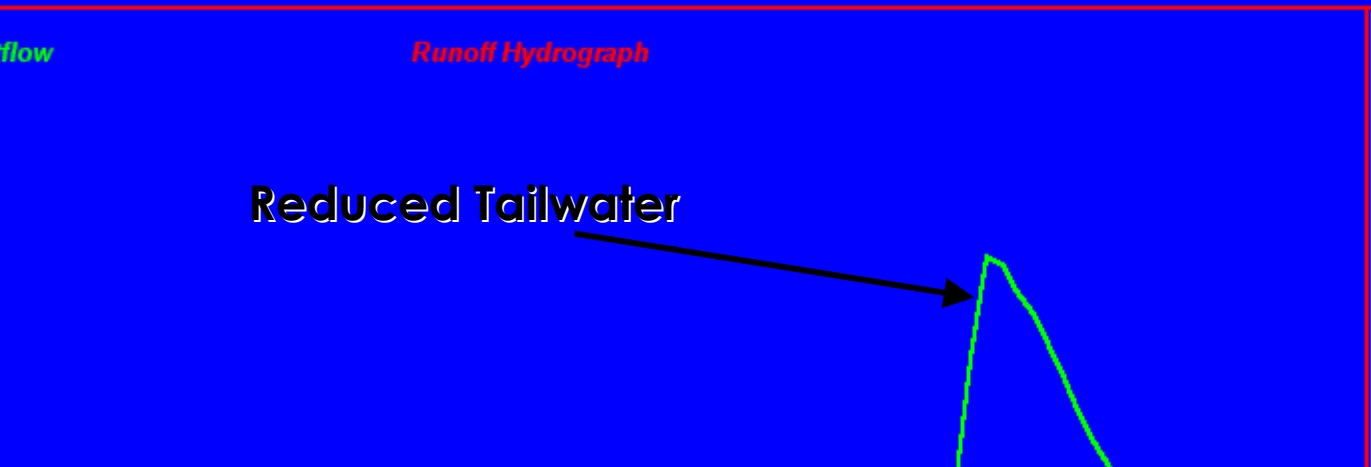
flow

Runoff Hydrograph



Simulation Results

Advance Time, min	323.4
Application Efficiency, %	88.06
Require'mt Efficiency, %	97.60
Distribution Uniformity, %	86.74
Abs. Dist. Uniformity, %	79.86

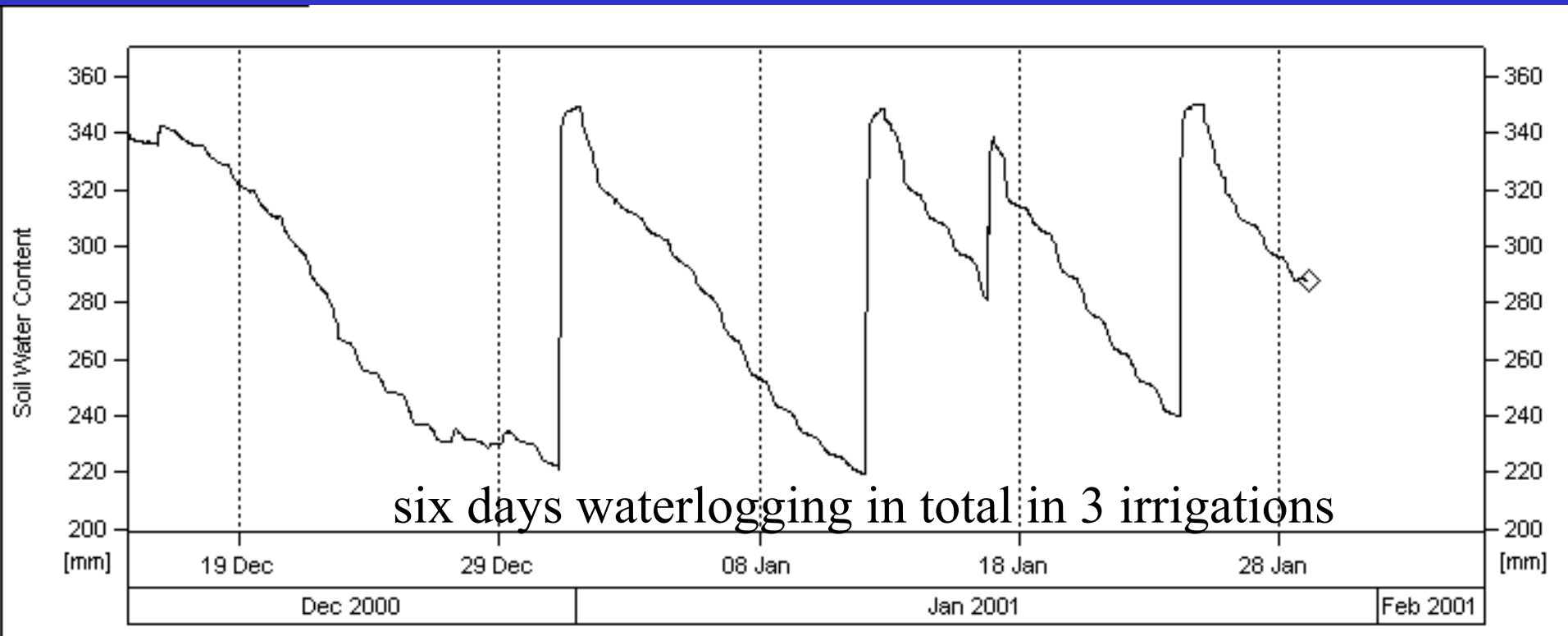
Volume Balance in Cubic Meters

Inflow	Outflow	Infilt	Error,%
180.0	10.2	170.1	-0.18

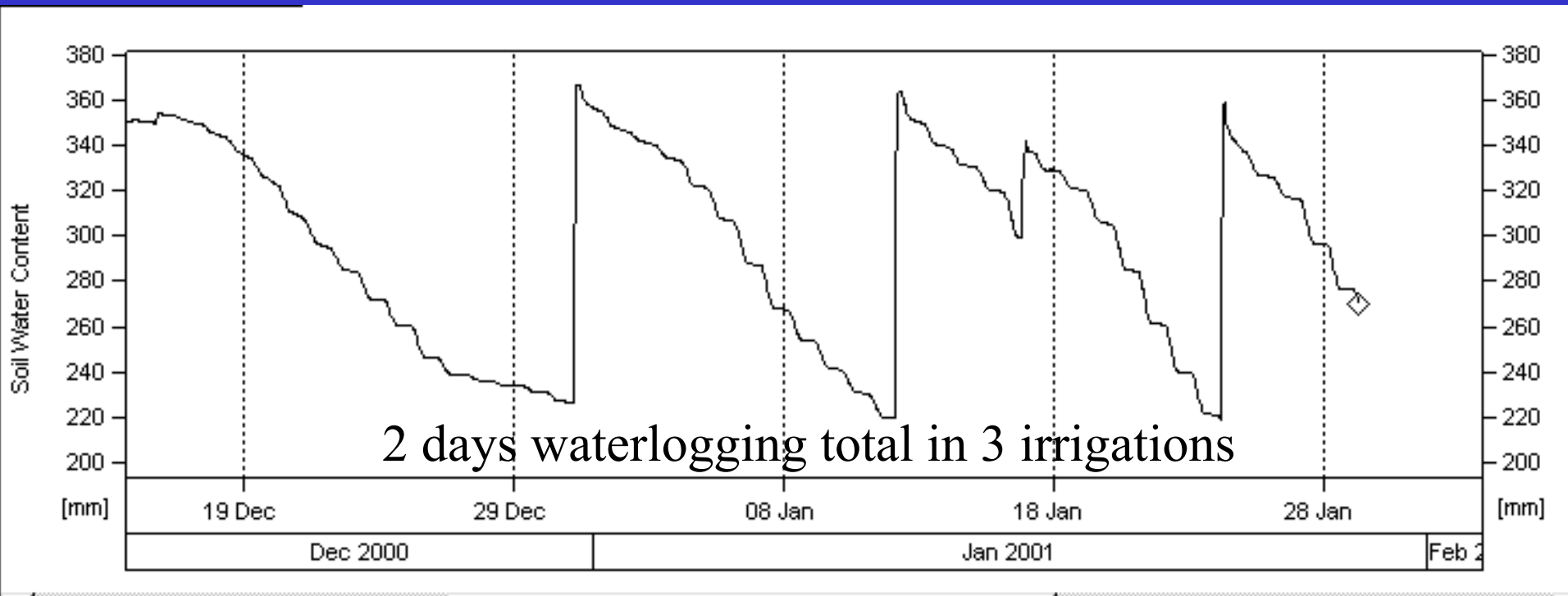
Comparison

Practice	Deficit (req'd) (mm)	Applied (mm)	Tailwater (mm)	Deep Drainage (mm)	Efficiency (%)
Current	70	113	10	33	62%
Optimse flowrate and time	70	82	4	8	85%

Normal Siphon Flow and Time



Optimised Flow and Time



What Has Been Achieved?

- Water Saving = 1-2ML/ha per season
- equivalent 10-20% water saving
- Improved water security for greater production
- Reduced water logging
- Reduced nutrient leaching
- Reduced salinity risk

Where is Industry with Measuring Water On Farm?

- Currently through the pump and at the soil
- Beginning to promote evaluation of application
  - Surface irrigation evaluation
  - Dairy, sugar and horticulture are doing evaluations of spray and drip systems
- Impetus is coming from RWUE - will it continue after that?

Importance of measurement and record keeping?

- Overland flow (and other unregulated) irrigators are installing meters for "evidence"
- Benchmarking and improvement
- Measure it to manage it

"Simple tools" - Feedback and Usefulness?

- Measure water applied
  - buckets
  - stopwatches
  - catch cans
  - pressure gauges
- Usefulness - irrigators must recognise the benefits

Key Areas for Improved WUE

- Storage Evaporation - upto 50% (less if deep and used regularly!!)
- Storage and channel seepage - not 10 - 20% gains
- Deep drainage in fields - 10-30% gains

Thoughts on Farm Water Measurement and STCF

- All decisions are "Risk" based!
- Must understand quantities to evaluate risk
- Scheduling / soil moisture - must know how full the bucket is
- Application volumes - how much is being applied - matching applied volume to deficit - RDI (not easy in surface systems)
- The "ideal" STCF must say when and how much.