



IRRIGATION RESEARCH & EXTENSION COMMITTEE

2007



FOR IRRIGATION CROPPERS

Managing irrigation water with **WATERTRACK™**

Paper prepared by

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1.0 BACKGROUND

Today's irrigator must know how much water he has to use and be able to use that water with minimum losses. There is also an increasing community demand for the irrigation industry to show it is using water wisely.

Water budgets in some respects are even more important than financial budgets given it is very difficult to go to a "water bank" and get more water three quarters of the way through the season.

Irrimate™ (www.irrimate.com.au) and **WaterTrack™** (www.watertrack.com.au) now provide commercial packages and ground tools to measure not only how much water is available but how much water is being lost to seepage, evaporation and deep drainage and where the losses are. This paper discusses how the WaterTrack™ products can assist with on-farm water management.

2.0 THE NEED FOR WATERTRACK™

The reduction in water availability to irrigators has meant the industry is now having to produce more product per megalitre of water. The first step in increasing production is to measure and track what happens to each megalitre once it comes onto the farm.

WaterTrack was developed out of the need to be able to conveniently calculate, based on real measurements at strategic locations, what happens to irrigation water as it is delivered around a farm, used on the fields and returned to storage or a scheme drain.

The **WaterTrack™** packages were developed through a joint venture between Aquatech Consulting, Narrabri NSW (Consulting Irrigation Engineers), Sustainable Soils Management, Warren NSW (Consulting Soils Specialists) and Scolari Software, Dubbo NSW (Software Specialists). This combination of specialist skills ensured robust and practical commercial products. WaterTrack Optimiser™ was released in May 2005 and is now being used on over 30 farms. WaterTrack Rapid™ was released in May 2007 and is being received well.

3.0 MANAGING WATER WITH WATERTRACK™

WaterTrack™ consists of two water balance computer programs:

- WaterTrack Rapid™, and
- WaterTrack Optimiser™.

These packages provide whole farm water balance information at different levels. As the names imply **WaterTrack Rapid™** provides a rapid and simple summary of water use performance and total losses while **WaterTrack Optimiser™** provides a comprehensive daily whole farm water balance with a full break down of losses and the ability to predict water use and losses forward to optimise production per megalitre.

3.1 WaterTrack Rapid™

WaterTrack Rapid™ is designed to provide a rapid and simple farm water balance for a selected period and irrigated crop but provide rigorous and accurate results without any performance assumptions. **WaterTrack Rapid™** provides a simple web based approach to calculating essential irrigation performance indicators for any farm and any crop. These performance indicators are an important starting point in establishing the water use efficiency of a farming operation and should form the basis of calculations for future estimated farm water requirements. **WaterTrack Rapid™** does not have prediction capabilities but provides accurate calculations which account for effective rainfall and the capture of rainfall runoff or captured overland flow.

WaterTrack Rapid™ is accessed and can be paid for on the web and has been designed to require only basic levels of user input to provide accurate calculations. The user must input crop starting dates, irrigation dates, crop yields, field details and pumping volumes from river, bores, or water delivered from

schemes. Measurements or estimates of stormwater captured are entered through the season. Weather data can be entered manually or downloaded from the Bureau of Meteorology SILO website automatically. Crop water use and effective rainfall are calculated by the program.

Attachment 3.1.1 and 3.1.2 show the two standard reports from **WaterTrack Rapid™**

The basic concept of **WaterTrack Rapid™** is that crop transpiration calculated from location, weather data, crop type and growing season is the only productive use of irrigation water. Both WaterTrack products use the United Nations FAO56 dual crop co-efficient method for calculating crop transpiration.

ATTACHMENT 3.1.1 PERFORMANCE INDICATORS

Farm: **Namoi Valley Cotton**
Balance Period: **09/10/2005 to 03/03/2006**

1.	Green Area:	435.00 ha		
2.	Yield:	4,764.00 Bales	10.95 Bales / ha	
3.	Total Gross Inflow Water Use Index	1.14	Bales / ML	$\frac{\text{Yield (Bales)}}{\text{Total Gross Water Inflow (ML)}}$
4.	Total Gross Available Water Use Index	1.07	Bales / ML (ML)	$\frac{\text{Yield (Bales)}}{\text{Total Gross Available Water including Effective Rainfall and Change in Soil Moisture Reservoir in Root Zone (ML)}}$
5.	Gross Irrigation Water Use Index	1.42	Bales / ML	$\frac{\text{Yield (Bales)}}{\text{Gross Irrigation Water Supplied (ML)}}$
6.	Crop Water Use Index	1.49	Bales / ML	$\frac{\text{Yield (Bales)}}{\text{Calculated Transpiration (ML)}}$
7.	Effective Rainfall Index	1.87	ML / ha	$\frac{\text{Effective Rainfall (ML)}}{\text{Total Green Area (ha)}}$
8.	Soil Moisture Index	0.62	ML / ha	$\frac{\text{Change in Soil Moisture (ML)}}{\text{Total Green Area (ha)}}$
9.	Total Water Inflow Loss	23.5	%	$\frac{\text{Total Water Inflow Losses (ML)}}{\text{Total Gross Water Inflow (ML)}}$
10.	Total Available Water Loss	28.1	%	$\frac{\text{Total Available Water Losses (ML)}}{\text{Total Gross Available Water (ML)}}$
11.	Effective Rainfall	79.7	%	$\frac{\text{Effective Rainfall on Irrigated Fields (ML)}}{\text{Total Rainfall in Irrigated Fields (ML)}}$

Notes on WaterTrack Optimiser

WaterTrack Rapid is a simple and easy to use water balance model which is rigorous in its calculations but lumps all losses into a single figure.

For a detailed breakdown of losses into seepage and evaporation in each element of the irrigation system on a daily basis, WaterTrack Optimiser should be used. WaterTrack Optimiser also allows prediction forward to optimise planted area decisions for various water availabilities and can provide assessment of infrastructure changes on water use (see www.watertrack.com.au or phone 1800 886 536).

Caution: Output of this model is based on sparse data together with an understanding of the processes of water movement on an irrigated farm. It should be used with extreme caution and supported by other measures of water movement on the farm. WaterTrack accepts no liability under any circumstances for decisions based on this output.

ATTACHMENT 3.1.2 WATER SUMMARY REPORT

Farm: **Namoi Valley Cotton**
Balance Period: **09/10/2005 - 03/03/2006**

Green Area (ha):	435.00		
		ML	ML / Green ha
Water Diverted	2,685.0	6.17	
Change In Storage Volume	264.0	0.61	(Negative means an increase in storage volume)
Harvested Land Surface Volume	412.0	0.95	
Effective Rainfall On Irrigated Fields	814.4	1.87	(That portion of rain infiltrated into soil)
Total Gross Water Inflow	4,175.4	9.60	
		ML	ML / Green ha
Change In Soil Moisture on Irrigated Fields	269.5	0.62	(Negative means an increase in soil moisture reservoir i.e. reduction in deficit)
Total Gross Available Water	4,444.8	10.22	(All water available for crop production including effective rainfall and change in soil moisture)
Crop Transpiration	3,195.3	7.35	(Does not include in-field soil evaporation)
Total Water Inflow Losses (Total Gross Water Inflow - Crop Transpiration)	980.1	2.25	Losses include: - Seepage and evaporation from: λ supply system λ ring tanks and dams λ drainage and tailwater system - In-field application including: λ evaporation from soil surface λ deep percolation - run-off from rainfall not harvested.
Total Available Water Losses (Total Gross Available Water - Crop Transpiration)	1,249.	5 2.87	
Gross Irrigation Water Supplied	3,361.0	7.73	(Total Gross Water Inflow - Effective Rainfall)
Total Rainfall On Irrigated Fields	1,021.4	2.35	
Effective Rainfall On Irrigated Fields	814.4	1.87	(That portion of rain infiltrated into soil)

Notes on WaterTrack Optimiser

WaterTrack Rapid is a simple and easy to use water balance model which is rigorous in its calculations but lumps all losses into a single figure.

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3.2 WaterTrack Optimiser™

WaterTrack Optimiser™ is a comprehensive water balance program which calculates daily water consumption in every element of a farm including:

- Seepage and Evaporation in
 - Supply system
 - Storages
 - Taildrains and tailwater return systems,
- Deep percolation and soil evaporation from fields,
- Plant water use,
- Effective rainfall, and
- Stormwater blowout

Accurate models of each element of a farm's irrigation operation is used to quantify water losses. This provides an extremely valuable farm management asset. A unique feature of **WaterTrack Optimiser™** is its ability to predict future irrigation performance. At any time before planting or during the season the prediction module allows accurate water budgeting INCLUDING losses.

WaterTrack Optimiser™ accepts as input:

- a farm map
- water allocations
- basic dimensions of the irrigation system
 - channel and drain lengths, top water widths and depth
 - storage volumes and surface areas to depth relationships
 - field sizes and soil types
 - pumping capacities
- crop types and planting dates
- weather data for the location
- standard irrigation records:
 - field irrigated
 - irrigation duration
 - siphon or outlet numbers and size
 - average siphon or outlet head or measured flow.

Once the initial farm set-up is complete (**done once only**) then only weather data and irrigation operations are needed as input. From this information **WaterTrack Optimiser™** calculates daily where and how much water is used in:

- growing the crop,
- deep drainage below the root zone, and
- seepage and evaporation in all channels, drains and storages.

WaterTrack Optimiser™ also calculates the amount of effective rainfall entering the soil and the amount of run-off leaving the fields and captured in storage if available.

The **WaterTrack Optimiser™** calculated storage volumes and/or water consumption before and after irrigations can be checked against measured volumes and variables simply adjusted slightly to calibrate the model. **WaterTrack Optimiser™** is a very useful and important tool that can at any time tell the irrigator where and how much water is used and lost as shown in **Attachments 3.2.1 and 3.2.2** which are standard **WaterTrack Optimiser™** Reports. The standard reports can be adapted to give visual reporting aids as shown in **Attachment 3.2.2**. This alone will help improve water management by targeting operational and infrastructure changes to reduce losses and increase production.

3.2.1 Prediction and Planning with WaterTrack Optimiser™

3.2.1.1 The Need

The ability to predict forward for water consumption including losses to the end of the season enables sound objective planning. Each season has a particular combination of temperature, humidity, sunshine hours, wind and rainfall. These weather variables each directly affect crop water use and evaporation losses. Rather than relying on “rules of thumb” to predict and manage water use and availability, **WaterTrack Optimiser™** can be used to run the farm from now till the end of the season (or whenever) to see how much water is required to irrigate the current crop.

3.2.1.2 Prediction with WaterTrack Optimiser™

The prediction module of **WaterTrack Optimiser™** is powerful yet simple to use. **WaterTrack** manages the modelled farm just as the irrigator would and completes the season based on a simple list of rules specified by the user. Weather data from SILO allows any season on record to be modelled for any farm.

Predictions are normally conducted prior to the ordering of seed to check how much planted area can be irrigated allowing for rainfall and losses. Predictions are then conducted throughout the season to assist in key decisions such as purchasing extra water, ploughing in a crop, or changing row configurations. Predictions can also assess infrastructure changes or capital investments such addition water licenses, increased farm area, more or less storages, and deeper storages, etc. Predictions can be done at any time and as often as required from historical weather data for a dry, wet, average or any particular year of interest.

3.3 WATERTRACK™ COSTS*

WATERTRACK RAPID™ \$675 + GST/farm/year

WATERTRACK OPTIMISER™

Single Farm Version	\$8,900 + GST
Support/year (includes free upgrade)	\$1,335 + GST
Multi Farm Version	
1st Farm	\$9,900 + GST
2nd Farm	\$7,425 + GST
3rd Farm	\$6,435 + GST
4th Farm	\$4,950 + GST
Additional Farms	\$4,950 + GST
Support/year (includes free upgrade)	15% up to \$3,000

Consultants Version	\$4,900 + GST
Farm license fee/farm/year	\$3.20 + GST/developed ha
	Up to a maximum of \$1,600/farm/year
Support & Upgrades	15% of program & licences

Or discuss a tailor made whole farm water management service with a WaterTrack™ Agent

Ph: 1800 886 536 www.watertrack.com.au Fax: 1800 899 768

**Prices are subject to change. Please obtain a quotation before purchasing*

ATTACHMENT 3.2.1 WHOLE FARM WATER BALANCE

Water Balance Period: 02/09/2005 To: 03/03/2006

Water Supplied	ML	ML/ha	(Area Used)	Description
Water Stored at Start:	1,437.0	2.99	Green	Sum of storage volumes on start date.
Inflows:	2,685.0	5.59	Green	Sum of all pump inflows.
Rainfall on Storage Water:	119.7	0.25	Green	Sum of rainfall falling onto storage water.
Rainfall on Remainder of Farm:	2,452.7	2.95	Developed	Sum of rainfall on the remainder of farm.
Less Water Stored At Finish:	1,043.6	2.17	Green	Sum of storage volumes on End Date.
Total Water Supplied:	5,650.8	9.61	Green	
Water Lost - Storages				
Seepage:	220.4	0.46	Green	Sum of seepage losses for all storages.
Evaporation:	447.0	0.93	Green	Sum of evaporation losses for all storages.
Change in soil moisture:	13.0	0.03	Green	Water at end - Water at start.
Total Storage Losses:	680.4	1.42		
Water Lost - Channels				
Seepage:	51.6	0.11	Green	Sum of seepage losses for all channels.
Evaporation:	73.0	0.15	Green	Sum of evaporation losses for all channels.
Change in soil moisture:	3.9	0.01	Green	Water at end - Water at start.
Total Channel Losses:	128.6	0.27		
Water Lost - Drains				
Seepage:	24.2	0.05	Green	Sum of seepage losses for all drains.
Evaporation:	65.9	0.14	Green	Sum of evaporation losses for all drains.
Change in soil moisture:	3.2	0.01	Green	Water at end - Water at start.
Total Drain Losses:	93.3	0.19		
Water Lost - Blow out:	0.0	0.00	Developed	Sum of all blowout volumes.
Water Added To Soil Profile				
Irrigation:	2,517.9	5.25	Green	Sum of water applied to field in irrigations.
Rainfall:	2,230.7	2.68	Developed	Sum all rainfall over field areas - Rain runoff
Total Water Added to Soil Profile:	4,748.5	7.93		
Whole Farm Water Balance:	0.0			
Root Zone Water Balance				
Total Water Added to Soil:	4,748.5			
Soil Water Use				
Evaporation:	1,855.6			Sum of all field evaporation.
Transpiration:	3,071.1			Sum of all field transpiration.
Seepage:	71.9			Sum of all field seepage.
Change in Soil Moisture:	-250.1			Soil moisture at end - soil moisture at start
Total Soil Water Use:	4,748.5			
Soil Water Balance:	0.0			
Storm water captured:	222.05	0.46	Green	Rainfall - Rainfall into rootzone - Blowout

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**ATTACHMENT 3.2.2
WHOLE FARM WATER BALANCE**

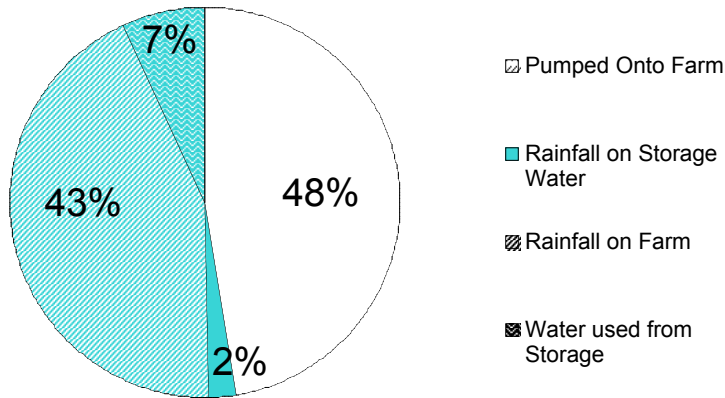


FIGURE 5 – Water Supply Source (ML)

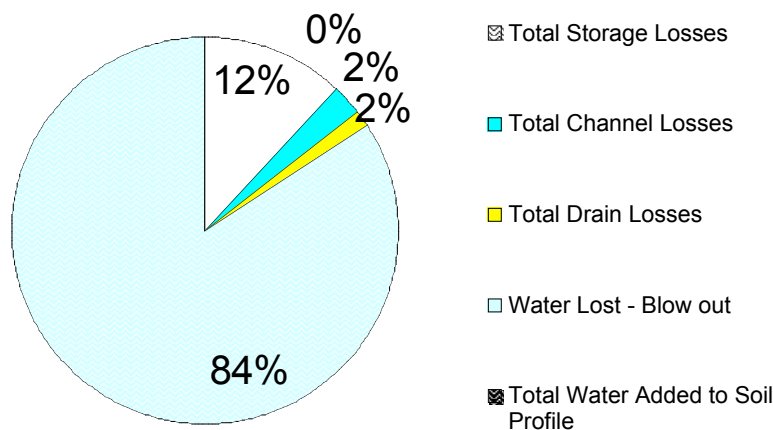


FIGURE 6 – Whole Farm Water Use (ML)

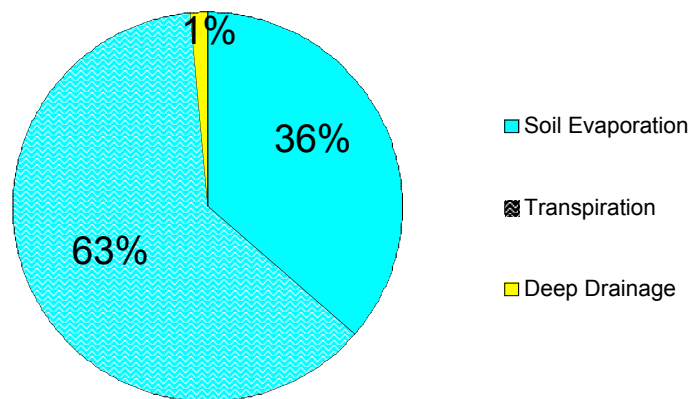


FIGURE 7 – Soil Water Use (ML)

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**ATTACHMENT 3.2.3
CROP PRODUCTION EFFICIENCY**

Live Farm

Irrigation Period: 02/09/2005 To: 03/03/2006

Field	Crop	Area (ha)	Yield (Bales / ha)	Transpiration (ML/ha)	Crop WUI (Bales / ML transpired)	Total Water Added to Profile (ML/ha)	Gross Production WUI (Bales / ML)	Irrigation added to Field (ML/ha) (modelled)	Irrigation WUI (Bales / ML irrigation water applied)
Field 51	Fallow	161.00	0.00	0.00	0.00	2.62	0.00	0.00	0.00
Field 52 nth	Irrigated Cotton	47.50	10.00	7.09	1.41	8.41	1.19	5.63	1.77
Field 52 sth	Irrigated Cotton	47.50	10.00	7.09	1.41	8.40	1.19	5.62	1.78
Field 53	Irrigated Cotton	175.00	10.00	6.61	1.51	8.76	1.14	6.10	1.64
Field 54	Fallow	190.00	0.00	0.00	0.00	2.62	0.00	0.00	0.00
Field 55	Irrigated Cotton	166.00	10.00	6.80	1.47	8.32	1.20	5.52	1.81
Field 55 nth	Pigeon Peas	44.00	0.00	2.54	0.00	2.70	0.00	0.00	0.00

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