Example Irrigated Farm Water Use Efficiency Assessment (IFWUEA)

March 2016

This document supports the development of Irrigation Farm Water Use Efficiency Assessments (IFWUEAs) as part of the NSW Sustaining the Basin: Irrigated Farm Modernisation program (STBIFM) and contributes to the planning of on-farm infrastructure modernisation projects. This document provides an example of what could be included in an IFWUEA and is indicative of the standard of report that meets the expectations and criteria of the NSW Department of Primary Industries (DPI). It should be noted that not all sections of this report will be applicable to every enterprise. Those preparing an IFWUEA should use their own discretion as to which methodology to use and which sections are applicable to their enterprise. The three main methodologies used in describing farm water losses are:

- Direct measurement of a particular component of the farm,
- Detailed modelling of the whole farm to identify performance of the main components of the irrigation system, and
- Reporting of water supplied to the farm, cropped areas and yields with supporting evidence for an extended period. Irrigation water losses can then be implied through comparison with industry benchmarks.

The IFWUEA Form provides a template to assist in the preparation of an IFWUEA.

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Part 1: Applicant Details

Business name:	Mr John Irrigator
Legal entity name:	Top Farm Enterprises
Contact Person:	John
ABN:	XX XXX XXX XXX
Postal Address:	'Top Farm', Waterville, NSW PO Box 11 Waterville NSW 2222
Phone:	XX XXXX XXXX
Mobile:	XX XXXX XXXX
Email:	john.irrigator@email.com.au

Part 2: Property details

Refer to STBIFM Guidelines for information on the area covered by an IFWUEA
www.dpi.nsw.gov.au/info/sustainingthebasin

Property name:	**"Top Farm"**		
Contact person:	**Bob Manager**		
Property address and postal address	'Top Farm', Waterville, NSW		
Phone:	**XX XXXX XXXX**	Mobile:	**XX XXXX XXXX**
Lot and DP(s)	**Lot X, DP XXXXXXX, Parish of Waterville, County of outback**		
Area of property (ha)	**5000**	Area irrigated (ha):	**2200**
Total area of irrigation development proposed	**2200**	Remainder (if any) of total area: (ha)	**2800**

You may wish to attach additional information to provide a brief description of the on-farm situation.

Water Resources

Water Access Licence Information

WAL number	WAL number	WAL number
WAL XXXXX 5,500 ML		
WAL XXXXX 10,000 ML		
WAL XXXXX 4,500 ML		

Attach additional sheets if required.

Summary of Water licences held (Shares):

General security entitlement:	10,000 ML
Supplementary entitlement:	10,000 ML
Groundwater entitlement:	2,250 ML
Harvestable Right	250 ML
Unregulated Right	Nil
Floodplain Harvesting	To Be Determined
Total water resource:	22,500 ML

If you have a verified IFWUEA that describes the Irrigation Management Area for which you may wish to submit an infrastructure funding application there is no requirement to complete another IFWUEA. **Please conclude this form here and return it to DPI.**

However, if you wish to modify your existing IFWUEA to include additional areas or water losses please complete the following pages.

Description of current irrigation systems, crops and their management

The farm maps in Appendices 1, 2 and 3 include field details, current irrigation infrastructure, individual farm management areas and EM survey results.

Water is supplied by gravity from the east via a joint water supply authority.

Irrigation is mainly carried out using a surface application system on 2080 ha, which consists of poly siphons discharging into rota bucks and furrows. Rota bucks / siphon / furrow combinations are changed throughout the season. 120 ha are used for intensive Lucerne production using a pressurised irrigation system.

All irrigation drainage water can be recirculated. An above ground irrigation storage is used to capture recirculated water or water supplied from the river via a pumping station located at the storage. Some command for gravity irrigation over all fields can be achieved when the water level in the storage is more than half full.

The first stage of irrigation development occurred in the early 1980s with final works completed in 1987. During the last decade Mr Irrigator has made minor improvements to increase on-farm water use efficiency and reduce water losses. A number of fields and channels in the water management areas have been realigned to improve water application efficiency.

The surface irrigation cropping program is a cotton system with the majority of available water used for that purpose. Up to 850ML has been used for irrigation of Lucerne and the rest of the crop and pasture rotations are rain fed. It is a goal to use winter cereal grain, grazing and hay to fatten vealers.

The lucerne is irrigated by a hand-shift spray line system consisting of 50 lengths of 9m pipe each with double nozzle Naan sprinklers with nominal sizes of 3.2 mm x 2.0 mm at one end. This system irrigates 30 ha of Lucerne with 42 shifts taking 21 days. The spray lines are supplied by underground mainlines and hydrants.

'Top Farm' currently utilises capacitance probes to schedule irrigations. Automatic logging and transmission of data to home and office computers allows soil moisture to be monitored in real time. A refill point is determined by analysing the soil drying cycle.

Part 3: Assessment of on-farm losses

Whole farm water balance (surface system)

Note: The water balance is used for the assessment of the surface irrigation system and the pressurised system is examined separately.

Whole farm water balance assessments were conducted over two contrasting seasons to determine whole farm water losses and efficiencies. Total water supplied for these seasons is shown in Table 1. Regulated water delivery information was retrieved from iWAS (State Water) (Appendix 4). Estimates were made of supply from rainfall runoff and other sources and it is noted that these total less than 15% of the aggregate.

Cotton plantings in the 2011-12 and 2012-13 seasons were 1,595 ha and 750 ha respectively.

The 2011-12 season had a good start in terms of in-crop rainfall but had a dry finish, whereas the 2012-13 season had a dry start and wet finish.

Industry comparison of Farm Water Use Efficiency

Irrigation Water Use Efficiency Index ($IWUI_{farm}$) relates total production to the amount of irrigation water supplied. The average $IWUI_{farm}$ for 46 cotton farms surveyed by DPI in 2008-09 was 1.97 bales/ML, with values ranging between 0.82 and 5.72 bales/ML (refer to Appendix 8).

Another index for comparing irrigation water use between farms in differing regions and across seasons is the Gross Production Water Use Index ($GPWUI_{farm}$). It relates total production to the total amount of water used from all sources (i.e. irrigation water, effective rainfall and soil moisture). From surveys of cotton farms, DPI found the industry average $GPWUI_{farm}$ for the 2006-07 season was 1.13 bales/ML and in the 2008-09 season 1.14 bales/ML, with values ranging between 0.64 and 1.58 bales/ML.

The GPWUI calculated for the 2011-12 and 2012-13 seasons at 'Top Farm' of 0.93 and 0.99 respectively suggest significant improvements in water use efficiency are possible. A GPWUI of around 0.93-0.99 is less than the average observed in the both the DPI 2006-07 and 2008-09 benchmarking studies. According to the results of the benchmarking study the top 20% of cotton irrigators are achieving GPWUI greater than 1.25 bales /ML. A detailed assessment of on-farm water losses is outlined in the following sections of this report. The following farm water balance analysis was undertaken to calculate seasonal water losses at 'Top Farm' (Table 1).

Table 1: Comparative whole farm water balance (surface system)

Whole farm water balance period	NSW DPI 2008-09 Cotton	2011-2012	2012-2013
Cotton production area		1595	750
Yield (bales/ha)		9.1	10.0
Total seasonal water use (ML/ha)		9.75	10.13
Theoretical crop water use (ML/ha)		8.30	8.80
Crop water use index (bales/ML)	AVE 1.41	1.10	1.14
Irrigation Water Use Index – IWUI (bales/ML)	AVE 1.97	1.26	1.58
Gross Production Water Use Index – GPWUI (bales/ML)	AVE 1.14	0.93	0.99
Estimated total farm water losses (ML)		2313	1000
Estimated whole farm efficiency (%)		80	79

A detailed whole farm water balance for the 2012-13 seasons is documented in Appendix 5.
Irrigation performance indicators would improve significantly if yields were to increase to 12 bales/ha, a yield which is commonly viewed as an industry benchmark.
Possible areas to investigate would be current agronomic and irrigation scheduling practices. It is also recommended that current agronomic practices be reviewed by a professional agronomist to ascertain if there are any agronomic constraints to crop performance.
Despite this, a whole-farm efficiency of 80% for surface irrigated cotton is not a poor result. Previous research studies and whole-farm water use efficiency audits have found whole farm efficiency is often below 70% (see Appendix 6). It is reasonable to expect that performance above 80% is achievable with well planned investment.

Assessment of Component Losses – surface irrigation systems

In order to determine farm water loss, various physical and theoretical studies were conducted. Field numbering is identified in Appendix 2.

Distribution System Assessments

In 2010-11 seepage rates in Storage 1 were measured at 2 mm/day. In addition some channel lockup tests were done on F1 and F8 which produced similar results. It is known that the soils on 'Top Farm' are fairly uniform (grey cracking clays) as this has been verified on a large proportion of the farm by an EM survey (Appendix 3) conducted in 2000. Based on this work, seepage losses from all on-farm irrigation infrastructure were assumed to be 2 mm/day.

Estimations of the seepage losses associated with the various parts of the farm are shown in Table 2.

Table 2: Estimated surface irrigation loss summary for 'Top Farm'.

	11-12 Season	12-13 Season
Storage Losses	1388 ML	610 ML
Channel Losses	139 ML	40 ML
Drain Losses	208 ML	60 ML
Field Losses	578 ML	290 ML
Total Losses	**2313 ML**	**1000 ML**

Storage Performance

As can be seen from both of the seasons evaluated (Table 2) the largest losses occurred in the storages. Generally, on this farm, water is collected in the late summer and early autumn months, with most of it being used in the following summer season. Therefore, this water is stored for 5-8 months prior to being used. Based on this, the need for efficient water storage is paramount.
'Top Farm' has three storages consisting of one large rectangular ring tank, and two small below ground storages (tail water surge areas). This report will focus on potential mitigation options for the large rectangular ring tank (Storage 1).
The dimensions for Storage 1 were obtained from design plans and an on-site inspection.

Application system assessments

As a result of discussions with 'Top Farm' management it was agreed that the irrigation application efficiency of F2 be investigated. This decision was driven by suspicions by 'Top Farm' management that significant water losses were occurring through deep drainage, a product of excessive runtimes, a long field length of 885m and relatively low siphon flow rates and head ditch capacity.
A series of evaluations were undertaken to determine irrigation efficiencies, and to establish if management changes or field redesign could save water. In F2, initial evaluations suggest that efficiencies could be optimised by halving the field length, increasing siphon flow rates and reducing the run time (Table 3).

Table 3: Surface Irrigation Performance Evaluation Results for F2

	Pre-management change/field redesign	Post management change/field redesign
Measurements	**Measured Event**	**Optimised Event**
Field Length (m)	885	408
Flow Rate (L/s)	2.70	3.8
Time Water Applied (hours)	20	6
Deficit (mm)	60	60
Inflow (mm)	110	83

Tail water (mm)	27	21
Water Infiltrated (mm)	83	62
Application Efficiency (85% of tail water recycled)	69%	92%
Distribution Uniformity (DU)	68%	92%
Potential Water Saving (ML/Ha)		0.22

Assessment of Component Losses – pressurised irrigation systems

Distribution System Assessments

In order to determine farm water loss, various analyses were conducted.

Distribution losses

Some delivery pipes have small leaks that were quantified by direct measurement.

Field losses

The hand shift spray line joints also leak and direct measurement of a percentage of these joints provided an estimate of the total field pipe losses.
Distribution Uniformity (DU) was assessed by completing a catch can test using NSW DPI Prowater® methodology.
(Evaluating a pressurised irrigation system according to the ProWater® methodology – in Appendix 6 of this document and available at: http://bit.ly/IrrigationEvaluation).

Whole Farm Benchmark Performance

Production losses

Table 4 is a sumary of water usage on the spray irrigation fields for the purpose of production loss assessment.

Table 4: Summary of water usage on the spray irrigation fields

Year	Allocation plus purchase ML	Usage ML
2003	388	388
2004	652	652
2005	850	850
2006	253	253
2007	255	255
2008	648	648
2009	560	560
2010	612	0
2011	850	850

2012	343	343
Average	**517.3**	**394.9**

An observed problem with the current pressurised system is the inability to get around the lucerne fields quickly enough to put on moderate amounts of water. It tends to take more than a fortnight to return to the starting point which leads to the typical scenario of application of 80 to 160 mm water every 10 to 20 days.
It is noted that best practice for lucerne production is to apply the crop water requirement on 10 to 14 day intervals and that substantially higher water use efficiency has been observed from this practice on other sites. A change from monthly to fortnightly irrigation intervals is said to increase yield by 30 to 50% without using any additional water, based on various studies. (See references in Appendix 6).
By calculating the whole farm gross production water use index (GPWUI) it is evident that performance of the lucerne production system is well below the industry benchmark.
Because all of the significant loss for the most recent years occurs in the cropped area, the extent of loss can be modelled based on the improved scenario of crop production. A target production level of 10 tonnes/ha of lucerne was used, based on an expected improvement of dry matter yield from 8 of 20% by closing the watering interval to once a fortnight (Appendix 7).
It is assumed that a linear relationship exists for the production function of lucerne yield and water use, within the range being examined in this report.

Scheduling assessment

The production losses that occur in the field can be estimated by looking at what area would be required to achieve the same production of tonnes of lucerne hay if the losses were fixed. It is reasonable to think that improved irrigation scheduling could achieve at least a 20% increase in yield per hectare. This would occur through reduced production losses due to waterlogging and reduced deep drainage losses due to over watering at the beginning of each irrigation, and reduced production losses due to under watering at the end of each irrigation. If overall farm production was kept the same, only 83% of the 120 ha Lucerne area is required for the same production. The water which was being applied to the extra 17% of area could be considered to be the loss in this scenario. Using this methodology water loss is calculated as the average irrigated water use per hectare (5.1 ML/ha) by the 20 hectares no longer required to be irrigated to produce the same yield, giving 102 ML of loss per annum.

Application system assessments

Some water is inevitably lost from a spray irrigation system. Some of this is from evaporation and droplet drift off the irrigated field. A reasonable assumption is that this would be around 10%for a system that is performing well[1].
Distribution Uniformity (DU) losses are calculated by the difference between the measured DU (68%) and an industry standard of 85%. This is then multiplied across the maximum normal water use of the properties irrigation system. The water use of 850 ML occurred in 2005 and 2011 (Table 4), so the losses due to poor DU are 85%– 68% = 17%, and 17% of 850 ML = 144 ML. Estimated losses for the various pressurised irrigation system components are shown in Table 5.

Table 5: Estimated loss summary for pressurised system

	2011-12 Season	2012-13 Season

[1] J. Uddin, N.H. Hancock, R.J. Smith, J.P. Foley (2013) *Measurement of evapotranspiration during sprinkler irrigation using a precision energy budget (Bowen ratio, eddy covariance) methodology*, Agricultural Water Management, 116:89-100.

Mainline Losses	5 ML	3 ML
Spray line Losses	85 ML	34 ML
Field Losses (DU)	144 ML	58 ML
Production losses	102 ML	41 ML
Total Losses	**336 ML**	**136 ML**

Statement of Losses

Discussion

Total on-farm water losses for the 2011-12 and 2012-13 cotton seasons were estimated at 2,649 and 1,136 ML respectively. Whole farm water use efficiency was estimated to be around 70% for both seasons. The results confirmed that for the 2011-12 and 2012-13 cotton seasons:

- Water storage losses contributed 53-55% of total losses
- Field losses contributed 28-31% of total losses, 75 to 80% of those losses from the surface fields
- Channel and drain losses contributed 10% of total losses
- All other components were less than 10%.

The whole farm water balance assessments on cotton seasons 2011-12 and 2012-13 suggest whole farm efficiency is comparatively good at 70%. However, infrastructure investment has the potential to deliver further water savings and boost whole farm water use efficiency. The largest losses occurring on "Top Farm" were from the storages and this should be a priority area for improvement. The infrastructure improvements should focus on potential mitigation options from surge area to the large rectangular ring tank.

Field losses were also high. Combine these with low GPWUI and there is potential to improve both by increasing flow rates. This will reduce field seepage losses and reduce water logging and potentially increase the GPWUI. Other possible areas to investigate are the current agronomic and irrigation scheduling practices.

The spray system's total losses are small compared to the surface system losses due to its relatively small area. Within that area, field and production losses need to be addressed to bring the irrigation system up to an industry standard performance.

In summary, it is estimated that up to **2649 ML** could be lost from useful crop production (Table 6).

Table 6: Combined (pressurised and surface) summary of losses from Tables 2 and 5

	2011-12 Season	2012-13 Season
Storage losses	1388 ML	610 ML
Channel losses	139 ML	40 ML
Drain losses	208 ML	60 ML
Mainline losses	5 ML	3 ML
Spray line losses	85 ML	34 ML
Field losses (DU) surface	578 ML	290 ML
Field losses (DU) spray	144 ML	58 ML
Production losses	102 ML	41 ML
Total losses	**2649 ML**	**1136 ML**

IFWUEA Verification Checklist

This checklist is to be used to ensure all appropriate documentation is provided to DPI to assess your IFWUEA. Please complete and provide with your IFWUEA document.

Please list IFWUEA water losses		Office Use Supporting Evidence	Office Use (DPI Assessment)
Losses 1 Storage	1388 ML		
Losses 2 Distribution	437 ML		
Losses 3 Field	722 ML		
Losses 4 Production	102 ML		
Total	2649 ML		

	Evidence attached (Tick to confirm)	Office Use (DPI Assessment)
Farm map	✓	
Evidence of consultant certification	✓	
Consultant Invoice attached	✓	
Consultant receipt attached	✓	
Invoice made out to DPI to 80% of the total cost to a maximum of $2000 ex GST	✓	

Consultant declaration: I,_____Mr Consultant_____(name) declare that the losses presented in the IFWUEA are a true and accurate estimation based on reasonable assessment methodologies and assumptions.

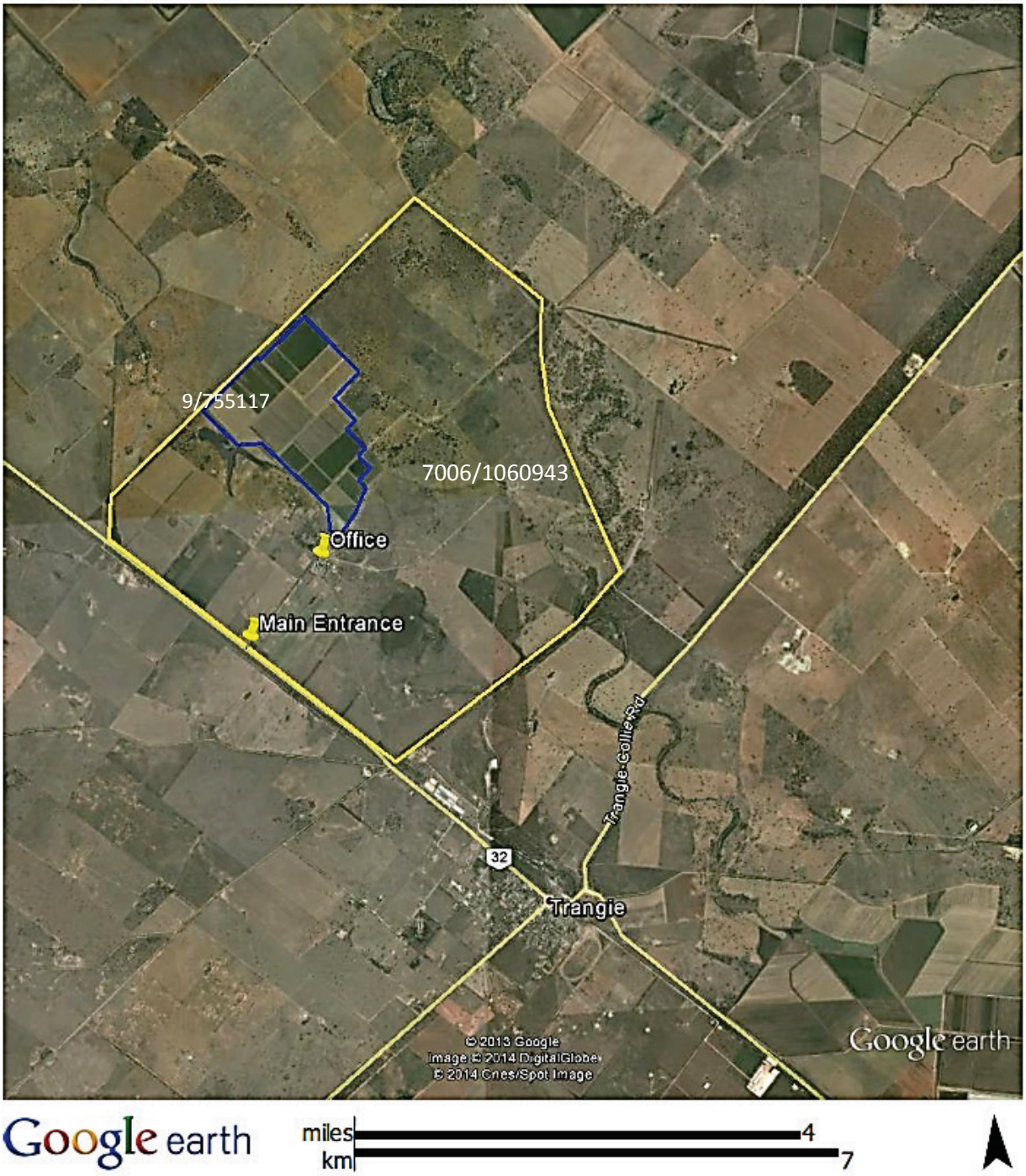
Signature: XXX Date: xx/xx/xxxx

Irrigator declaration: I,_____John Irrigator_____(name) declare that I am satisfied that the losses identified in the IFWUEA are a reliable estimation of on-farm water losses.

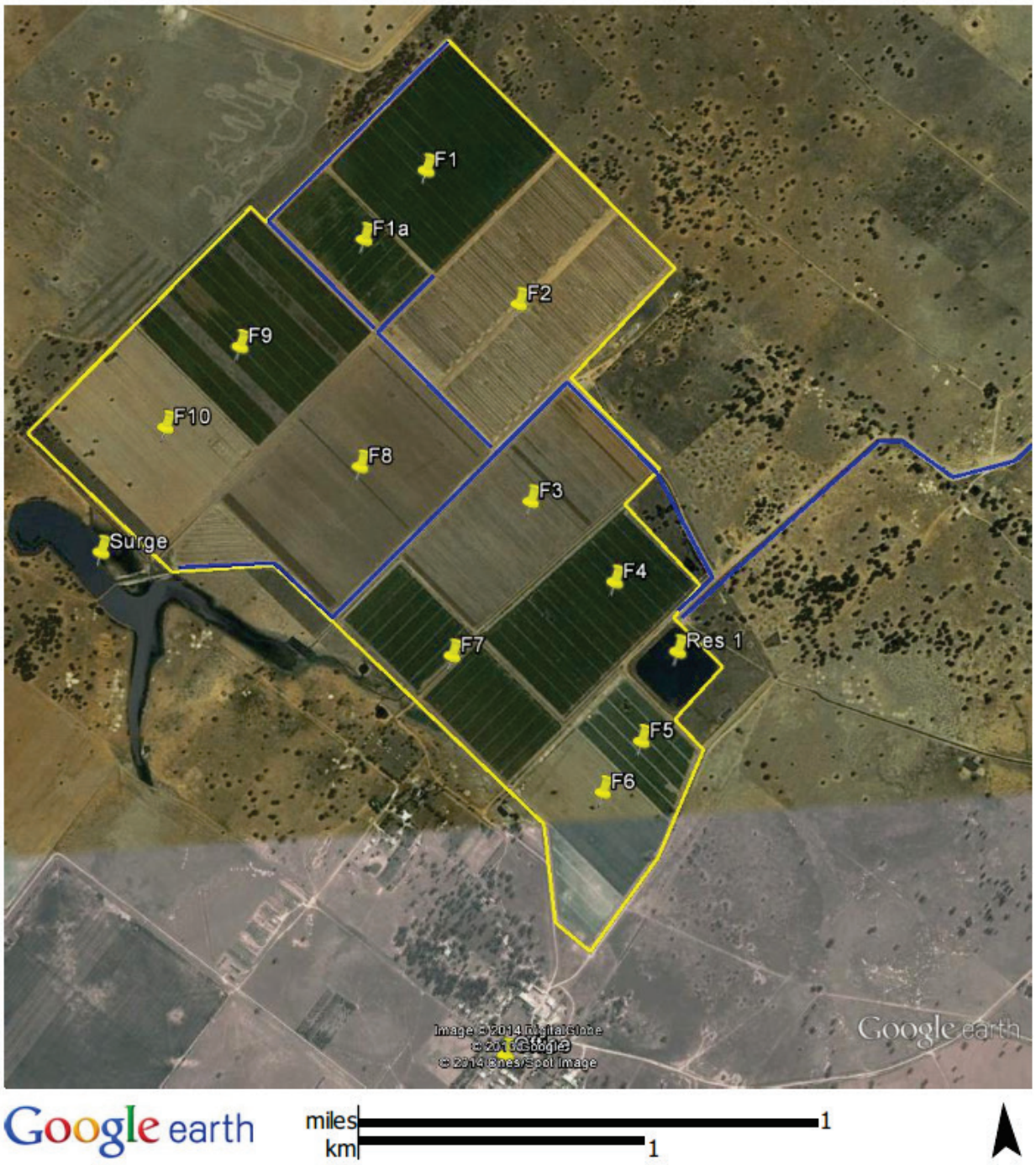
Signature: XXX Date: xx/xx/xxxx

Office Use Only				
	Previous funding for water use assessment services		Yes	No
	IFWUEA verified by		Yes	No
	DPI Initials:	Date:	TRIM Ref:	
	E:			

Appendix 1: Farm locality map

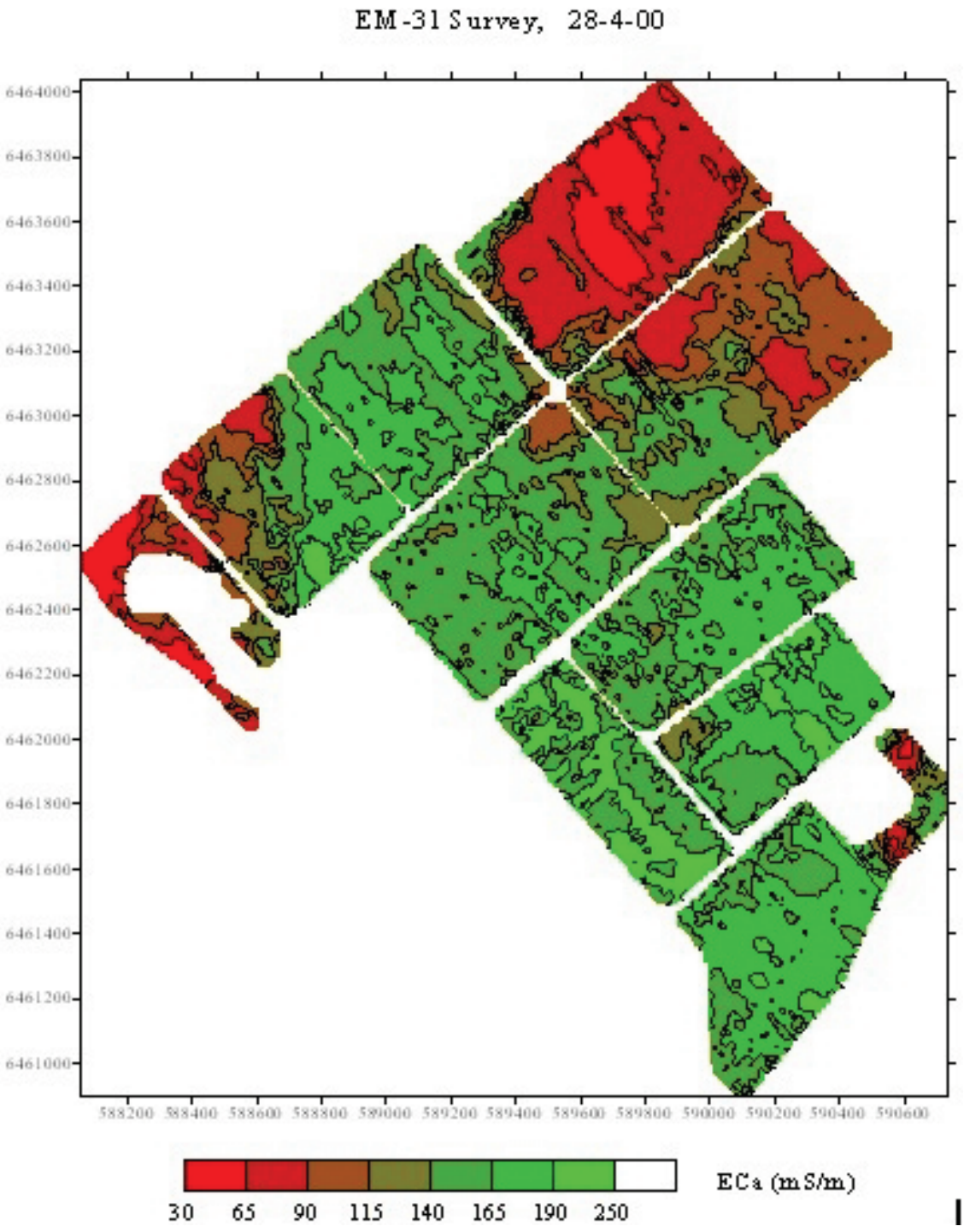


Appendix 2: Irrigation area and layout



Supply channels are shown in blue. Water is supplied by a scheme channel to the east.

Appendix 3: EM survey



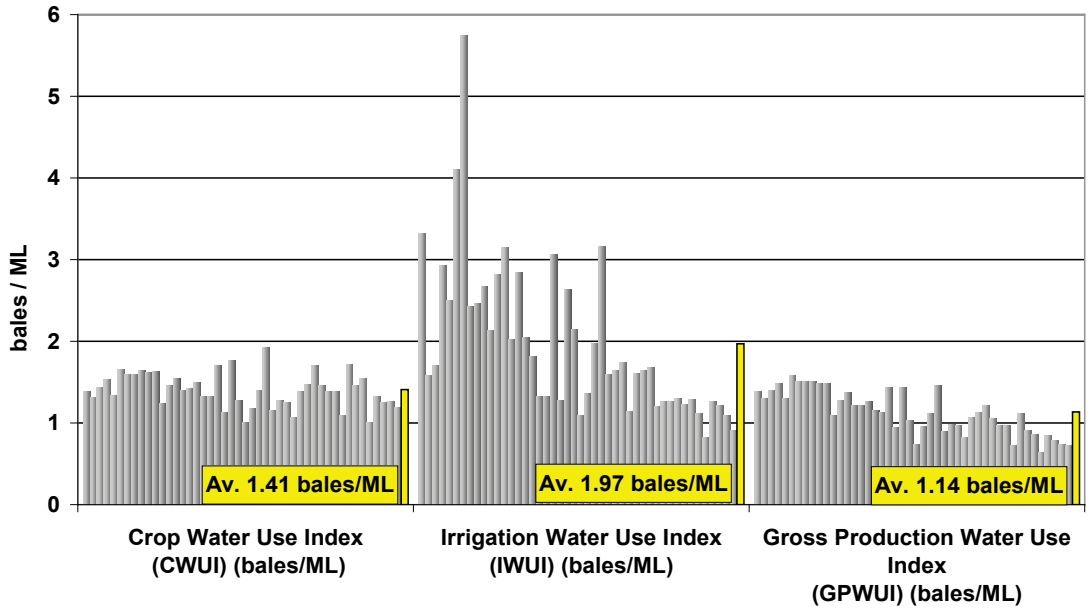
Appendix 4: Seasonal whole farm water balance (Whole Farm Water Balance Work Sheet – September 2012 to June 2013)

Production details		**Soil Water**	
(**A**) Area grown ha (cotton)	750	(**R**) Used Soil reserve (mm) average of all fields	180
(**B**) Total Production (Bales)	7520	**(S)** Used Soil reserve ML = **(R ÷ 100) x A**	1350
(**C**) Average Yield (Bales/ha) = **B ÷ A**	10.0	**(T) Total seasonal water usage (ML) = L + Q + S**	7600
Water supply		**Water use summary**	
(**D**) Total water pumped (bore)	NA	ML/ha pumped = **F ÷ A**	4.81
(**E**) Total water pumped (river)	3605	ML/ha effective rainfall = **Q ÷ A**	2.00
(**F**) Total water pumped (ML) = **D + E**	3605	ML/ha irrigation water applied = **L ÷ A**	6.33
(**G**) On farm storage at planting (ML)	295	ML/ha used soil reserve = **S ÷ A**	1.80
(**H**) On farm storage at harvesting (ML)	50	ML/ha total water usage= **T ÷ A**	10.13
(**I**) Used from farm storage (ML) = **G – H**	245	**(U) Total seasonal crop water use (ETc) mm**	880
(**J**) On farm harvested including rainfall on storage (ML)	1150	**Water Use Indices**	
(**K**) Water used on other crops (ML)	250	Crop Water Use Index (kg/mm/ha) = **(C x 226) ÷ U**	2.57
(L) Total irrigation applied on cotton (ML) = F + I + J – K	4750	Crop Water Use Index (Bales/ML) = **C ÷ (U ÷ 100)**	1.14
Rainfall		Gross Production WUI - Farm (Bales/ML) = **B ÷ T**	0.99
(**M**) In season rainfall (mm)	280	Irrigation WUI - Farm (Bales/ML) = **B ÷ L**	1.58
(**N**) Run-off (green ha) (mm)	80	**Farm Irrigation Efficiency**	
(**O**) Effective rainfall estimate (mm) = **M – N**	200	(**V**) Irrigation water used for ET (mm) = **U – O – R**	500
(**P**) Rainfall efficiency (%) = **(O ÷ M) x 100**	71	**(W)** Irrigation water used for ET (ML) = **V x (A ÷ 100)**	3750
(Q) Estimated effective rainfall for farm (ML) = (O ÷ 100) x A	1500	**(Y)** Estimated total farm water losses (ML) **= L – W**	1000
		Whole farm irrigation efficiency (%) = (W ÷ L) x 100	**79**

Appendix 5: Resources for Preparation of an IFWUEA

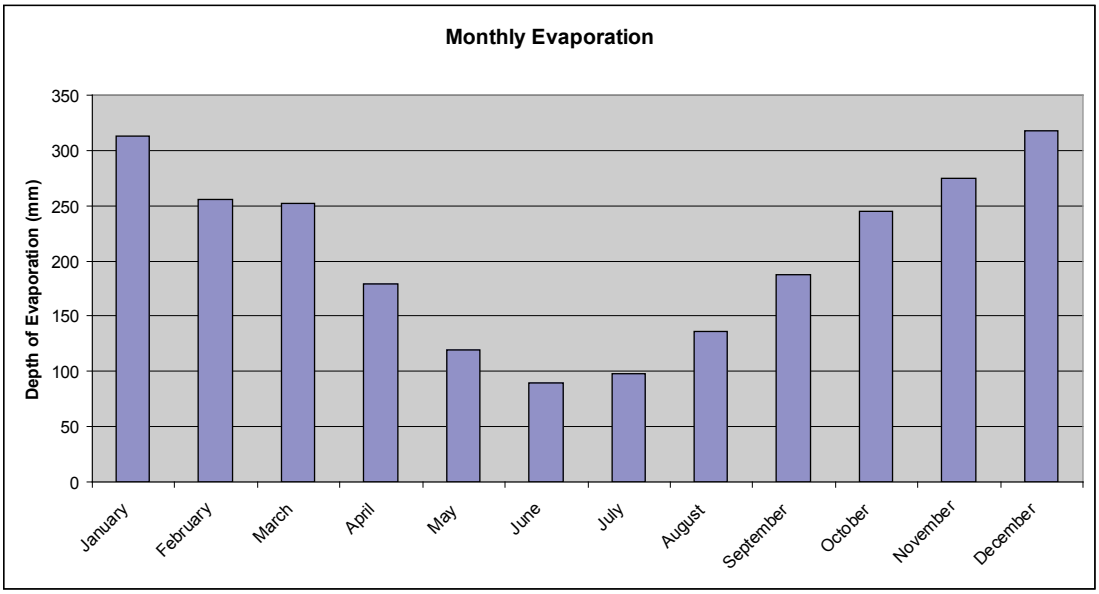
The following are examples of relevant and valuable resources which may be used for the preparation of the IFWUEA. This is not a comprehensive list of tools to prepare an IFWUEA, nor is there any requirement for these tools to be used. Other similar, or better, tools may exist. Listing of a tool here is not in any way an endorsement of the tool and users should be aware the tool may have changed since it was considered by DPI. Use of tools below is entirely at the risk of the user.

Resource: 2008-09 Cotton Benchmarking Survey



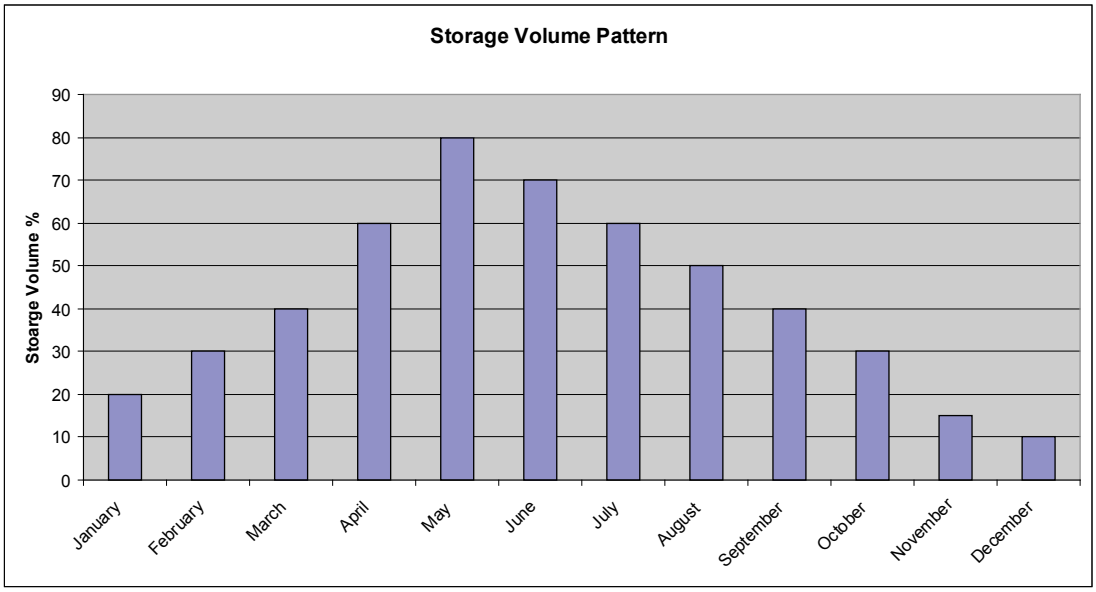
NSW DPI 2008-09 Cotton Benchmarking Survey from
http://www.australiancottonconference.com.au/LiteratureRetrieve.aspx?ID=76551

Resource: Evaporation data and storage trends



Monthly Evaporation at 'Top Farm' (source: 'Ready Reckoner' – Monthly Evaporation Calculator bureau of meteorology 2014)

The typical water storage pattern for 'Top Farm' Storage 1 can be seen in the figure below.



Monthly Water Storage Pattern for RES 1 at 'Top Farm'

Resource:

Water Access Licence Conditions Register

http://registers.water.nsw.gov.au/wma/AccessLicenceNoSearch.jsp?selectedRegister=AccessLicense

Resource: Calculating Mean Application Rate (MAR) and Distribution Uniformity (DU)

Introduction to irrigation management – Evaluating your pressurised system

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/176643/irrigation-evaluation-1.pdf

Introduction to irrigation management – Lateral boom and linear move

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/176651/irrigation-evaluation-2.pdf

Introduction to irrigation management – Centre pivots

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/176652/irrigation-evaluation-3.pdf

Introduction to irrigation management – Spray lines Side roll; end tow; hand shift

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/176653/irrigation-evaluation-4.pdf

Introduction to irrigation management – Fixed under-canopy micro systems and fixed overhead, solid set and bike shift

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/176661/irrigation-evaluation-5-6.pdf

Introduction to irrigation management – Non-overlapping under-canopy spray system

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/176662/irrigation-evaluation-7.pdf

Introduction to irrigation management – Drip (trickle) systems

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/164431/evaluating-pressurised-system.pdf

Example summary of steps used to calculate Mean Application Rate (MAR)

MAR = average application depth ÷ test time (minutes) x 60		
Total volume in all catch cans	*2116* ml	**A**
Catch-can diameter	*113* mm	**B**
Conversion factor for catch-cans	*10.0*	**C**
Convert catch can volume into depth (mm) = volume ÷ conversion factor		
Total depth of application	**= A ÷ C** **=** *2116* **÷** *10.0* **=** *211.6* mm	**D**
Number of catch cans between spray line positions	**36**	**E**
Average depth of application	**= D ÷ E** **=** *211.6* **÷** *36* **=** *5.88* mm	**F**
Test duration	*30* minutes	**G**
MAR = F ÷ G x 60		
Convert rate of application into hours	**=** *5.88* **÷** *30* x *60* **=** *11.8* mm per hour	**MAR**
In a well-designed system, the MAR figure for the whole irrigation should be less than or equal to the infiltration rate of the soil.		
Infiltration rate of soil	*15* mm per hr	**H**

Calculating Distribution Uniformity (DU) —side roll, end tow, hand shift

This calculation uses the catch *totals* to take into account overlap from adjacent spray line positions rather than individual catch-can amounts. The table below summarises the steps used to calculate DU.

Summary of steps used to calculate DU

LQ cans = number of catch cans between lateral positions ÷ 4		
(If not a whole number round down)	**= E ÷ 4** **= 36 ÷ 4** **= 9**	**LQ cans**
On your overlap addition table, highlight the lowest **totals** for the appropriate number of Lowest Quarter (LQ) cans. *These are your lowest quarter catch cans (LQ cans) (see above, i.e. the lowest 9 catch-can totals)*		
Total volume of the selected LQ cans	**= 48 + 47 + 46 + 37 + 45 + 37 + 47 + 37 + 31** **= 375 mL**	**K**
Convert Total LQ volume into depth	**= LQ volume (mL) ÷ conversion factor** **= K ÷ C** **= 375 ÷ 10.0** **= 37.5 mm**	**L**
LQ average depth of application = total depths of LQ cans ÷ number of LQ cans		
LQ Average depth	**= L ÷ LQ cans** **= 37.5 mm ÷ 9 cans** **= 4.17 mm**	**N**
Average LQ application rate = LQ average depth ÷ test time (minutes) x 60		
	= N ÷ G x 60 **= 4.17 ÷ 30 x 60** **= 8.34**	**P**
DU = average LQ application rate ÷ MAR		
	= P ÷ MAR **= 8.34 ÷ 11.76** **= 0.709** mm	**DU**
Convert DU into a percentage = DU x 100		
	= 0.709 x 100 **= 70.9% Round up to 71%**	

A DU of 85% is acceptable for spray lines. If the DU is **below** this, then changes to your irrigation system may be required in order to improve the DU%. It is a good idea to check the original specifications supplied with the irrigator to make sure the system is operating correctly.

Appendix 6: Example Evidence of consultant's certification

IRRIGATION AUSTRALIA

Irrigation Australia Limited
certifies that

Mr Consultant

has met all the requirements to become a

CERTIFIED IRRIGATION AGRONOMIST

This Certification is bestowed for two years and can then be renewed subject to ***Mr Consultant*** undertaking further professional development activities

Valid until 30 Sept 2016
Certificate No CIAg 932

Irrigation Australia Limited

CERTIFIED IRRIGATION AGRONOMIST
IRRIGATION AUSTRALIA

www.irrigation.org.au

Appendix 7: Example Invoice to proponent

TAX INVOICE

Date: April 9, 2014
Invoice 201459710

Adept Irrigation Consultants
Maintown, NSW
Fax 02688129856
adeptirr@gmail.com
ABN: 50 326 222 809
CIAg Certificate Number 932

TO:
Mr John Irrigator
'Top Farm'
Waterville
NSW
Customer ID [ABC12345]

SALESPERSON	JOB	PAYMENT TERMS	DUE DATE
		Due on Receipt	

QUANTITY	DESCRIPTION	UNIT PRICE	LINE TOTAL
	Irrigation Agronomy – Skeleton mapping		
	Irrigation Agronomy – Farm inspection and records of water sources, volume,		
	Irrigation Agronomy – Existing irrigation maped		
	Irrigation Agronomy – Inspection of irrigated soils		
	Irrigation Agronomy – WUE evaluation		
	Irrigation Agronomy – Reporting		
	Water track fee		
		Subtotal	3 200
		Sales Tax	320
		Total	$3 520

Due 26/5/2014]

THANK YOU FOR YOUR BUSINESS!

Appendix 8: Example receipt to proponent

RECEIPT		No.: 3569
Paid by: Mr. John Irrigator 'Top Farm' Waterville NSW	Paid to:	
DESCRIPTION		**AMOUNT**
IFWUEA Invoice # 201459710		
	SUBTOTAL	3200
	DISCOUNT(S)	
	TAX	320
	TOTAL	3520
Date: 20/4/2014	Received by: Adept Irrigation Consultants	

Appendix 9: Example Invoice to DPI

[1] Name

Address

Phone

[2] **ABN** XX XXX XXX XXX

[3] Date: 00/00/0000

[4] **TAX INVOICE** No. XXXX[5]

To:[6]

NSW Department of Industry

Attn: STBIFM Program

Wagga Wagga Agricultural Institute

Private Mail Bag

WAGGA WAGGA NSW 2650

ABN 72 189 919 072

DESCRIPTION	QTY	UNIT PRICE (excl GST)	SUB TOTAL (excl GST)	GST AMOUNT	AMOUNT PAYABLE (incl GST)
Project No: EXXX IFWUEA Reimbursement[7]	[7]1	2,000.00	2,000.00	[8]00.00	2,000.00
Totals			2,000.00	00.00	2,000.00

TOTAL (excl GST)	[9]2,000.00
TOTAL GST AMOUNT PAYABLE	[9] 0.00
TOTAL AMOUNT PAYABLE (incl GST)	[9]2,000.00

Please refer to numbered references on the sample invoice

1. The **identity** of the supplier (business trading name, address and telephone number at the top.
2. The **ABN** of the supplier at the top.
3. The **date of issue** of the tax invoice at the top, on the right hand side.
4. That the document is intended as a tax invoice, such as including the words '**tax invoice**' at the top.
5. An '**invoice number**' shown prominently alongside the words 'tax invoice'.
6. **Department of Industry's details**, ABN and contact person's details.
7. A **unit description** of each good or service supplied, including **quantities**.
8. An indication of which goods **don't include GST** by showing a 'zero' in the GST payable column

9 The **GST exclusive price**, the GST amount and the GST inclusive price for each item, together with the totals for these, vertically in the bottom right hand corner.

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