



Burdekin Bowen Integrated Floodplain Management Advisory Committee Inc.

Water and Energy Assessment Tools

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Discussion topics

- NCEA Background
- Energy Auditing
- Software Tools
 - Whole Farm Water Management
 - Irrigation Scheduling
 - Pump Efficiency Assessments
 - Pressurised System Assessments
 - Surface Irrigation Assessments
 - Storage and Dam losses

NCEA Background

- Largest of 7 USQ research centres
- Two focus areas of research
 - NRM – Irrigation, water resources, soils
 - Biosystems – Livestock, energy, precision agriculture
- Dozens of research projects in the farm energy field
 - Alternate energy
 - Life Cycle Analysis
 - Auditing

Energy Auditing

- Systematic review of operations
 - Used to identify inefficiencies
 - Improve performance

- Australian Standard AS/NZS 3598:2000
 - Specifies how energy audits should be completed
 - Details of what should be included in the reports and recommendations

Energy Auditing

■ Level 1

- Basic look at gross energy usage
- Overview – Accuracy of savings and costs +/-40%

■ Level 2

- More detailed look at individual areas of energy use
- Energy Use Survey – Accuracy +/-20%

■ Level 3

- Detailed investigation into how much energy is being used over time
- High Level Audit - +/- 10%

Level 1 Energy Auditing



Welcome

Welcome to the Burdekin Bowen Integrated Floodplain Management Advisory Committee (BBIFMAC) Level 1 Energy Assessment tool.



This tool has been developed to collect energy use data for the Energy Efficiency Gains For Australian Irrigators (EEGAI) project. The project is funded by the Australian Government's Energy Efficiency Information Grants Program. The EEGAI project aims to build the capacity of Australian irrigators to adopt energy efficiency practices and technologies. BBIFMAC will use trusted local organisations and consultants to deliver high quality and relevant information, on-farm assessments, benchmarking exercises, and case studies to small and medium enterprises in the Burdekin, Bowen and satellite areas.

Level 1 Energy Auditing



Welcome

Welcome to the Burdekin Bowen Integrated Floodplain Management Advisory Committee (BBIFMAC) Level 1 Energy Assessment tool.



This tool has been developed to collect data for energy audits. The project is funded by the Australian Government to build the capacity of Australian irrigation organisations and consultants to deliver case studies to small and medium enterprises.

System Type

Furrow

Lateral move

Center pivot

Trickle

Sprinkler

Water source

Ground

Surface

Number of diesel pumps

3

Number of electric pumps

5

List electric meters,
separate by comma

Level 1 Energy Auditing



Welcome

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System Type

Furrow

Lateral move

Center pivot

Trickle

Sprinkler

Water source

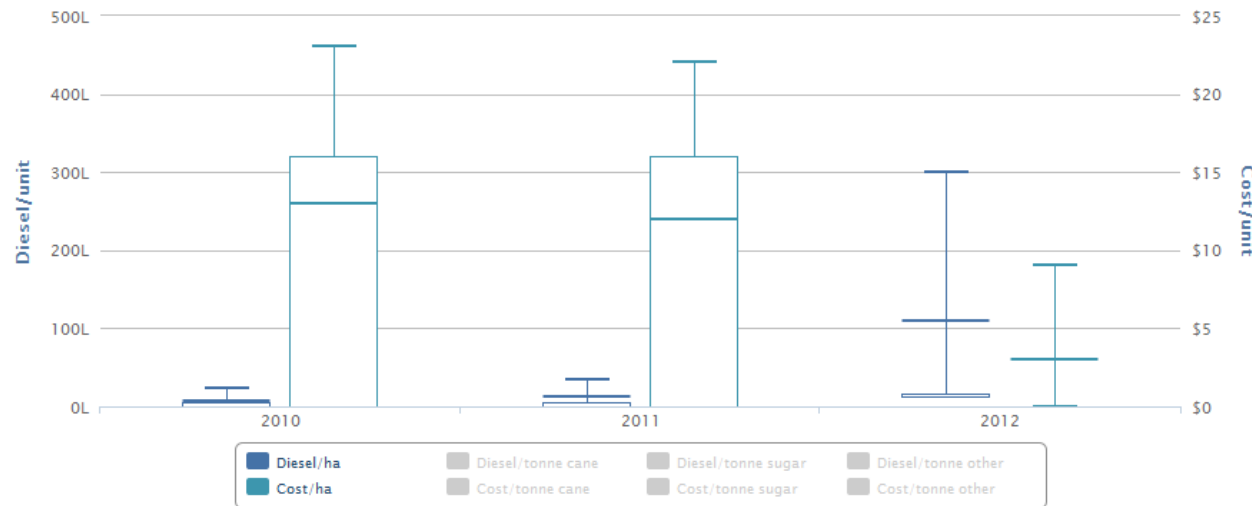
Ground

Surface

This tool has been developed to collect

The project
build the
organisa
case stud

Diesel usage per unit and cost per unit



Level 3 Detailed Assessments

- Drought - 10 years ago
 - Water use efficiency was the focus
 - RWUEI
 - NPSI
 - CRCIF
 - SEQIF
- Focus is now on Energy Use Efficiency
- In a pumped system improved WUE can result in improved EUE

Knowledge Management System for Irrigation



EconCalc [Free Access]

EconCalc is a decision support tool used to economically evaluate the costs and benefits associated with a new irrigation system. EconCalc calculates a number of economic performance indicators such as i) Nett Present Value (NPV); ii) annualised costs / benefits (annuity); iii) the internal rate of return (IRR) and the Benefit Cost Ratio.



EnergyCalc

EnergyCalc assesses direct on-farm energy use, costs and the greenhouse gas emissions (GHGs) associated with diesel, petrol, LPG and Electricity consumption. EnergyCalc examines energy use across key processes within a production system and can be used to evaluate farming practices such as tillage, spraying, irrigation etc.



Gmap

GMap is a map request and repository tool for irrigators in SEQ. The web portal provides a graphical interface that allows users to identify their particular farm based on a Google Maps environment. GMap facilitates the generation of farm resource maps with the appropriate organisation.



IPart

The Irrigation Performance Audit and Reporting Tool (IPART) is designed to assist in the evaluation and collation of infield irrigation application system performance data. IPART provides a range of functions including standardisation of infield data record acquisition, calculation and presentation of infield irrigation performance evaluation indices, automated generation of grower recommendations and grower report generation.



IPART Public Access [Free Access]

IPART Public Access is part of IPART and is used to view the Application Uniformity of Irrigation Systems. The performance of infield application systems is normally reported both in terms of the efficiency of application and the uniformity of application. The efficiency of the application system is calculated as the ratio of the water used by the plant relative to the water applied. The efficiency is primarily affected by the management of the irrigation and may vary significantly between irrigation events. However, the uniformity of application is primarily a function of the irrigation system design and maintenance. Low levels of uniformity limit the maximum efficiency achievable.



IPert

The Irrigation Pump Evaluation and Reporting Tool (IPERT) is designed to assist in the evaluation and collation of onfarm irrigation pumping system performance data. IPERT provides a range of functions including standardisation of on-farm data recordacquisition, calculation and presentation of on-farm irrigation pumping system evaluation indices, automated generation of grower recommendations and grower report generation.



IRUSTIC [Free Access]

IRUSTIC is a database reference tool used to identify the seasonal irrigation demand for crops in South East Queensland (SEQ). The IRUSTIC database contains simulated seasonal irrigation demands for various crop averaged over a period from 1970 to 2007.



ISID

The Irrimate Surface Irrigation Database, known by the acronym ISID is designed to collate field measurements and simulation results to facilitate benchmarking of surface irrigation performance at the farm, catchment and industry levels. ISID is fully compatible with the Irrimate™ system. It provides the ability to record and store all data necessary to conduct simulation runs, system evaluation and optimisation using Irrimate™ procedures. However, the system is generic and may be applied to a range of field measurement and evaluation techniques.



Nutrient Balance and Reporting Tool

Nutrient Balance and Reporting Tool is an online nutrient management calculator designed with an interactive data record management system and tiered reporting capability. It will help with the interpretation of soil test values, and record nutrient requirements, actual fertiliser inputs and subsequent productivity data. The data captured by Nutrient Balance and Reporting Tool can also be used to assist broader-scale interpretation (e.g. district, regional or industry scales) and trend analyses.



ReadyReckoner [Free Access]

The 'Ready Reckoner' performs a simple, site-specific economic assessment of the viability of evaporation mitigation systems. The user enters appropriate data to customise the 'Ready Reckoner' to their site.



RESSTAT

RESSTAT is an on line irrigation survey questionnaire that can be used to report regional irrigation statistics and benchmark performance. The questionnaire covers details of property ownership and location, irrigated land, water availability and cost, annual irrigated production and area, water use and irrigation management. Questions on demographics, drivers for change and knowledge of rural water use efficiency programs are also included.



Scheduling Irrigation Diary

The Scheduling Irrigation Diary is tactical decision support tool with simple irrigation recording and scheduling features based on evapotranspiration (ET). The Scheduling Irrigation Diary allows irrigators to record irrigation and rainfall while also calculating daily crop water use. The Scheduling Irrigation Diary assesses crop water needs (i.e. supply vs. demand) based on the actual irrigation amount, irrigation frequency, rainfall and crop water use.



Water Manager Tool

The Water Manager Tool is a strategic decision support tool used to assess current irrigation management practices and the interactions between crop and irrigation system. The Water Manager tool also develops a personalised irrigation schedule and water budget for the grower based on the characteristics of the enterprise



Water Resource Info Tool [Free Access]

The Water Resource Info Tool consolidates information used by irrigators such as rainfall, ET, commercial storage levels, surface water and ground water information in a single location. Information publicly available via the web and from a range of organisations is presented to irrigators by the Water Resource Info Tool.

KMSI.usq.edu.au

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Water and Energy Assessment Tools

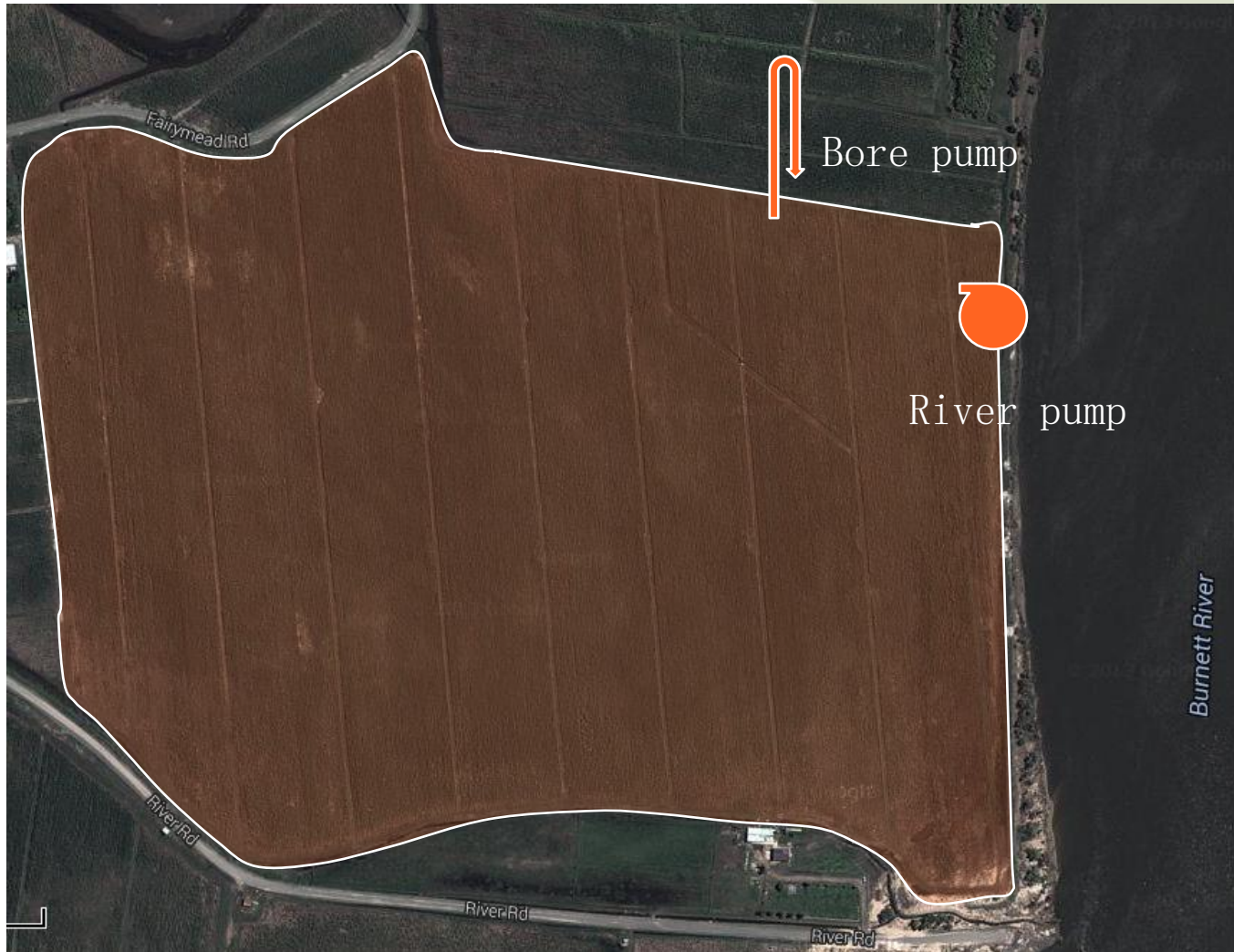


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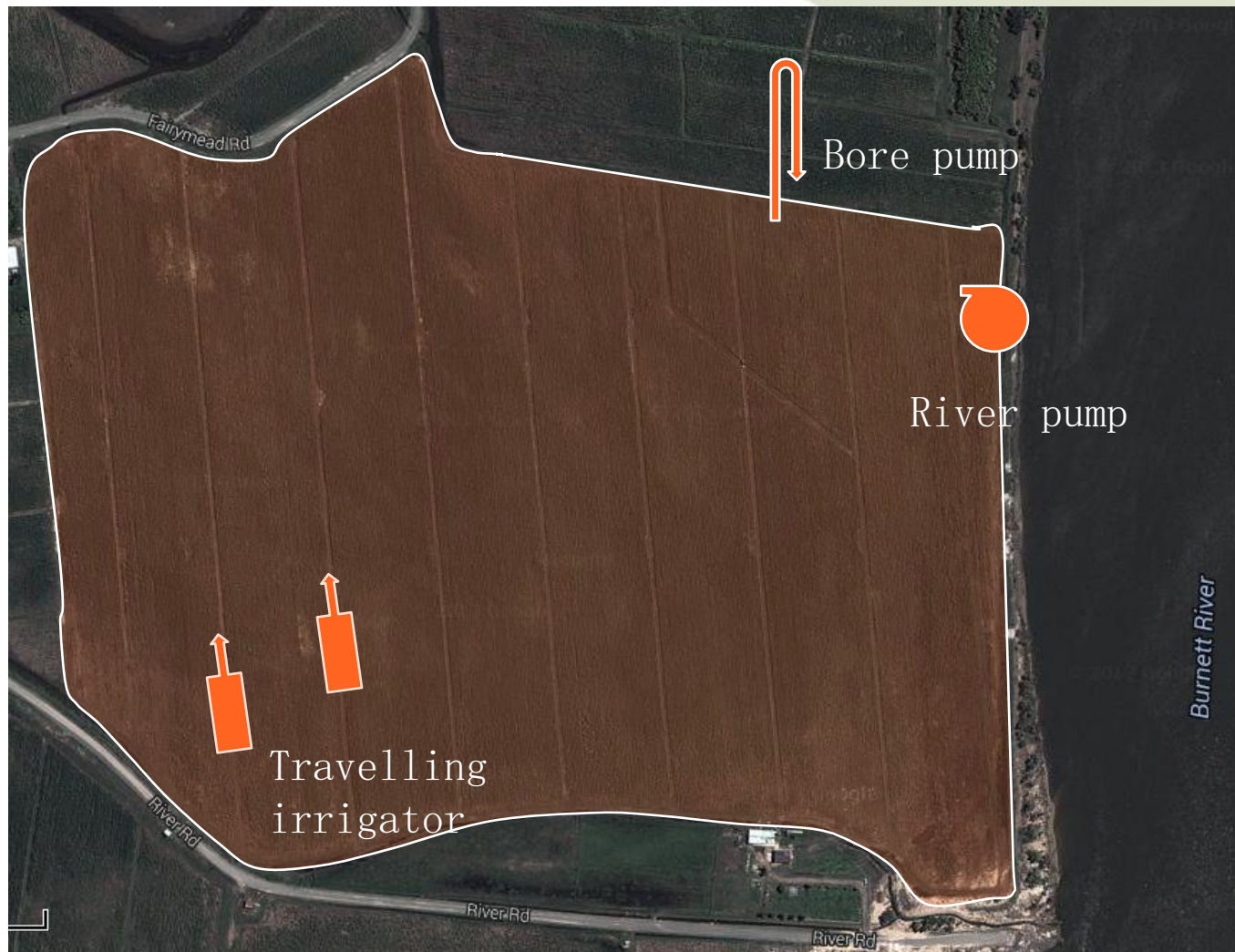
Water and Energy Assessment Tools



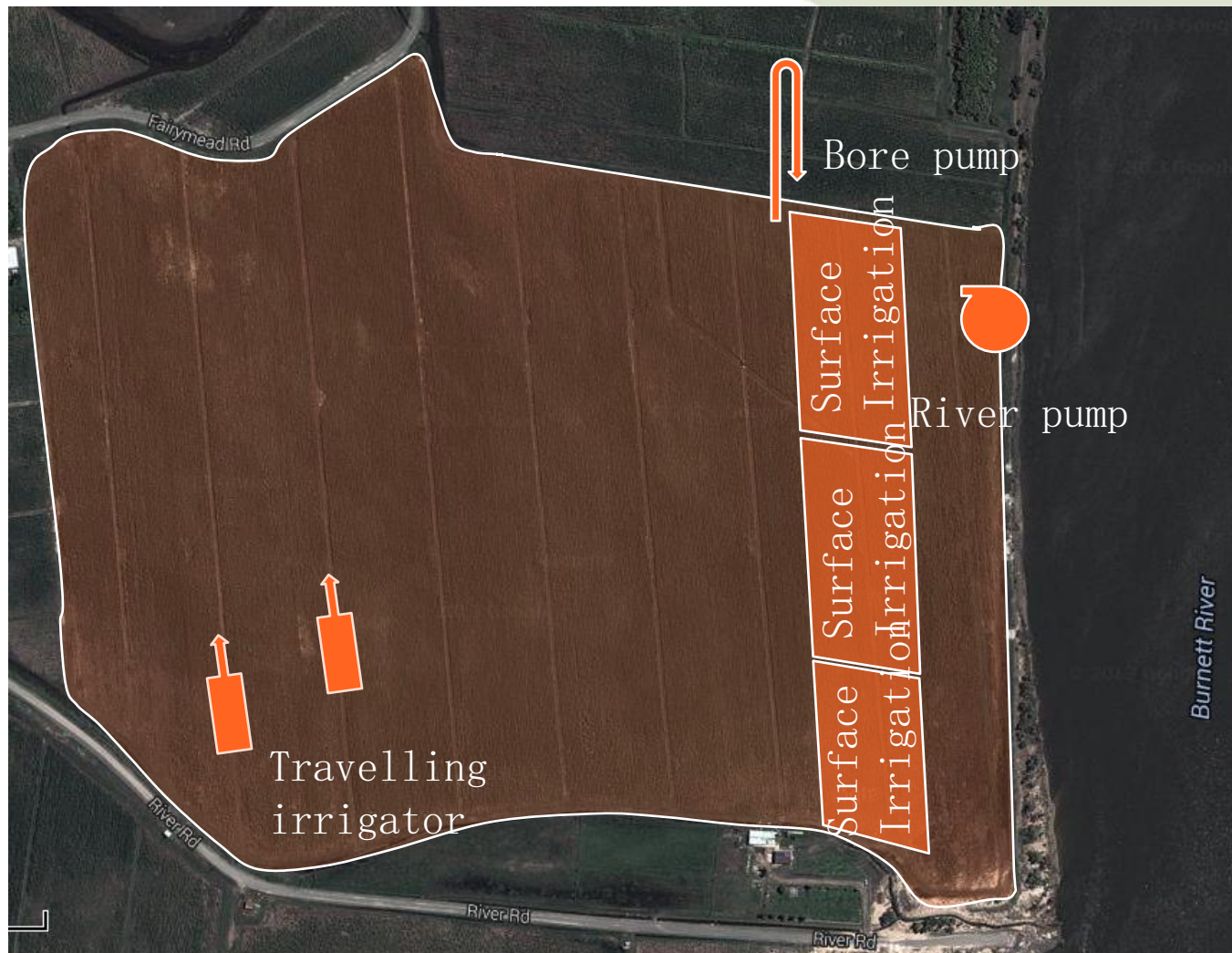
Water and Energy Assessment Tools



Water and Energy Assessment Tools



Water and Energy Assessment Tools



Water and Energy Assessment Tools



Whole Farm Water Management



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Whole Farm Water Management

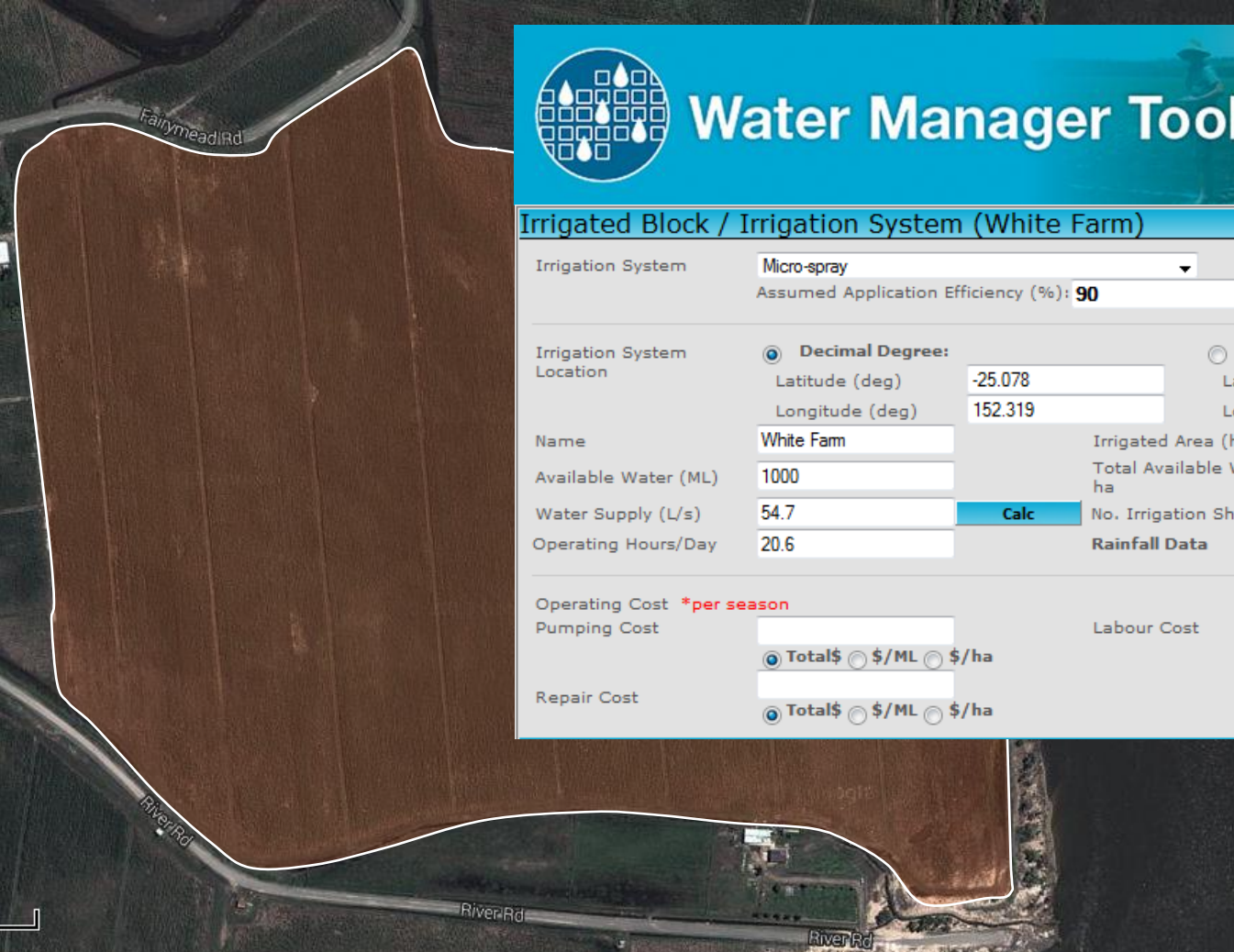


Water Manager Tool



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Whole Farm Water Management



Water Manager Tool

Irrigated Block / Irrigation System (White Farm)

Irrigation System:
Assumed Application Efficiency (%):

Irrigation System Location: ☒ **Decimal Degree:** ☐ **Degrees/Minutes/Seconds:**

Name: Irrigated Area (ha):

Available Water (ML): Total Available Water per ha:

Water Supply (L/s): No. Irrigation Shift:

Operating Hours/Day: Rainfall Data:

Operating Cost ***per season**

Pumping Cost: ☒ Total\$ ☐ \$/ML ☐ \$/ha

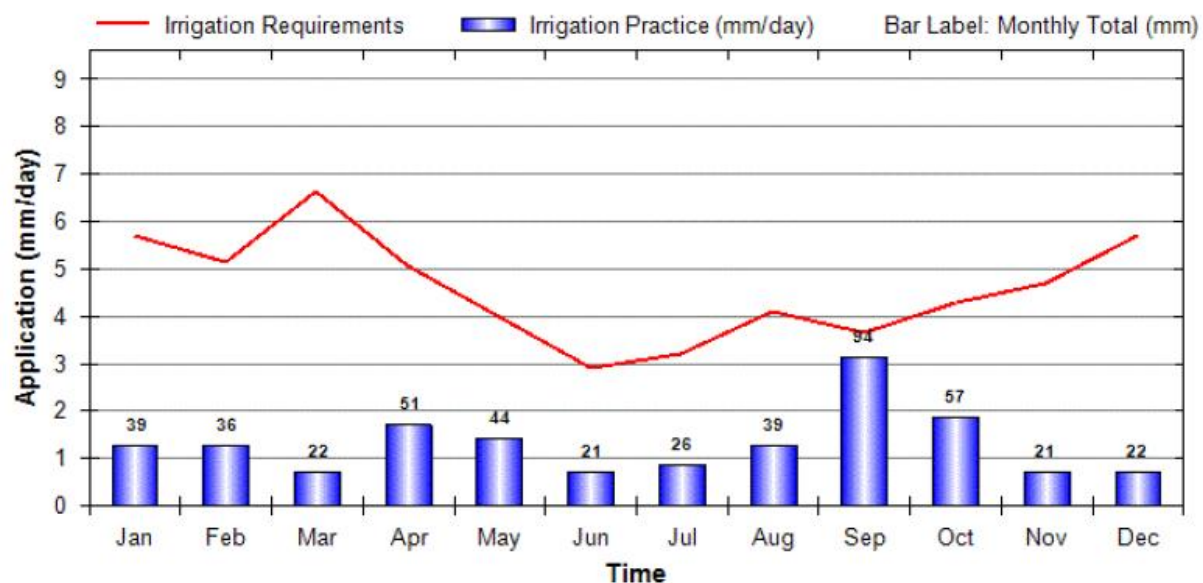
Labour Cost: ☒ Total\$ ☐ \$/ML ☐ \$/ha

Repair Cost: ☒ Total\$ ☐ \$/ML ☐ \$/ha

Whole Farm Water Management



Water Manager Tool



Whole Farm Water Management



Water Manager Tool

Crop 1

Crop	Cotton	Area	52 (ha)
Planting Date	20-10-2010	Harvesting Date	5-05-2011
Irrigation Water Applied	65 ML		
Production/Yields	6.87 (bales/ha)	Operating Hours/Day	
Soil Moisture at Planting (mm)	0	Soil Moisture at Harvest (mm)	-50

Additional Info

Additional Comments

Potential System Capacity 0 (mm/day)

System Operating Capacity 0 (mm/day)

Indices

Irrigation Water Use Index (IWUI) (bales/ML)	5.5	Gross Production Water Use Index (GPWUI) (bales/ML)	0.95	Gross Production Water Use Index (Effective) (GPWUI) (bales/ML)	0.98
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Indices (Catchment)

Irrigation Water Use Index (IWUI) (bales/ML)	4.82	Gross Production Water Use Index (GPWUI) (bales/ML)	1.22	Gross Production Water Use Index (Effective) (GPWUI) (bales/ML)	1.28
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Irrigation Scheduling

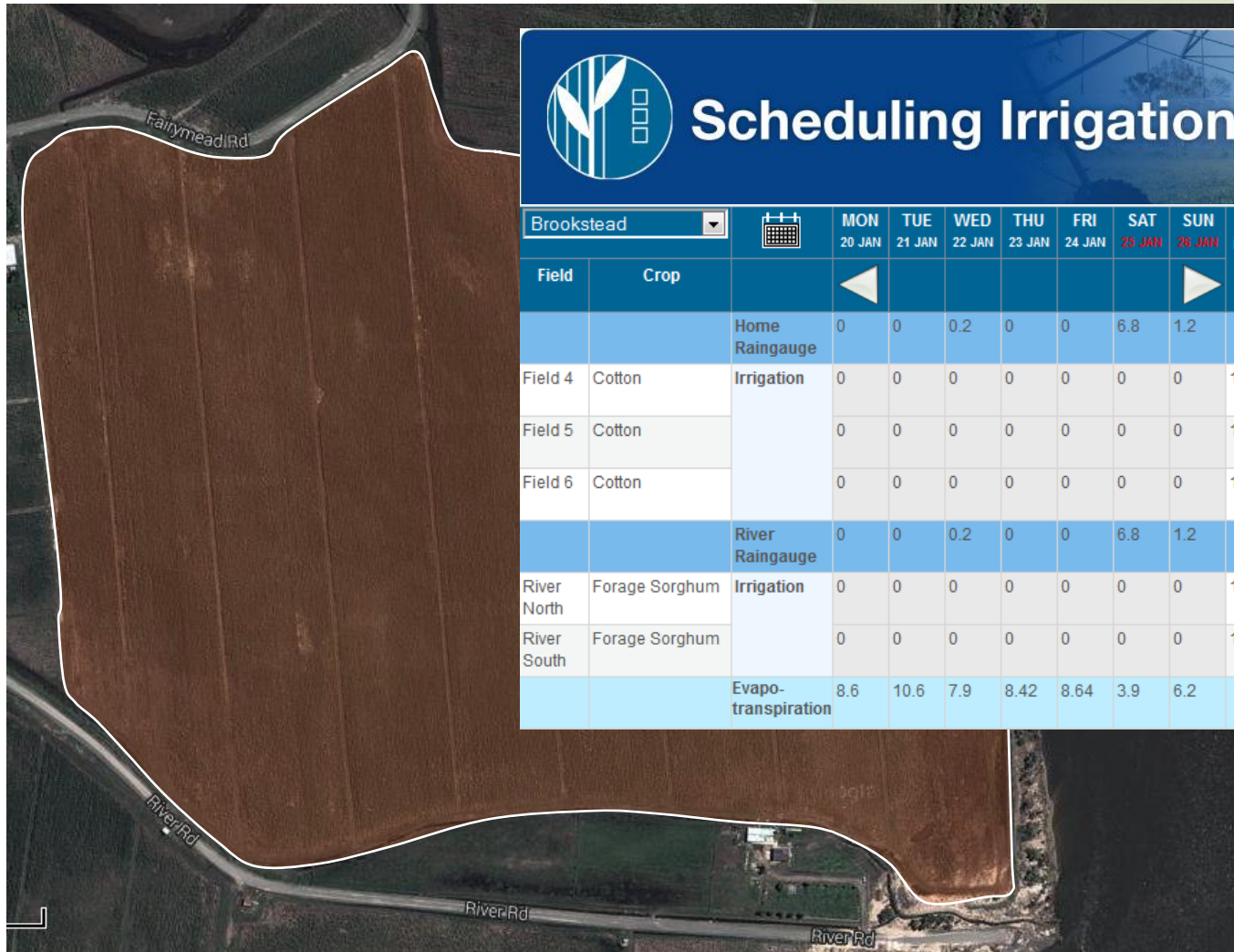



Scheduling Irrigation Diary



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Irrigation Scheduling





Scheduling Irrigation Diary

Brookstead



MON
20 JAN

TUE
21 JAN

WED
22 JAN

THU
23 JAN

FRI
24 JAN

SAT
25 JAN

SUN
26 JAN

Total
in-seas
on rain
(mm)

Total
irrig.
(mm)

Irrig. due
in (days)

Actual
harvest
date

Graphs

Field

Crop

Home
Raingauge

0

0


0.2

0

0

6.8

1.2



Field 4

Cotton

Irrigation

0

0

0

0

0


0

0

1990.6

300

>14



Field 5

Cotton

0

0

0

0

0


0

0

1990.6

270

7



Field 6

Cotton

0

0

0

0

0


0

0

1990.6

170

overdue



River
Raingauge

0

0


0.2

0

0

6.8

1.2



River North

Forage Sorghum

Irrigation

0

0

0

0

0


0

0

1975.6

380

2



River South

Forage Sorghum

0

0

0

0

0


0

0

1975.6

150

2



Evapo-
transpiration

8.6

10.6

7.9

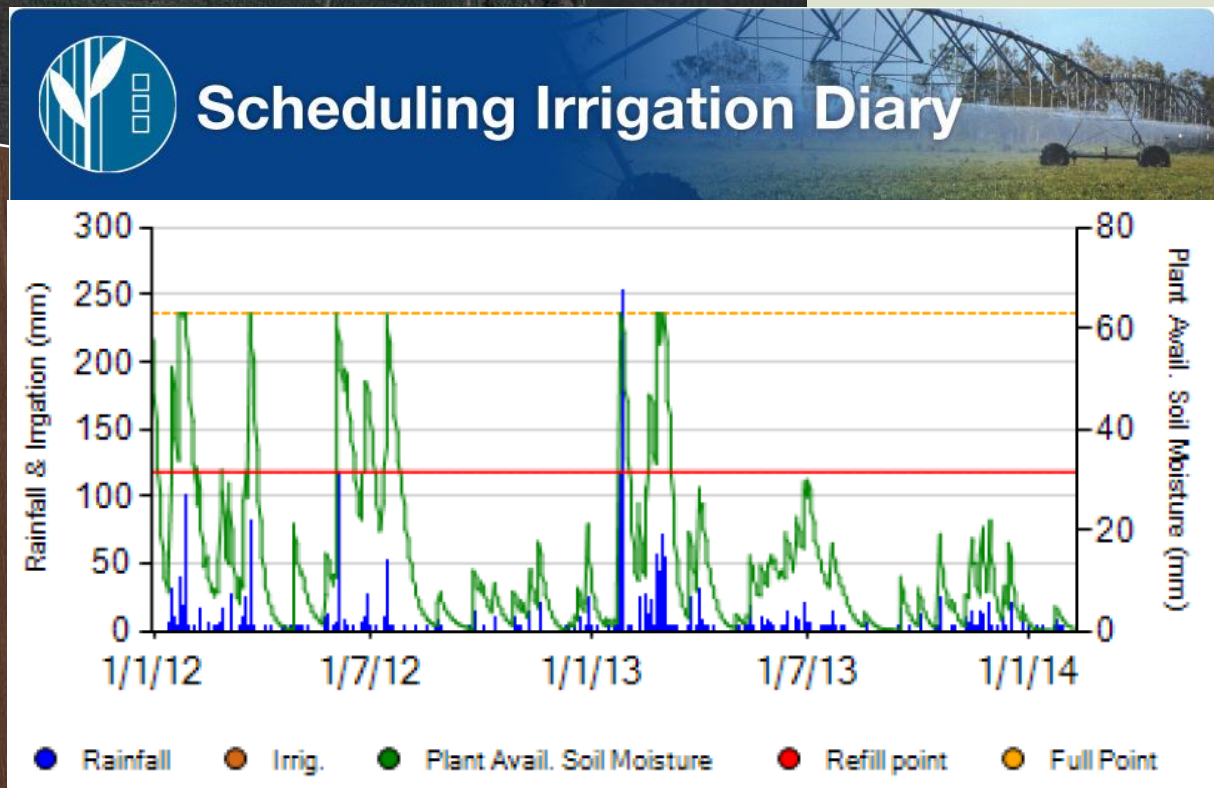
8.42

8.64

3.9

6.2

Irrigation Scheduling



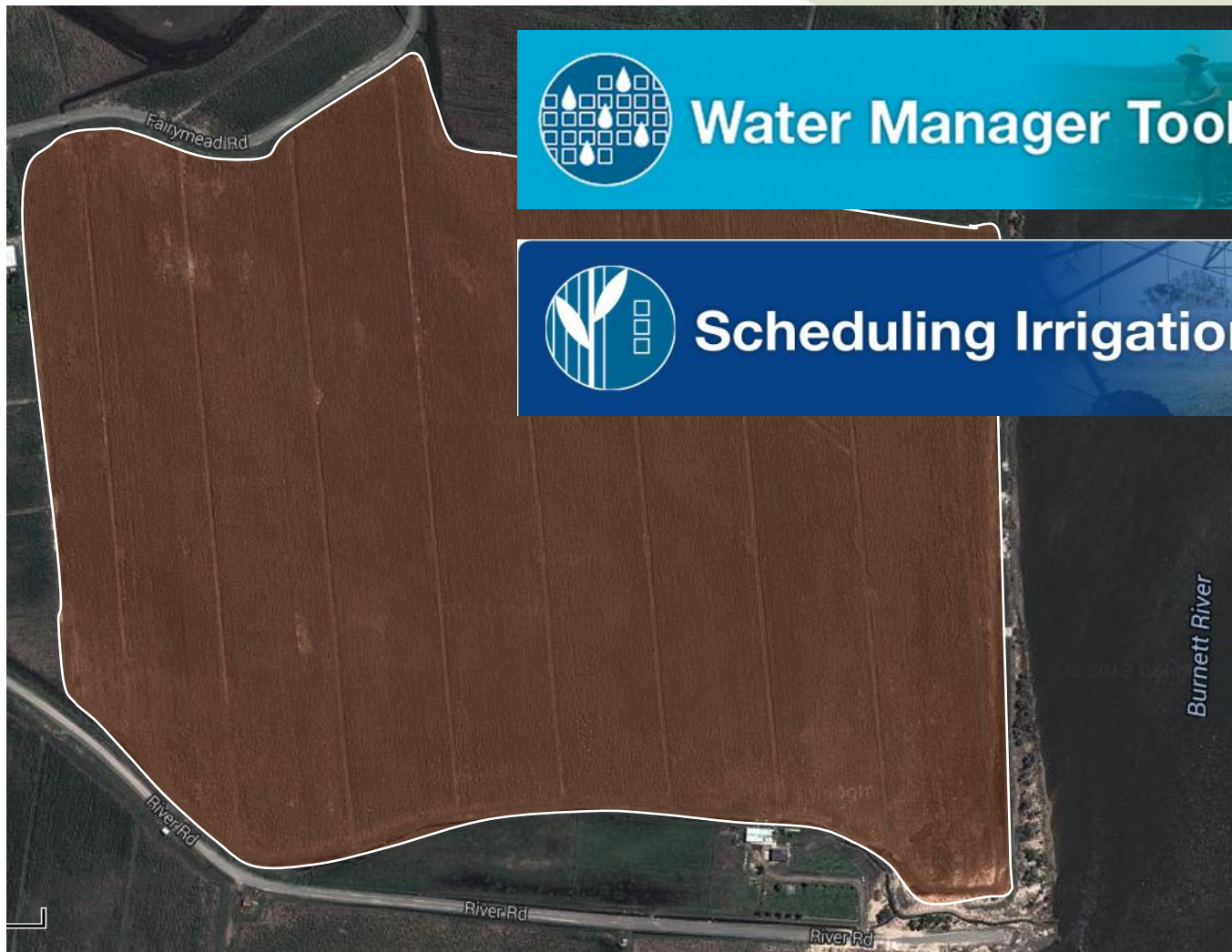
Whole Farm Water Management



Water Manager Tool

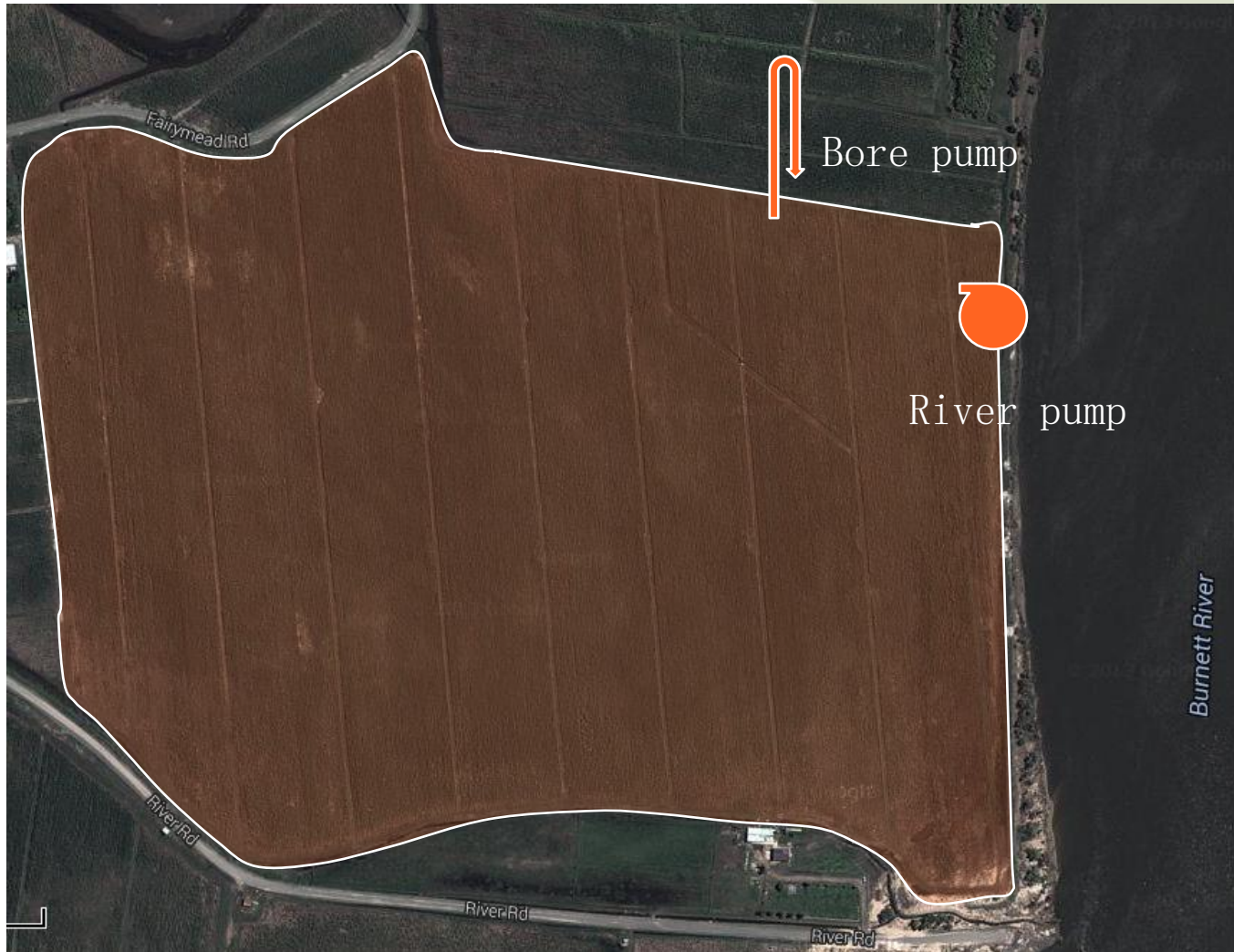


Scheduling Irrigation Diary

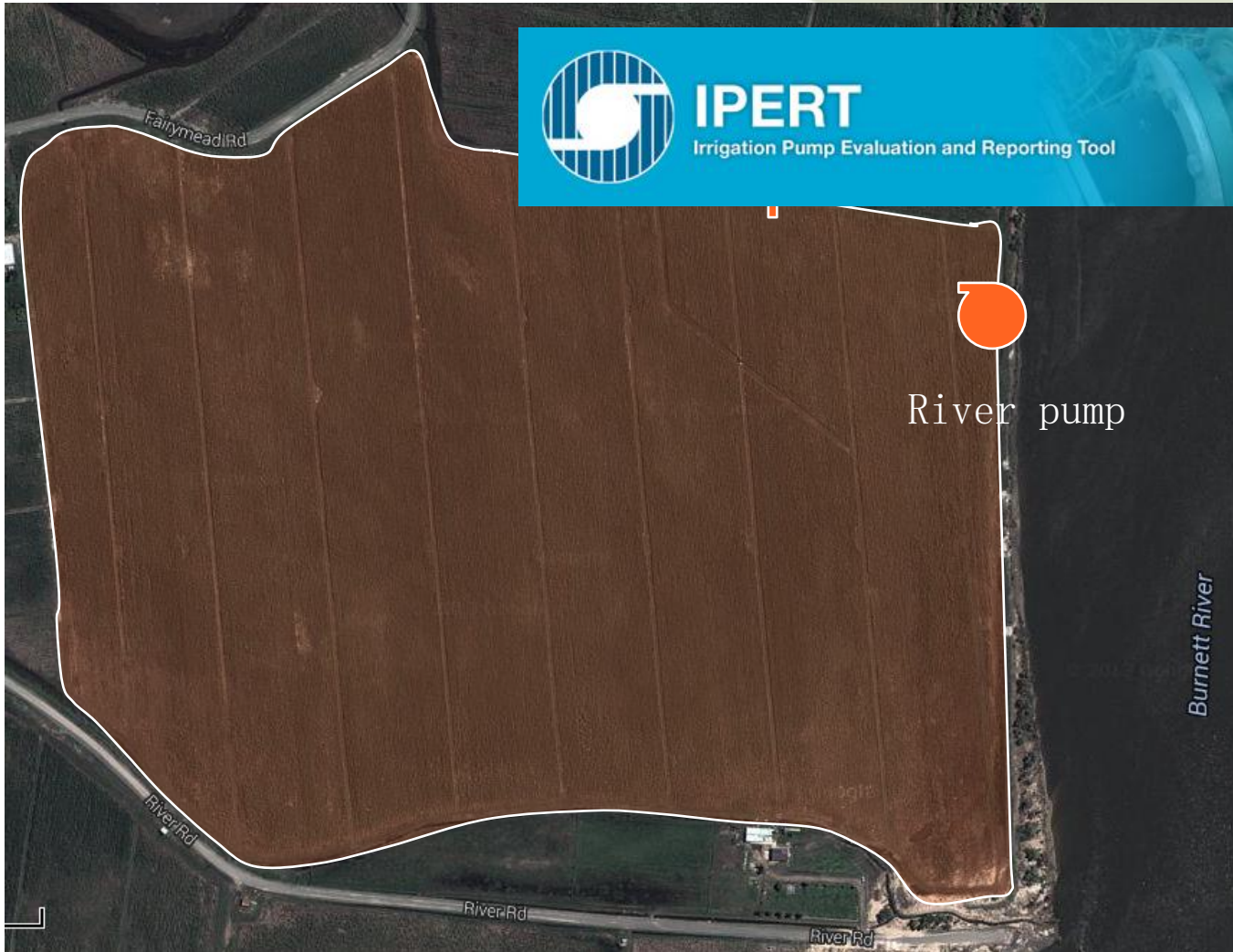


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Pump Energy Efficiency



Pump Energy Efficiency



IPERT

Irrigation Pump Evaluation and Reporting Tool


River pump

Burnett River

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Pump Energy Efficiency





IPERT

Irrigation Pump Evaluation and Reporting Tool



IPERT - Data Record Sheet

Electric Centrifugal

Field Sheet Printed by _____ on _____

Grower Details

Name _____

Phone (Mobile) _____ Phone (Work) _____

Email _____

Postal Address _____

Street Address _____

Organisation _____ Crop _____

Pump Site

Site Name _____ Catchment _____

Latitude (deg) _____ Longitude (deg) _____

Description _____

Pump Details

Make & Type of Pump _____ Model / Size _____

Actual Impeller Diameter (mm) _____ Serial # _____

Pump Inlet ID (mm) _____ Pump Outlet ID (mm) _____

Motor Details

Make _____ Model _____

Rated Motor (kW) _____ Rated RPM _____

Drive Type _____ Speed _____ Fixed / Variable _____

_____ Date _____

Pipe Material _____

Suction gauge fitted Yes / No _____

Pipe OD & Specification (mm) _____

Discharge Pipe ID at Pressure Gauge (mm) _____

Inlet Pressure (kPa) _____

Elevation Difference between Outlet & Inlet Pressure Gauges (m) _____
* value should be negative if inlet gauge is below outlet gauge

Suction Line Velocity (m/sec) if measured _____

Measured Motor RPM _____

_____ Date _____

Measure the time between two readings

Litres Measured _____

Time (sec) _____

Method (single outlet)

Time (sec) _____

Multiple outlets

Rear Nozzle		Total Sprinkler Flow Rate	
4 (l)	Time (sec)	(l/s)	(l/s)
Sprinkler Discharge Rate (l/s)			

Add all the total sprinkler head flow rates together and

by the average sprinklers discharge rate by the total

Pump Energy Efficiency



IPERT

Irrigation Pump Evaluation and Reporting Tool



Calculated Performance Parameters

Flow Rate	26.78 ML/Day (310 l/sec)
Flow Rate (target)	25.06 ML/Day (290 l/sec)
Total Dynamic Head	33.66 (m)
Total Dynamic Head (target)	27.96 (m)
Energy/Volume	104.44 (kW.h/ML)
Engine Derating Factor	98%

Performance

Combined / Overall Performance	28.04%
--------------------------------	--------

Specific Speed

Target Specific Speed	<i>Insufficient input to calculate Target Specific Speed</i>
Nominal Specific Speed	<i>Insufficient input to calculate Nominal Specific Speed</i>
Measured Specific Speed	71.92

Pumping Cost

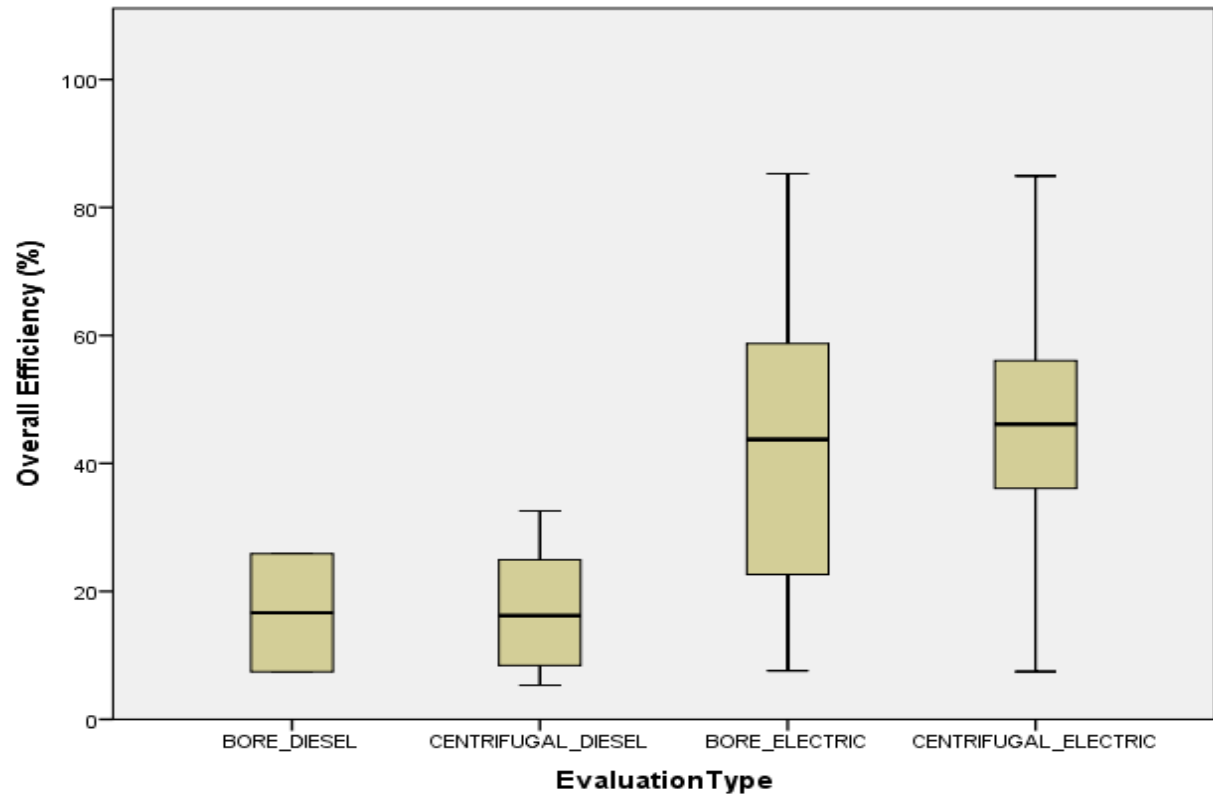
Grower Cost	32.93 (\$/ML)
Comparison Cost at \$1.20/l	37.63 (\$/ML)
Grower Cost (\$/ML/m)	0.98 (\$/ML/m)
Comparison Cost at \$1.20/l	1.12 (\$/ML/m)

Pump Energy Efficiency



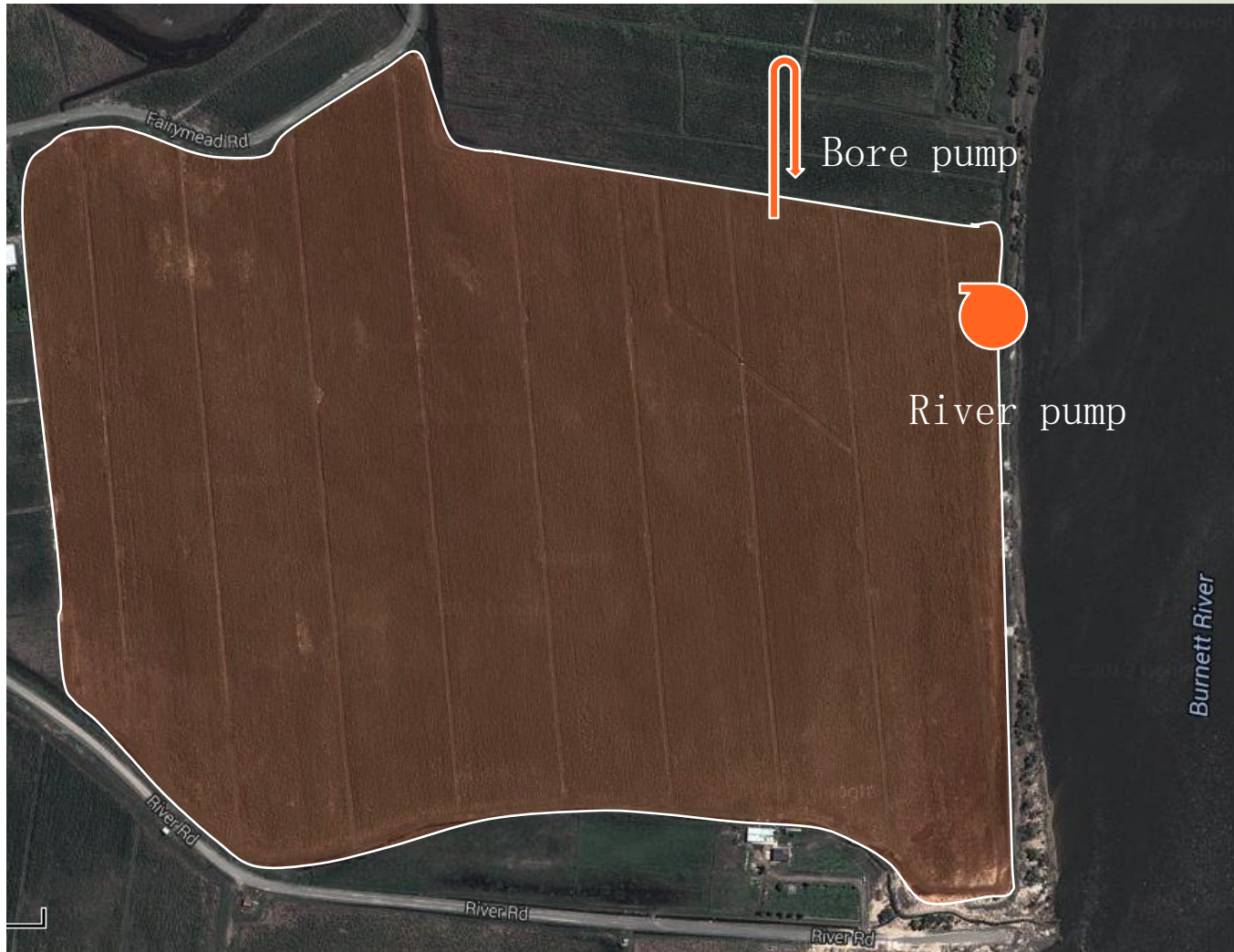
IPERT

Irrigation Pump Evaluation and Reporting Tool

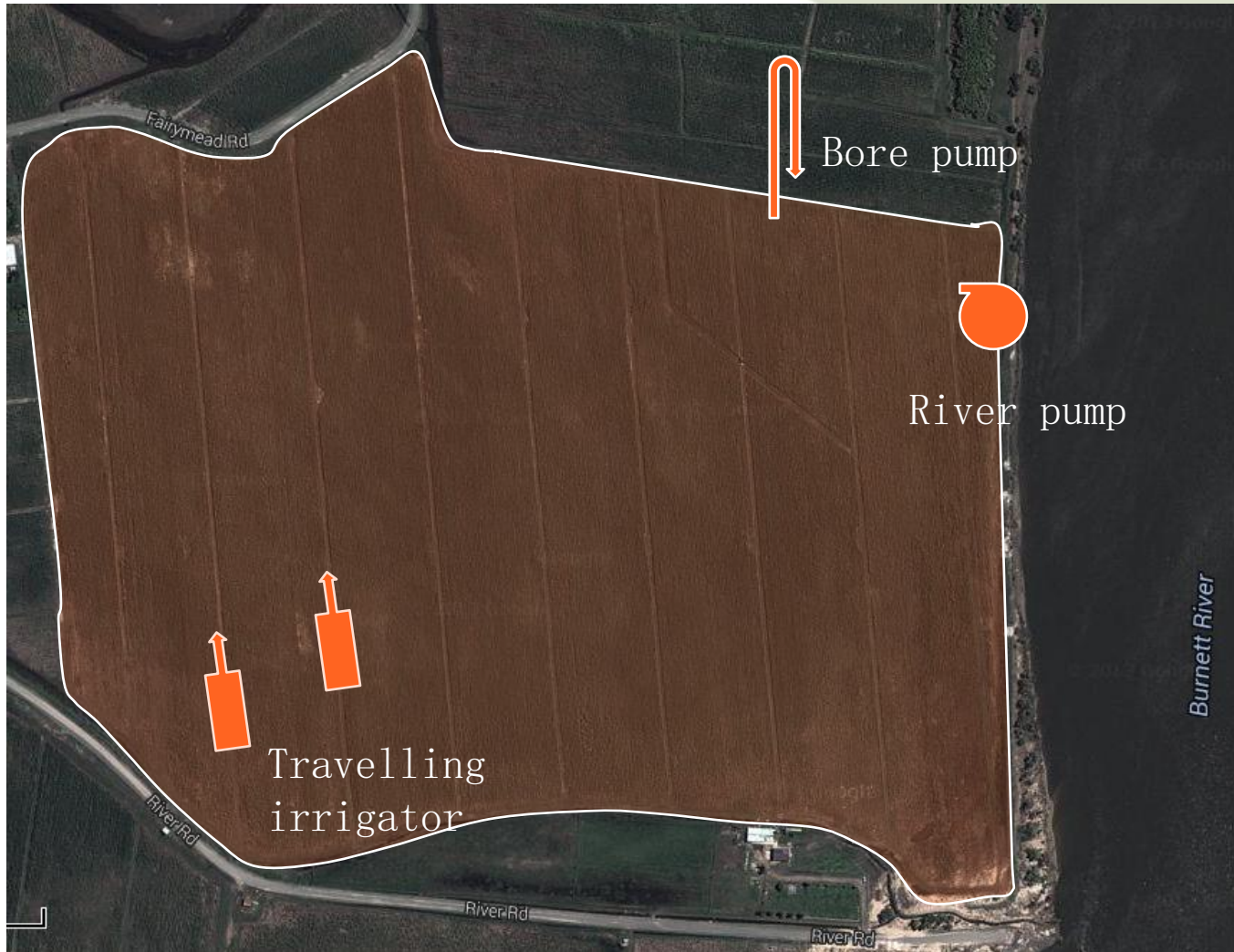


Assessment 100IS

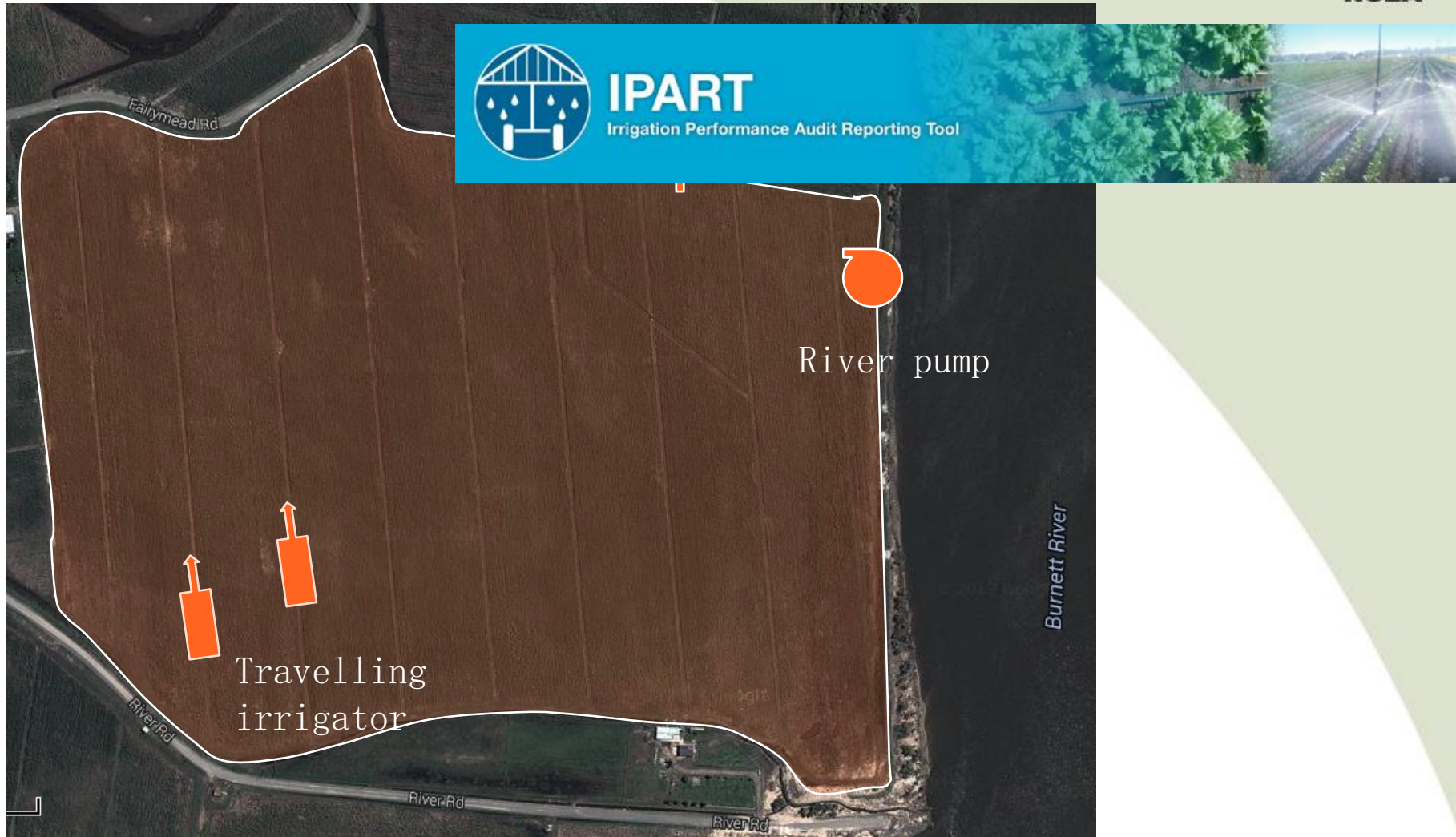
Pressurised System Assessments



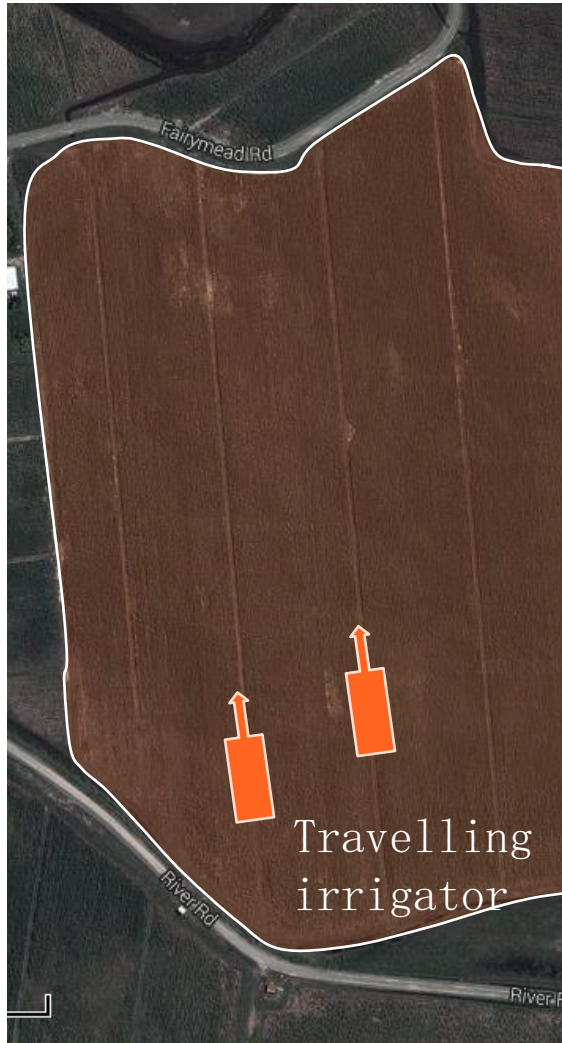
Pressurised System Assessments



Pressurised System Assessments



Pressurised System Assessments



IPART

Irrigation Performance Audit Reporting Tool

IPART

Lateral Move Evaluation

Field Sheet, Created on 27/6/2012 by Michael Scobie

Grower Details

Grower Name _____

Phone (Work) _____

Phone (Mobile) _____

Email _____

Business Name _____

Street Address _____

Postal Address _____

General

Organisation _____

Collection Date _____

Additional Comments _____

Farm Details

Farm Name _____

Field ID _____

Catchment _____

Description _____

Latitude _____

Longitude _____

Irrigation System

Machine ID _____

Machine Make _____

Travel Direction _____

Sprinkler Spacing (m) _____

Sprinkler Height (m) _____

Sprinkler Make _____

Sprinkler Model _____

Design Flow Rate (L/s) _____

Design Pressure (kPa) _____

Nozzle Size _____

Pressure Regulators Fitted? _____ Y / N

Pressure Regulator Value (kPa) _____

Wetted Radius Intermediate Sprinkler (m) _____

Wetted Radius 1st Left Sprinkler (m) _____

Wetted Radius 1st Right Sprinkler (m) _____

Wetted Radius Last Left Sprinkler (m) _____

Wetted Radius Last Right Sprinkler (m) _____

Distance to 1st Left Sprinkler (m) _____

Distance to 1st Right Sprinkler (m) _____

Pressure at Inlet (kPa) _____

Pressure at End (kPa) _____

Speed Setting (m/hr) _____

Application Depth (mm) _____

Soil/Crop

Crop _____

Soil Texture _____

Pumping Details

Total Dynamic Head (m) _____

Flow Rate (L/s) _____

Measurements for Flow Rate Calculator

Water Meter Reading at Start (ML) _____

Water Meter Reading at End (ML) _____

Time Elapsed (min) _____

OR

Water Measured (L) _____

Time Elapsed (s) _____

OR

Volume Pumped (ML) _____

Field _____ Date _____

Irrigator Speed

No	Distance (m)	Time (min)	Speed

Left Spans

Length	Distance	# of Sprinklers

Right Spans

Length	Distance	# of Sprinklers

relative elevation for points.

Description

Field _____ Date _____

Travel direction to be set for each evaluation. Catch spans should extend beyond the wetted diameter of the

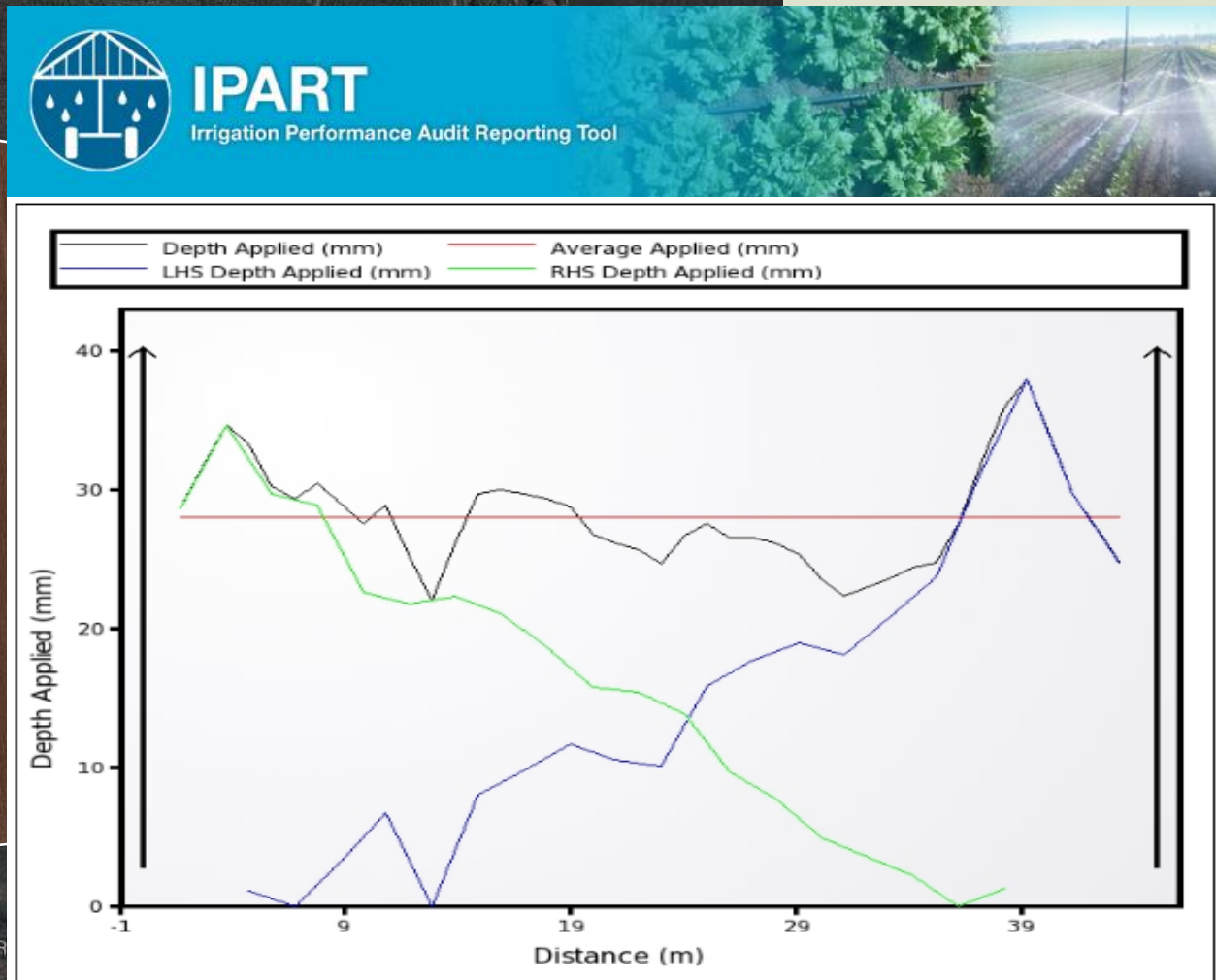
Along the Field to 1st Right Can to 1st Left Can

Edge of Field

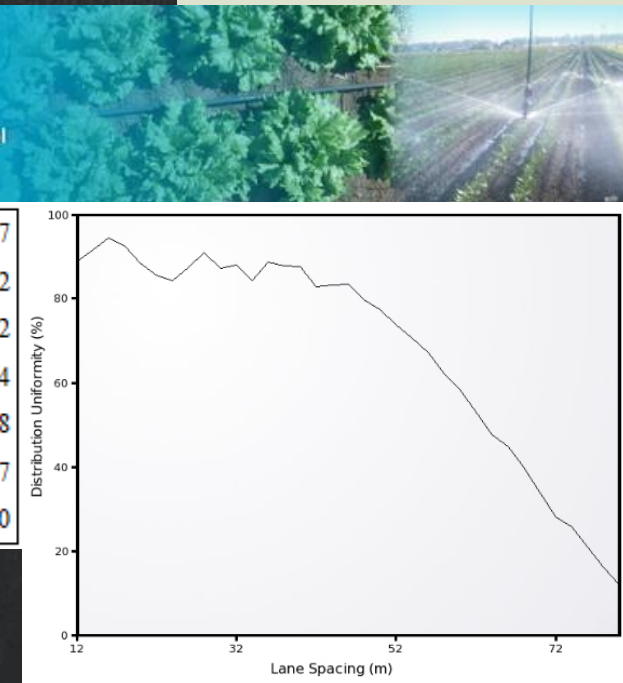
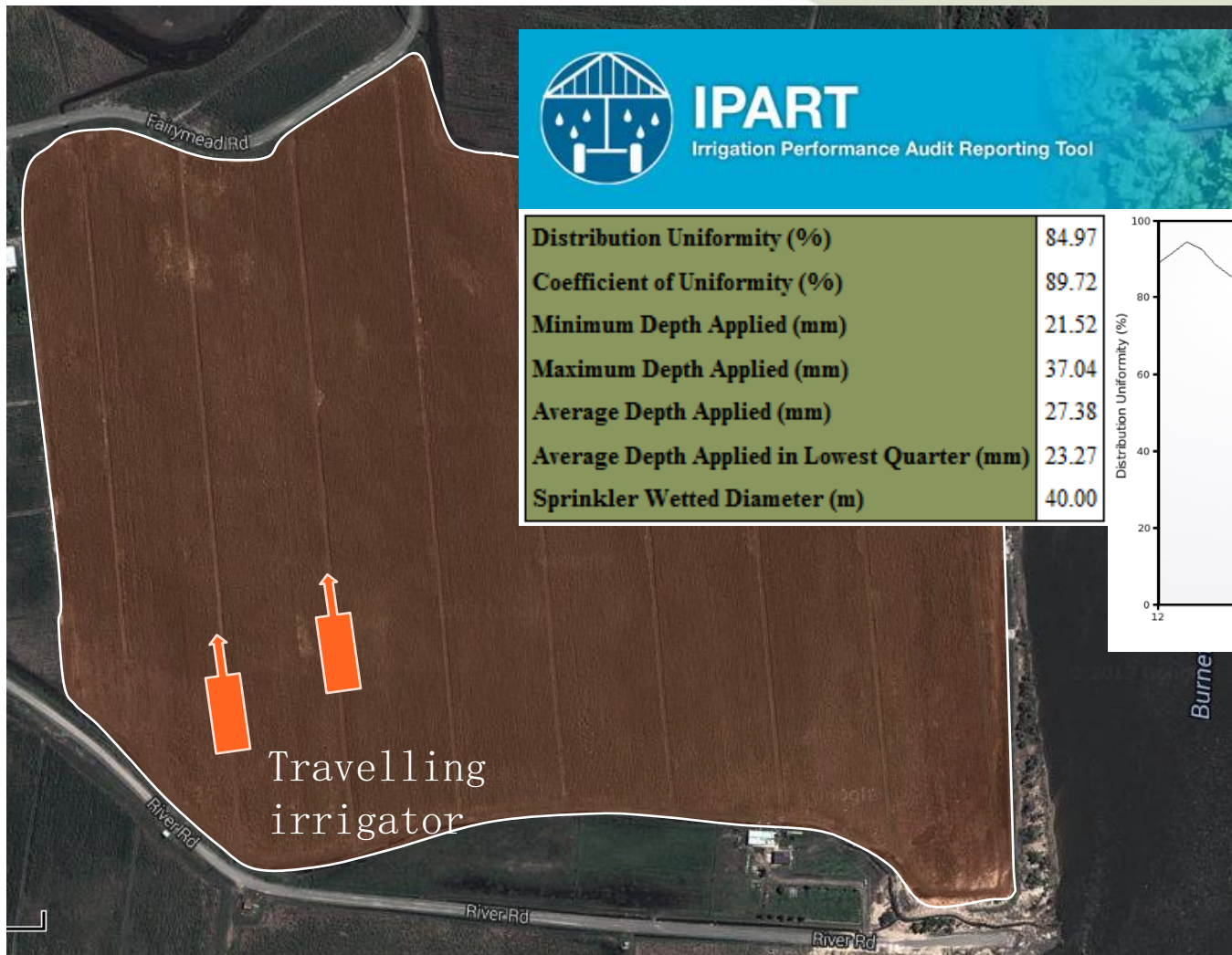
Distance from Cart / Centre of 1st Can

Edge of Field

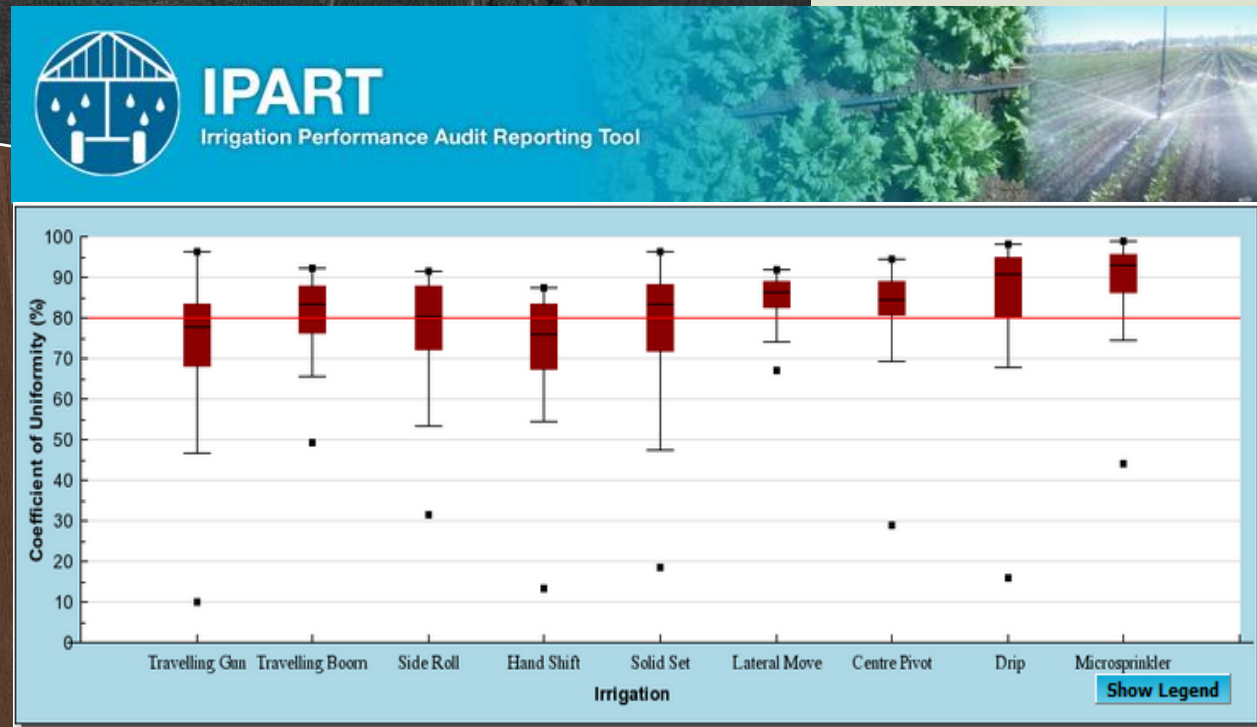
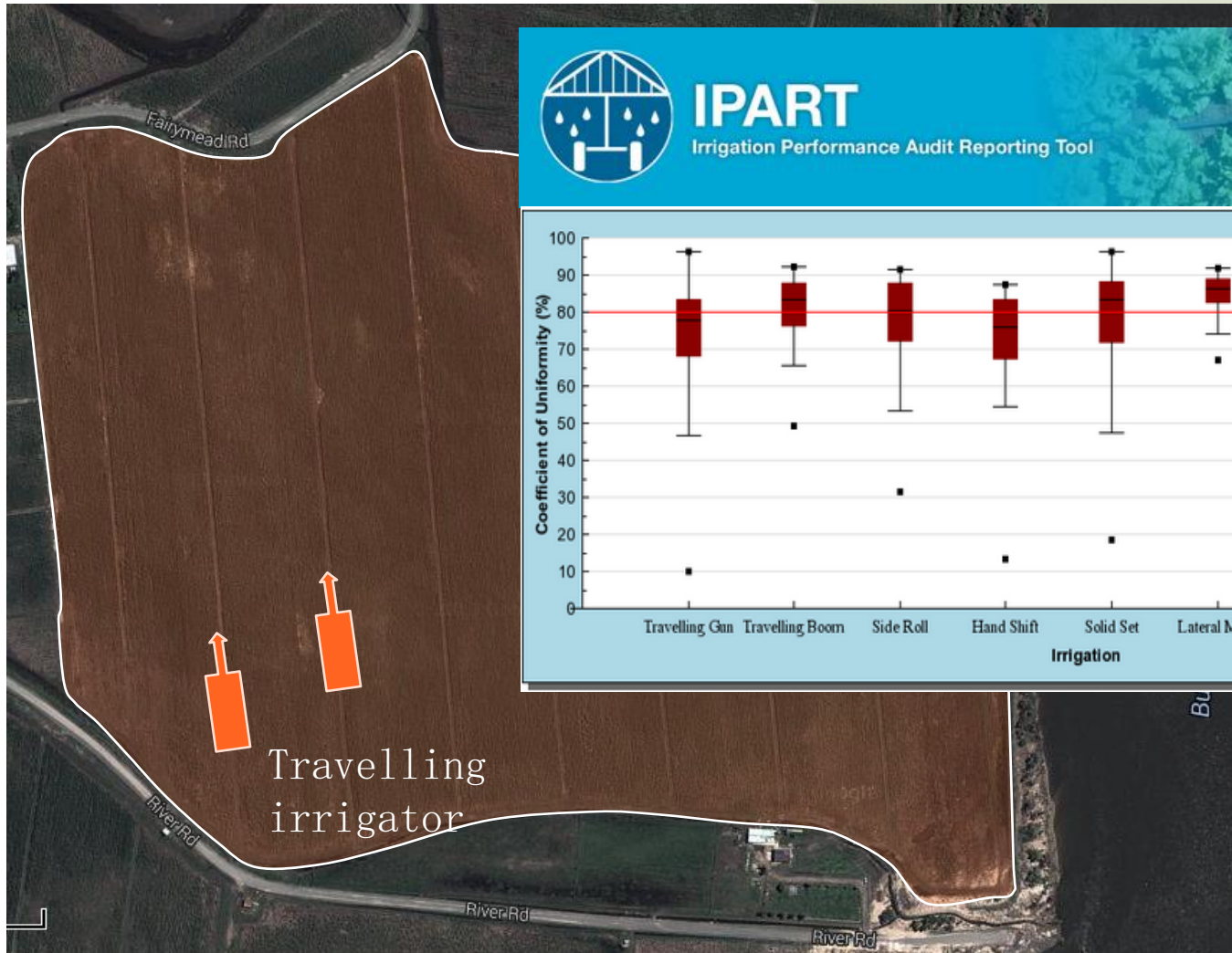
Pressurised System Assessments



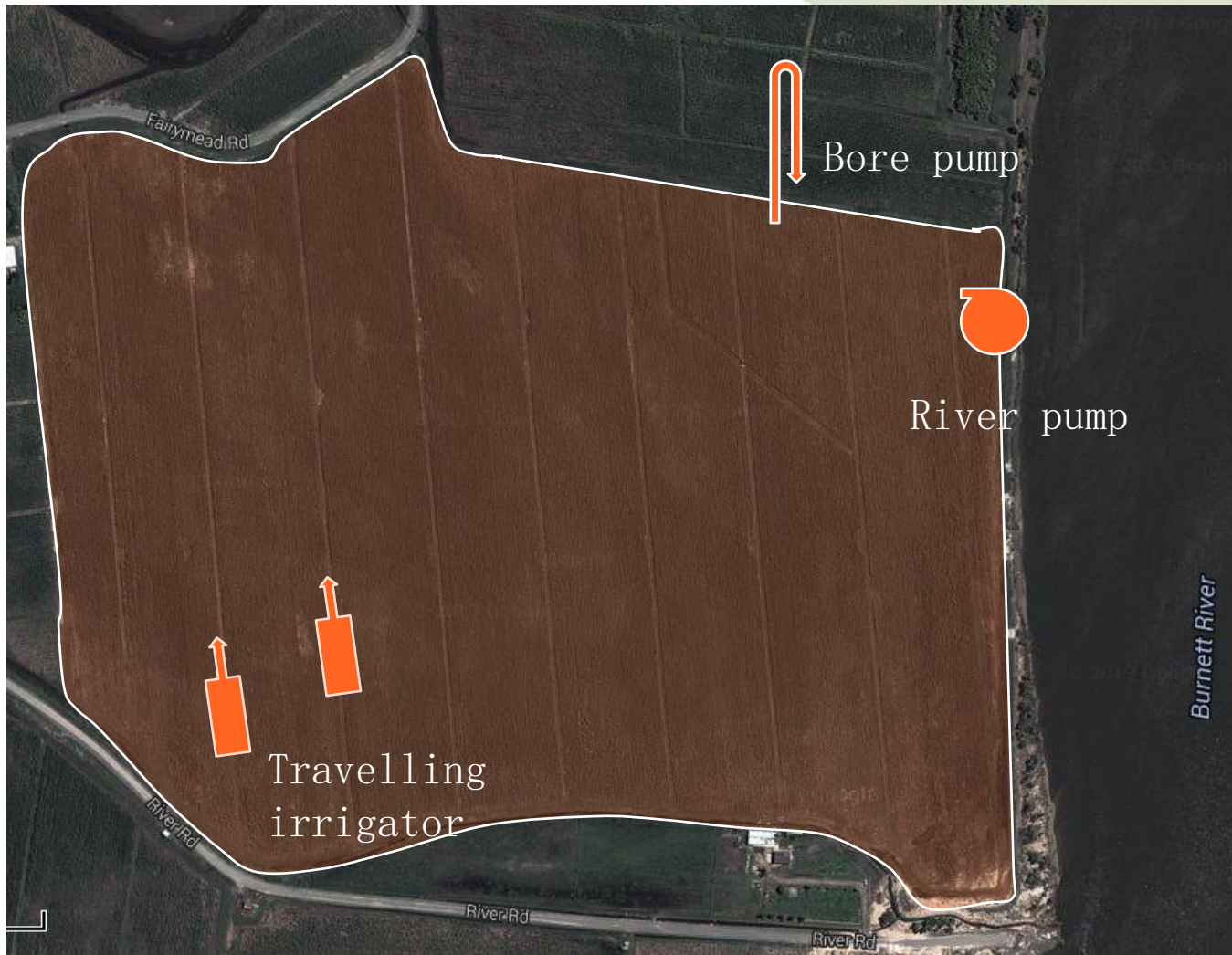
Pressurised System Assessments



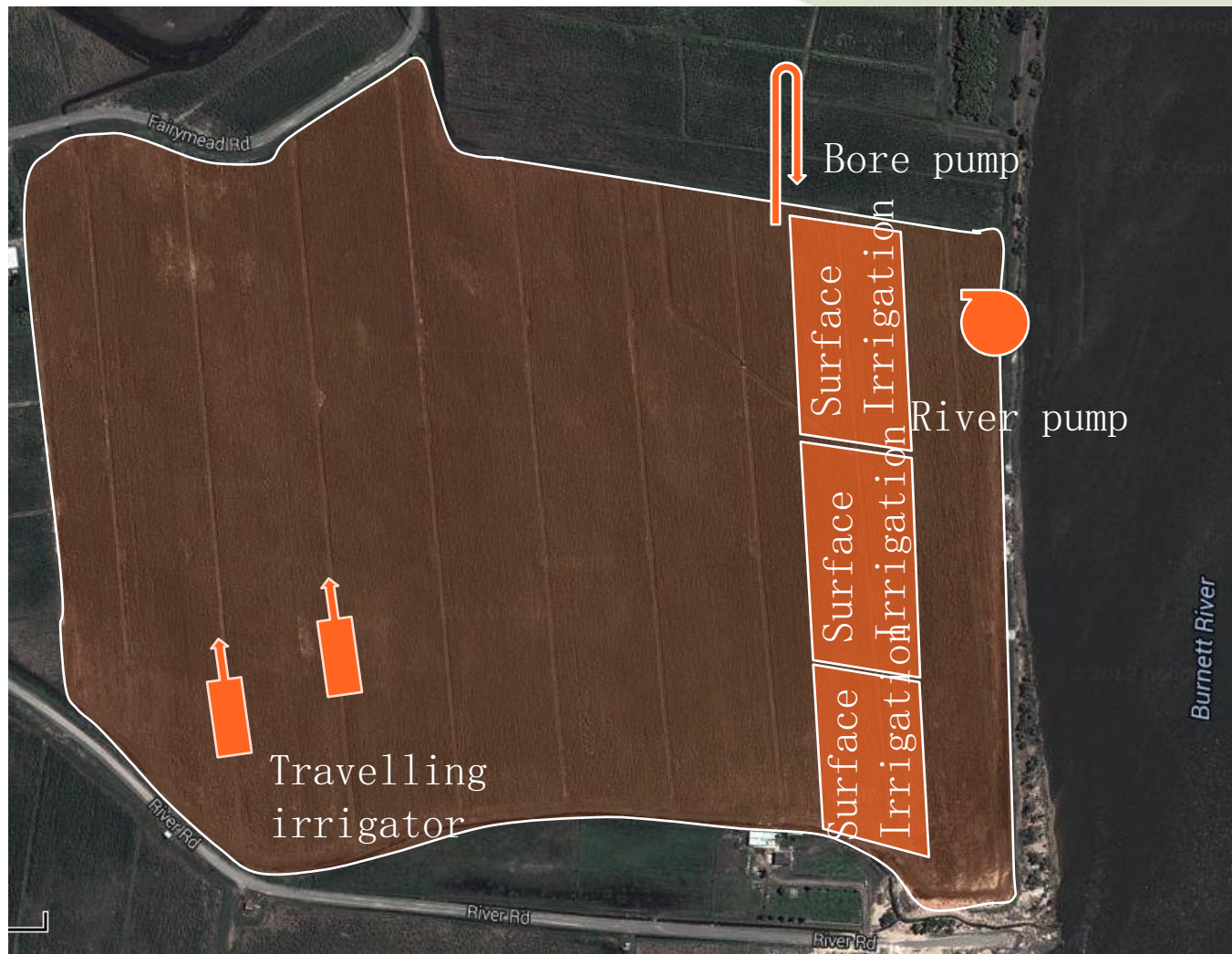
Pressurised System Assessments



Surface Irrigation Assessments



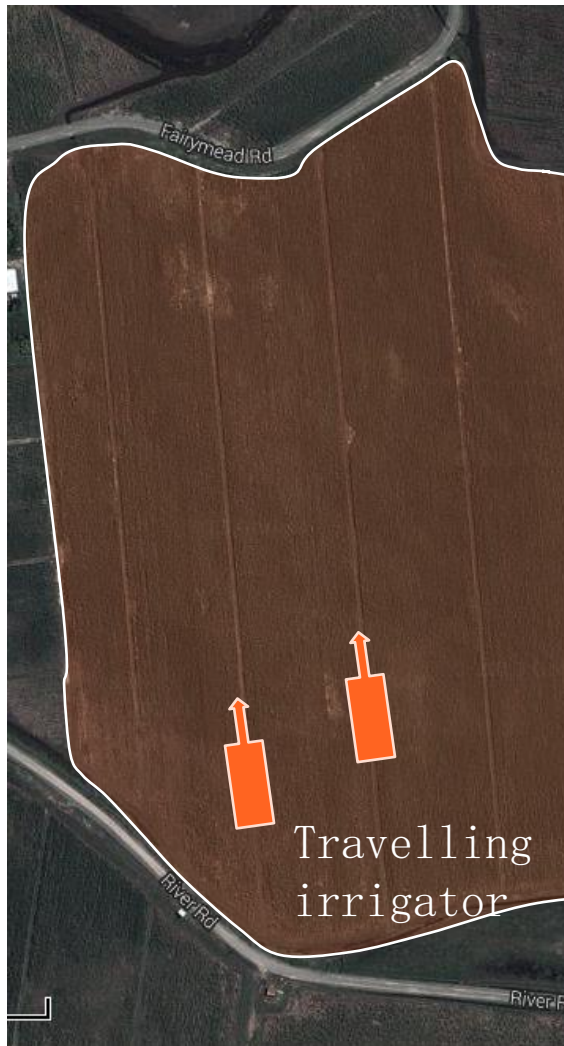
Surface Irrigation Assessments



Surface Irrigation Assessments



Surface Irrigation Assessments



SISCO
Surface Irrigation Simulation, Calibration and Optimisation
V 1.5.1

Input - SISCO - DownsTest

Field Details

Field Length m
Manning n
Spacing (wetted) m

Downstream Condition:

☒ Free Draining ☐ Blocked
Recycling Eff. %
Runoff Meas Dist m

Upstream Condition:

☐ Drainback
Draw Down min.

Field Slope

☐ Variable
Constant slope

Inflow Data

Cut-off Time min.
Inflow Rate L/s
☐ Variable

Alternative Inlet Measurement

☐ Depth inflow Mode

Furrow Shape (mm)

☒ Furrow ☐ Bay/Basin
Furrow Type
☐ Variable
Top Width mm
Middle Width mm
Bottom Width mm
Max Height mm

Numerical Parameters

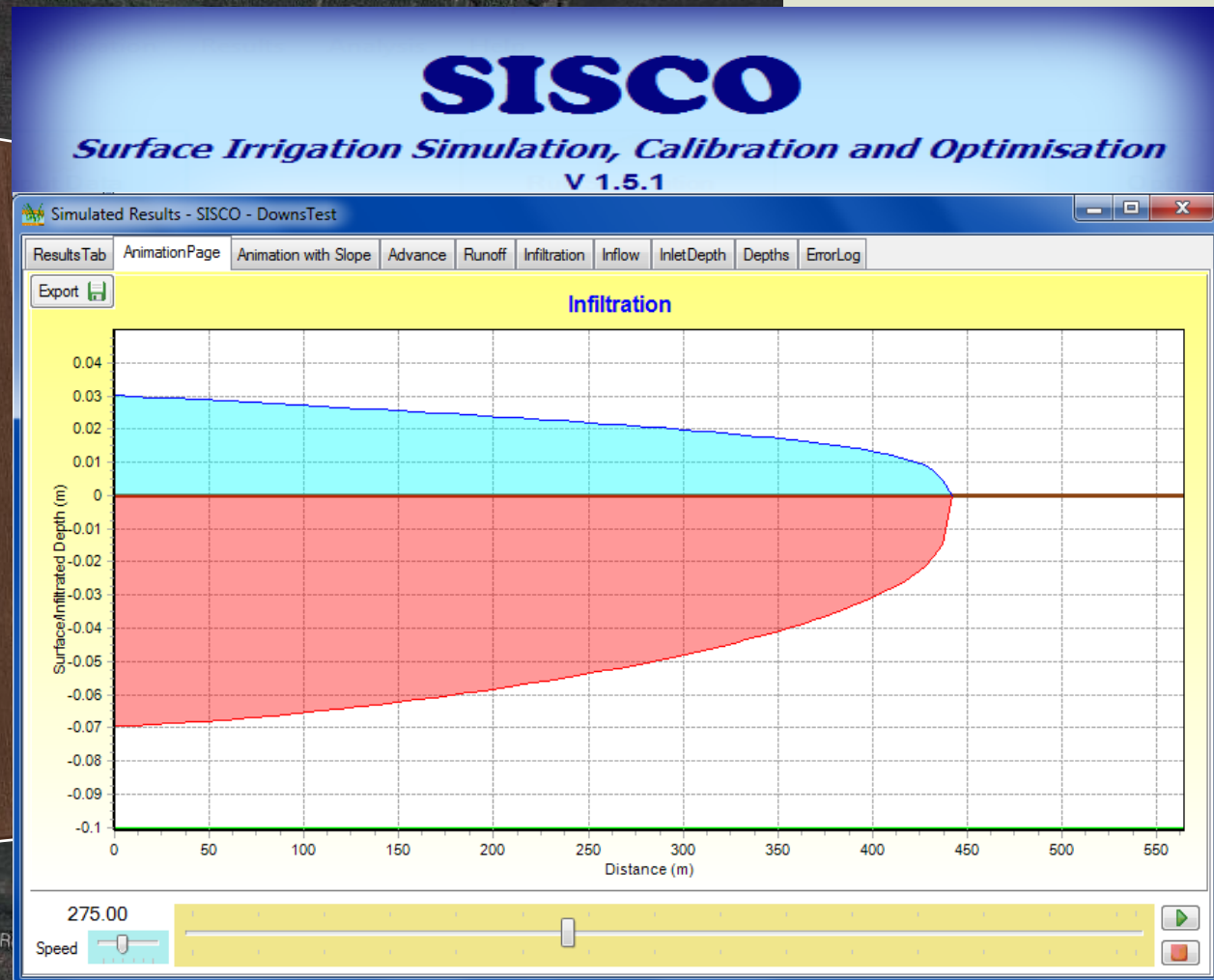
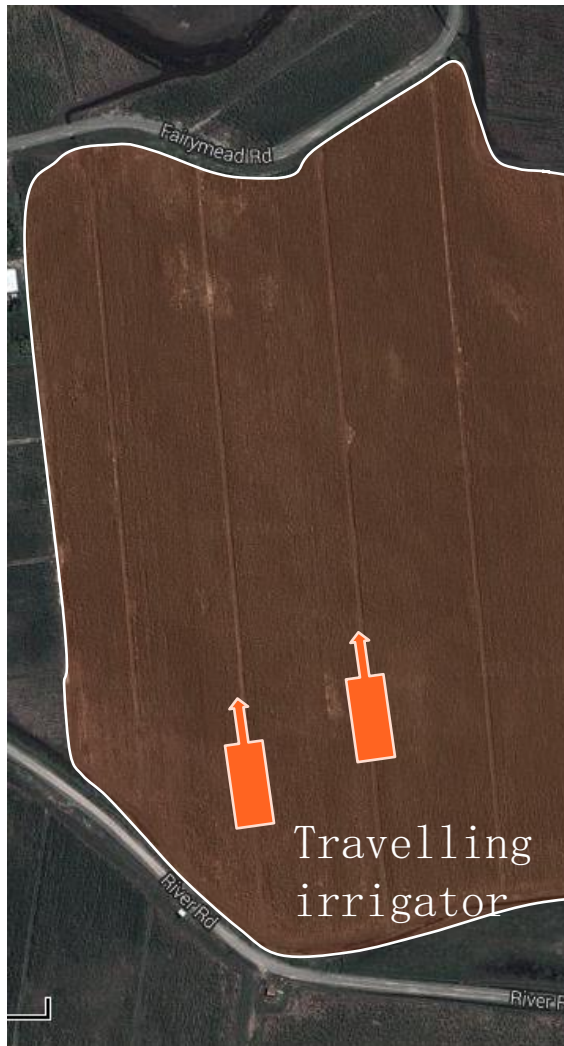
Time Step seconds
Distance inc.
☐ Allow negative velocities
☒ Simulation Stability
☐ Just Advance
QTol
ATol

Infiltration Parameters

☐ Variable
a
k m³/min²/m
f₀ m³/min/m
C m³/m
Source
Deficit mm
Time required min.

Assessment Tools

Surface Irrigation Assessments



Assessment Tools

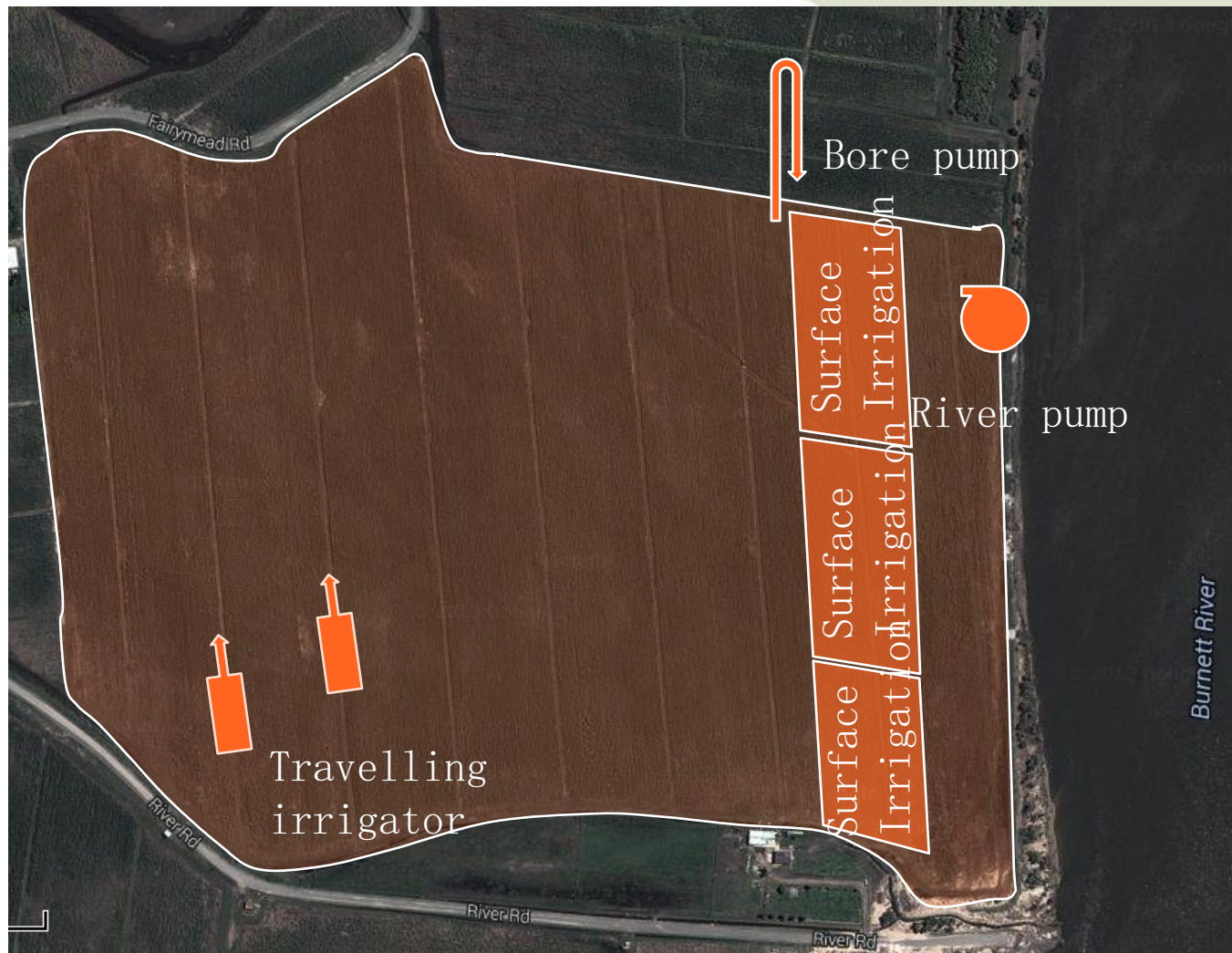
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Surface Irrigation Assessments

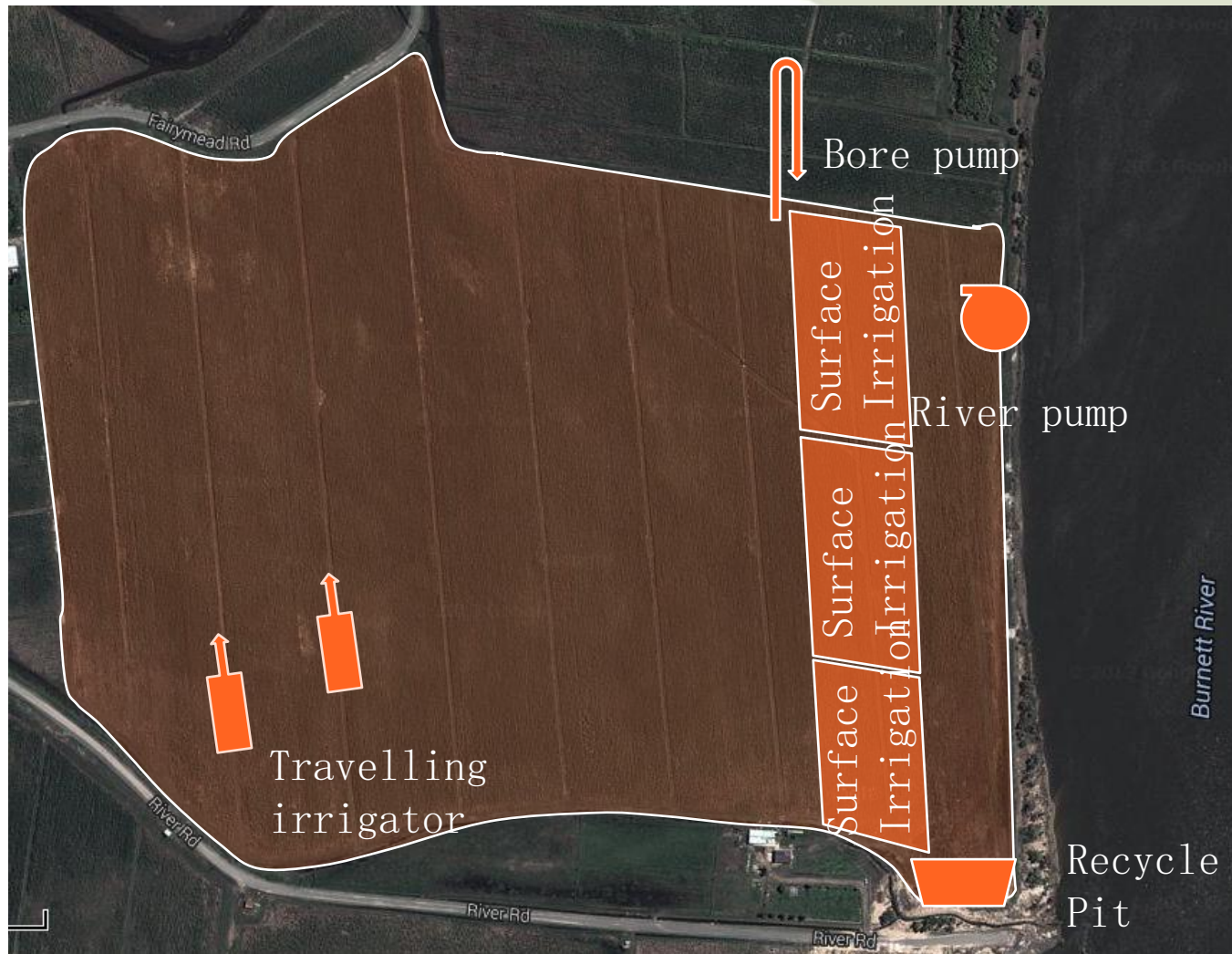


Assessment Tools

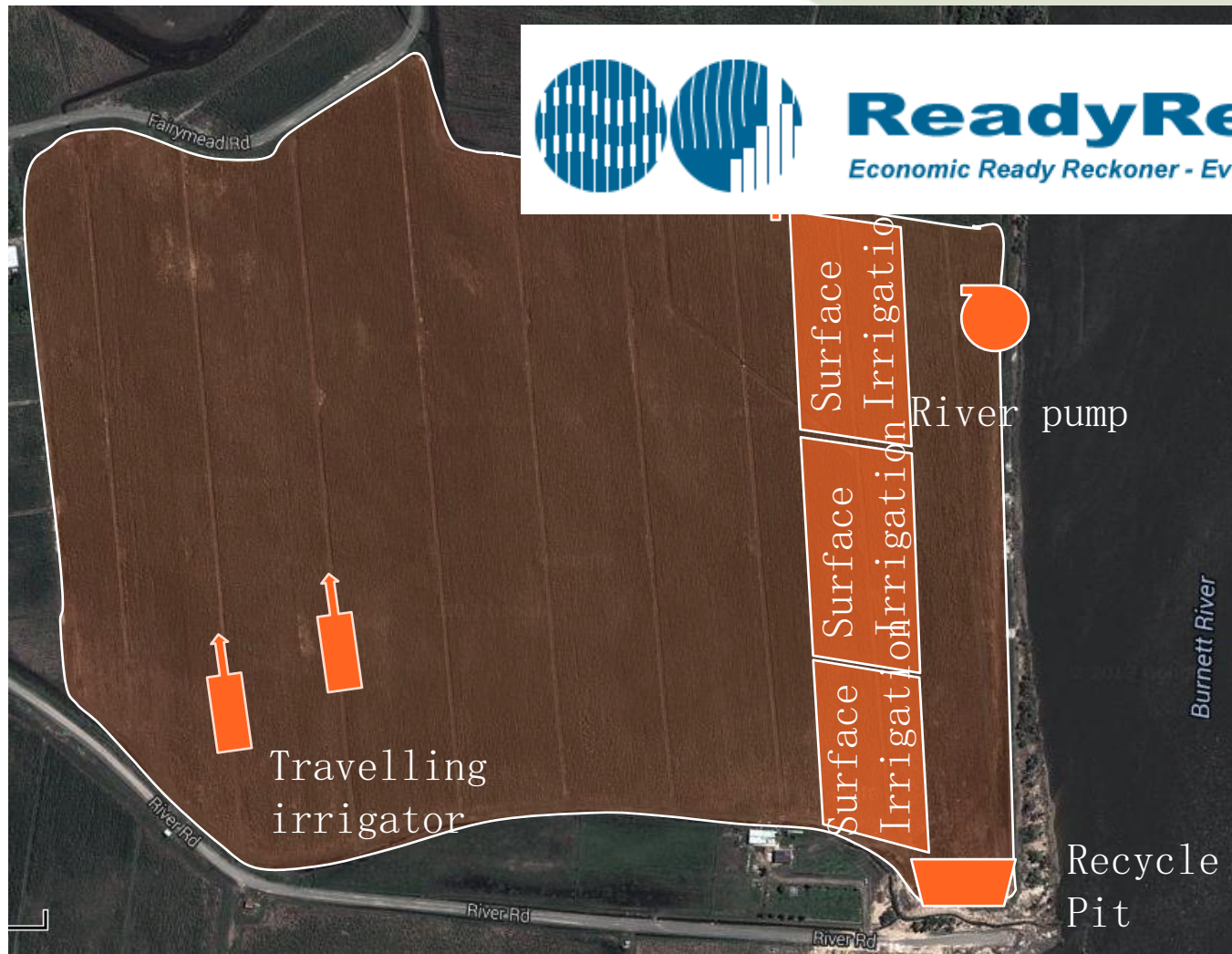
Water Storage Loss Calculations



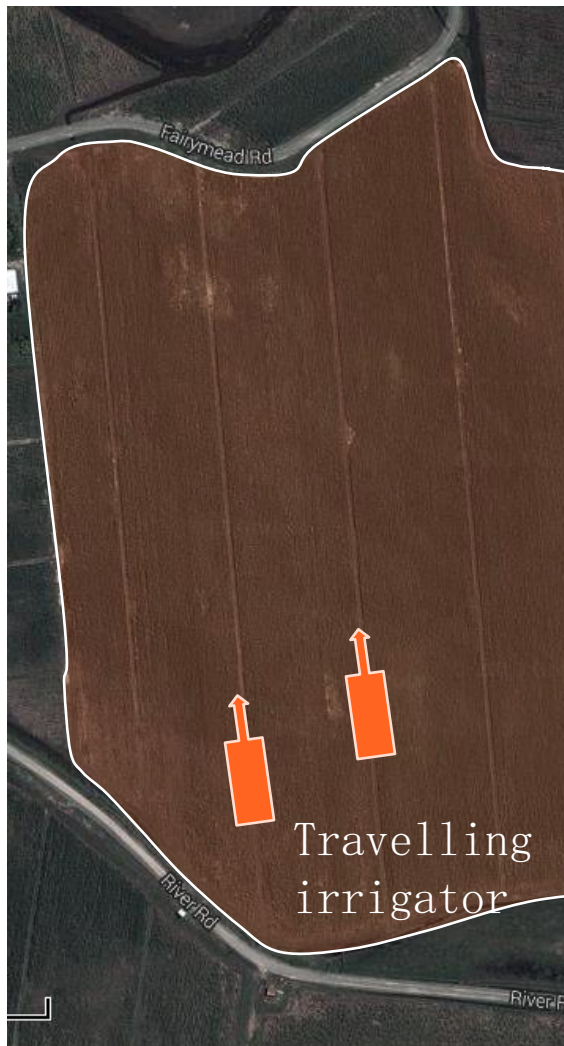
Water Storage Loss Calculations



Water Storage Loss Calculations



Water Storage Loss Calculations



ReadyReckoner
Economic Ready Reckoner - Evaporation Mitigation Systems

Monthly Evaporation Calculator Evaporation Resources About Assumptions Case Studies

Demo Case Studies: Bourke-North-Western-NSW-CottonProduction

Location: Bourke, North-Western New South Wales,
Description: Cotton Production,

- ✓ 1. Select Storage Type: Circular Ring Tank
- ✓ 2. Enter / Import Monthly Evaporation Data
- ✓ 3. Enter the Average Amount of Water Stored Per Month (as a % of Total Storage Volume)
- ✓ 4. Enter the Average Percentage of Years that the Storage Contains Water (per month)
- ✓ 5. Select your Most Applicable Seepage Option: I Have Measured the Seepage Loss
- ✓ 6. Initial evaluation for various Evaporation Mitigation System (EMS)

Initial Evaluation

- ✓ 7. Modify selected Evaporation Mitigation System (EMS): Increase Wall Height
- ✓ 8. Modify selected Seepage Mitigation System (SMS): No Seepage Mitigation Required

Water Storage Loss Calculations



ReadyReckoner

Economic Ready Reckoner - Evaporation Mitigation Systems

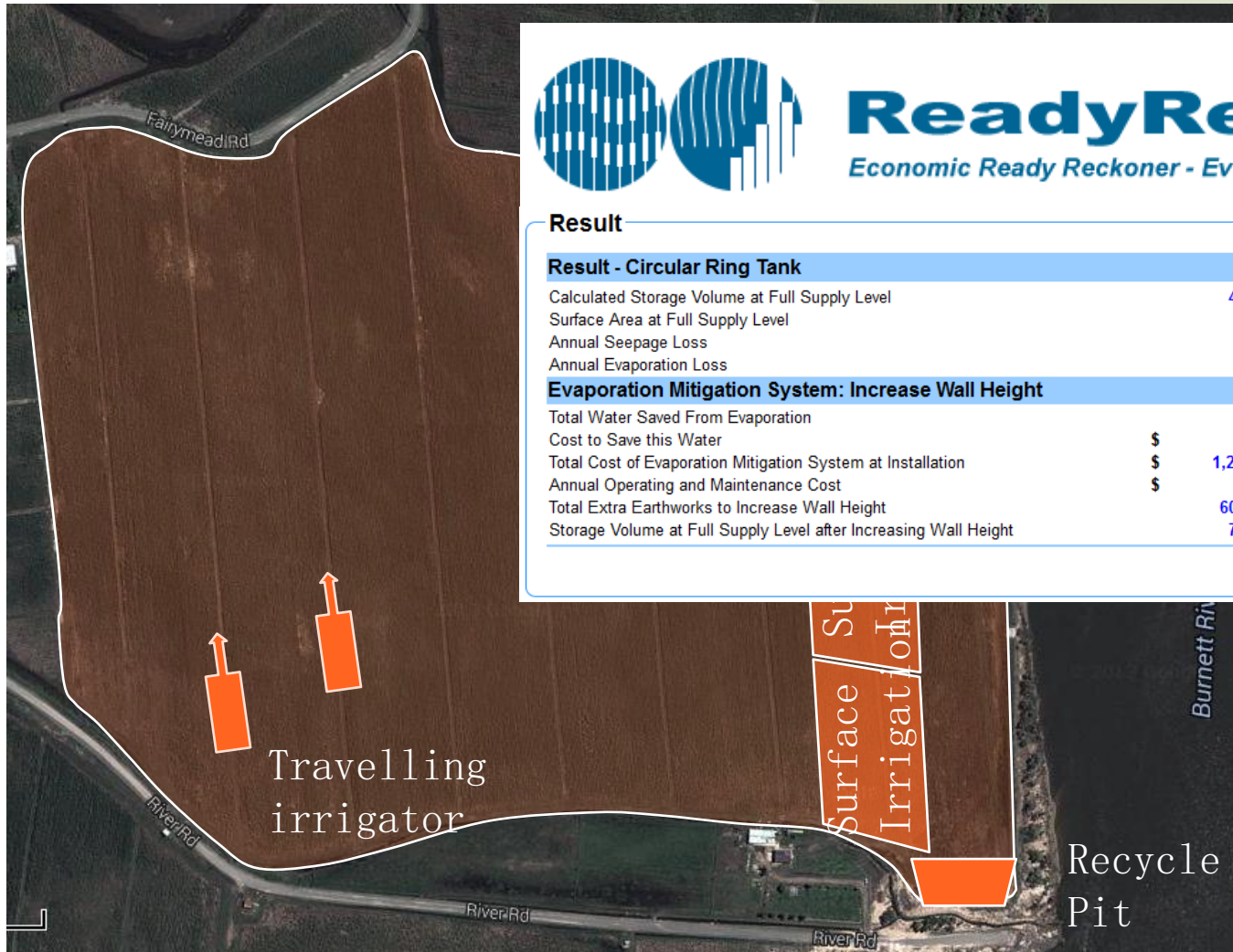
Result

Result - Circular Ring Tank

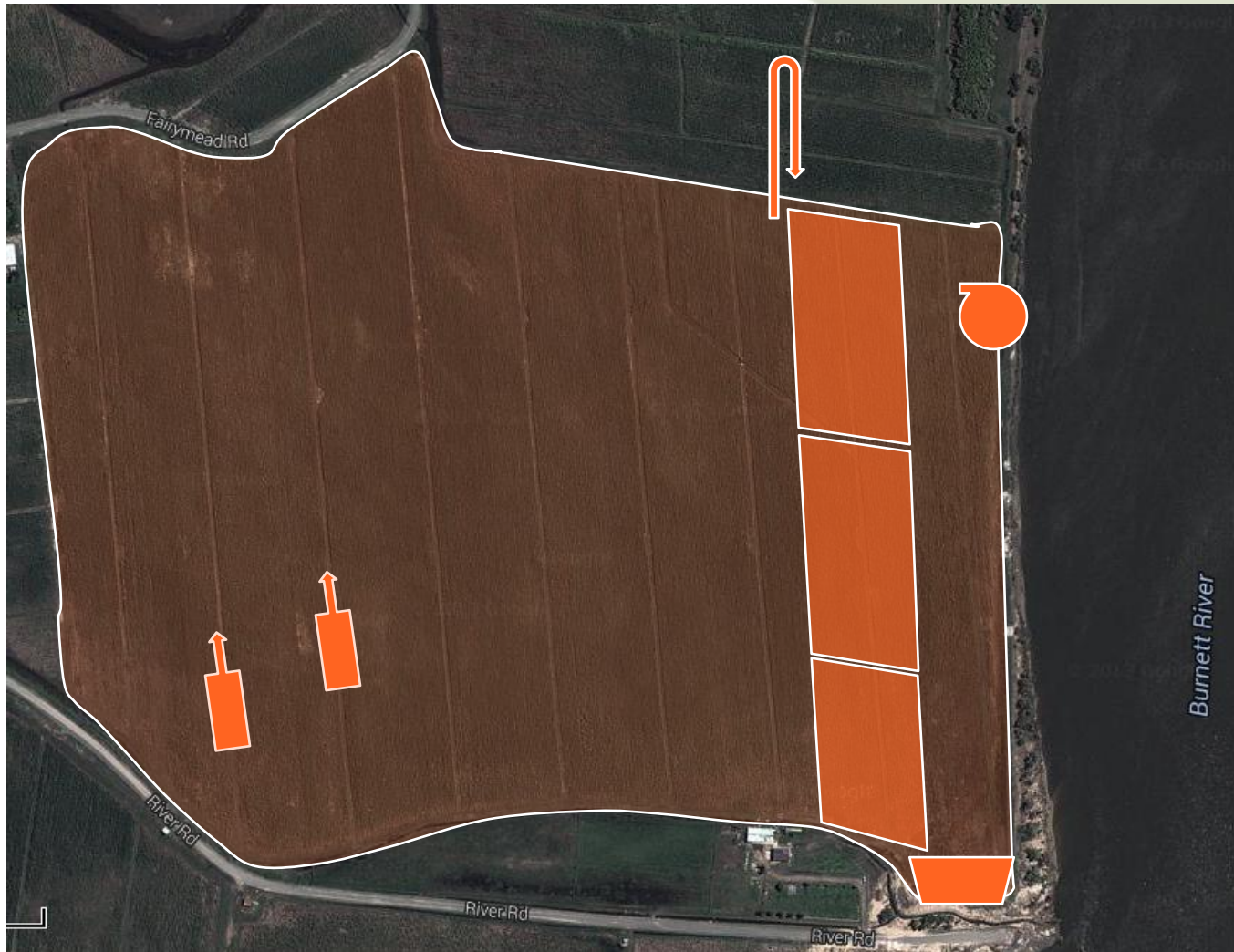
Calculated Storage Volume at Full Supply Level	4,243.2	ML
Surface Area at Full Supply Level	109.7	ha
Annual Seepage Loss	99.1	ML
Annual Evaporation Loss	877.8	ML

Evaporation Mitigation System: Increase Wall Height

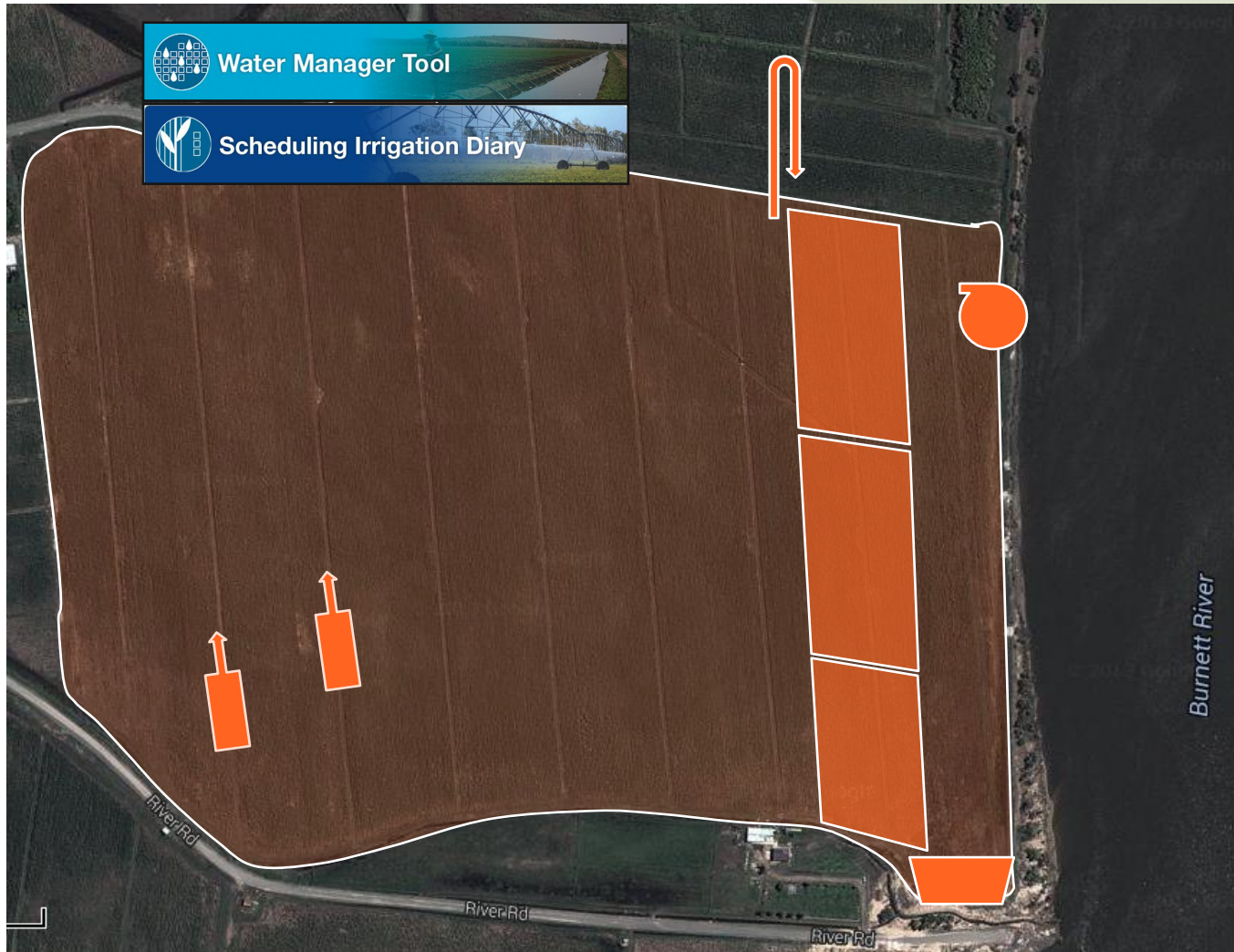
Total Water Saved From Evaporation	363.3	ML each year
Cost to Save this Water	\$ 178.7	per ML per year
Total Cost of Evaporation Mitigation System at Installation	\$ 1,210,141.5	
Annual Operating and Maintenance Cost	\$ 1,000	
Total Extra Earthworks to Increase Wall Height	605,070.7	m3
Storage Volume at Full Supply Level after Increasing Wall Height	7,239.7	ML



KMSI tools for Water and Energy



KMSI tools for Water and Energy



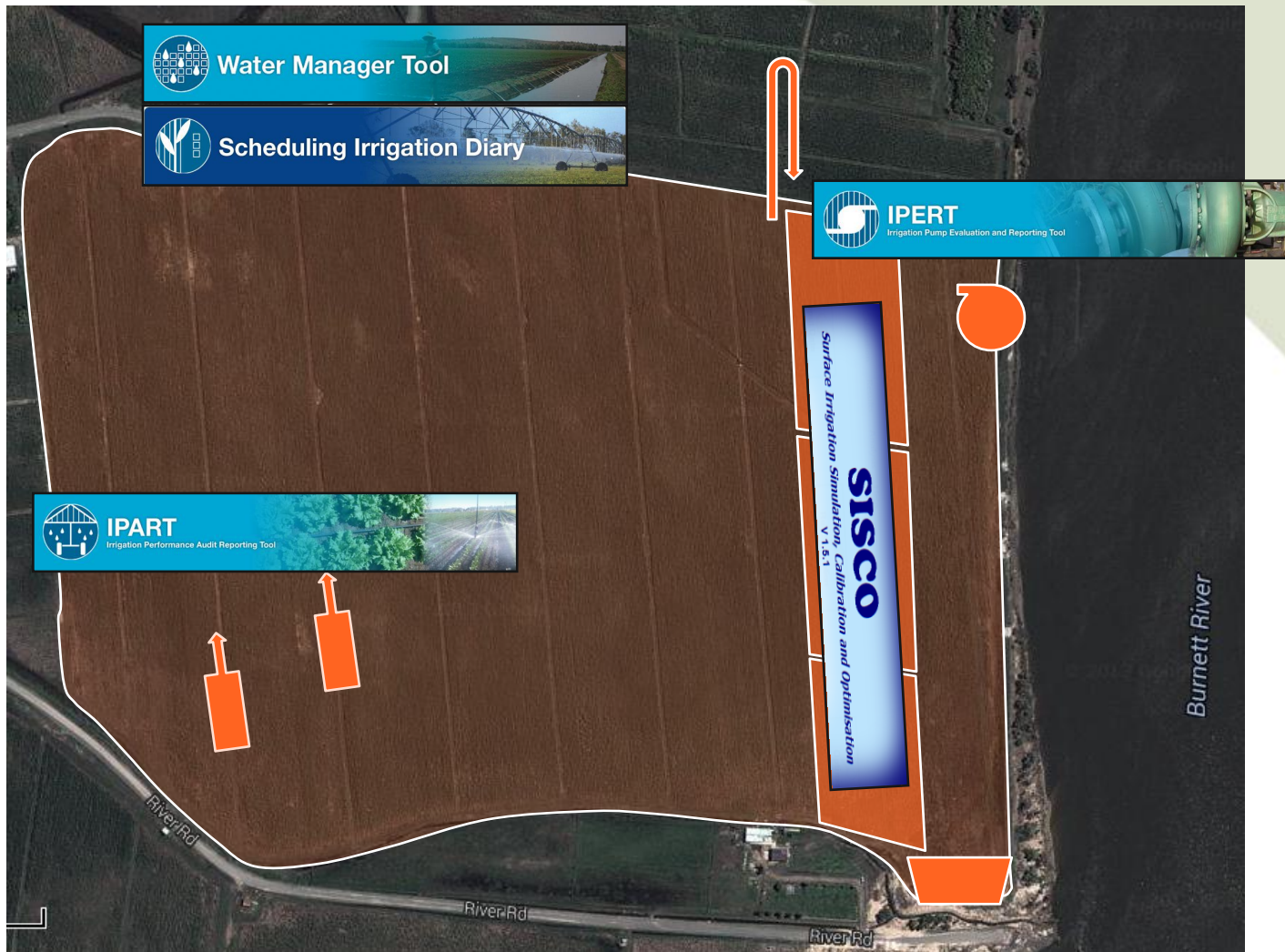
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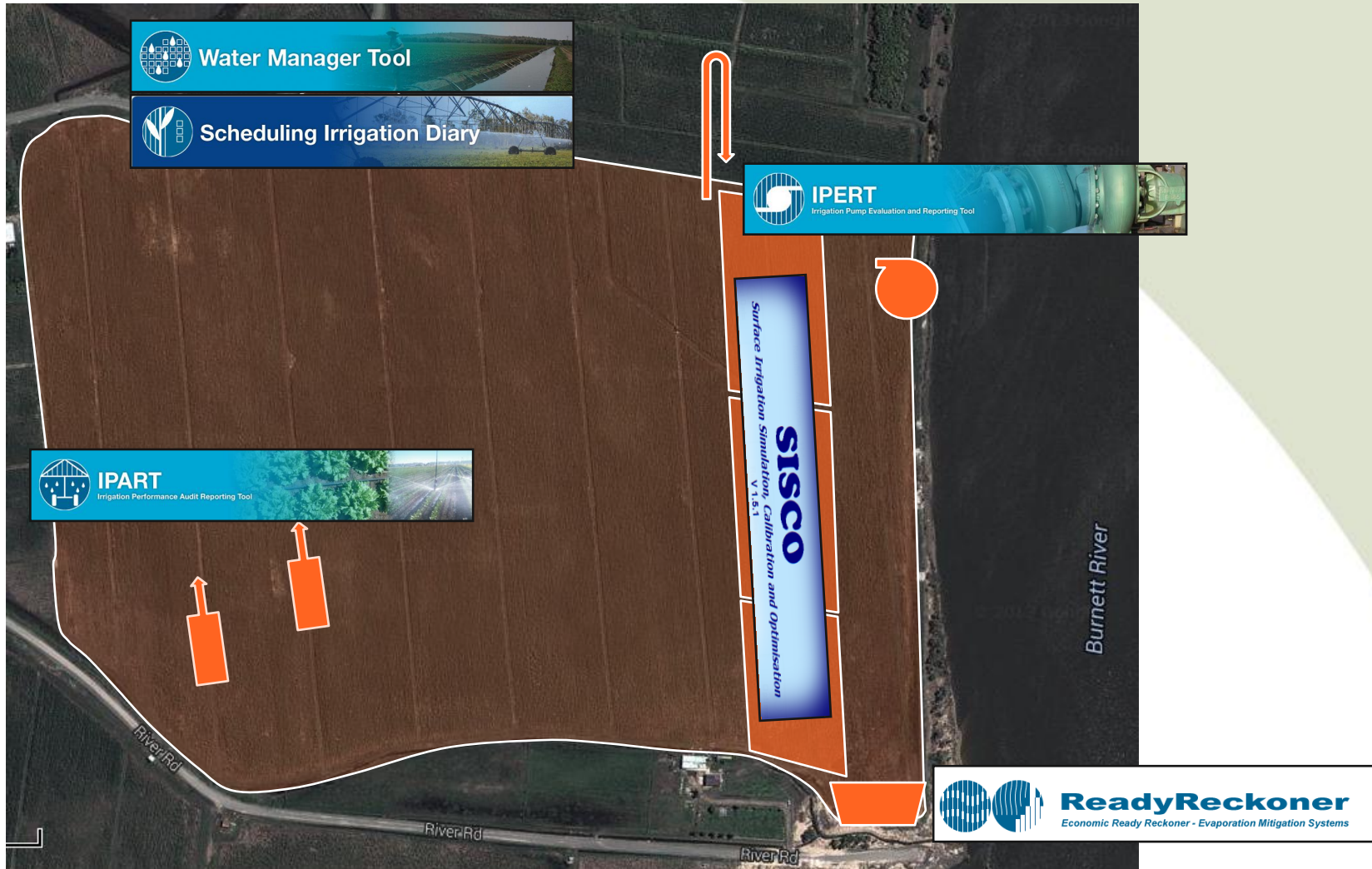
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Burdekin Bowen Integrated Floodplain Management Advisory Committee Inc.

Water and Energy Assessment Tools

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