Riverina Oils and BioEnergy

Integrated Oilseed Processing Plant

Appendix G
Soil and Water
Management Plan

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Draft Soil and Water Management Plan

Incorporating the
Wastewater and Irrigation Management Plan
and
Groundwater Management Plan

Riverina Oil and Bio Energy Pty Ltd

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1. INTRODUCTION

1.1 Soil and Water Management Plan

This document describes the Soil and Water Management Plan (SWMP) at the Riverina Oil and Bio Energy Pty Ltd (ROBE) Integrated Oilseed Processing Plant (IOPP) site. The Project Approval conditions issued for the IOPP required that the plan be prepared and implemented to the satisfaction of the Director General of the Department of Planning.

SWMP addresses the management processes required to satisfy the Project Approval and Development Consent Conditions relevant to the construction and operation of the IOPP.

1.2 Background

In 2008, ROBE proposed the construction and operation of an Integrated Oilseed Processing and Biodiesel Plant (IOPBP). The proposed site location is situated north east of Wagga Wagga in the south western Riverina region of New South Wales (NSW). The proposed development had a manufacturing capacity of 75 million litres (ML) of biodiesel, one of two primary forms of biofuel produced in Australia. The development also planned to generate co-products through the integrated oilseed crushing plant including, refined edible vegetable oil, vegetable protein meal, and refined glycerine.

In 2009 a decision was made by ROBE not to establish the biofuel component of the project. The updated project involves the construction and operation of an Integrated Oilseed Processing Plant (IOPP), which focuses on the production of vegetable protein meal and edible vegetable oil. These products would be distributed from the IOPP and sold to regional and domestic markets.

The project involves the construction and operation of a number of components which collectively comprise the IOPP, including:

- Oilseed crushing plant;
- Solvent extraction plant;
- Vegetable oil refinery; and
- Storage and handling facilities.

1.3 Overview of Assessments & Legal Requirements

The project is defined as a *rural industry* under the provisions of Clause 4 of the *Environmental Planning and Assessment Model Provisions 1980* (Model Provisions).
Development of the site is subject to the provisions of Wagga Wagga Rural Local Environmental Plan 1991 (LEP 1991) which identifies the zoning of the site as zone No. 1 (Rural). An assessment of the relevant matters of consideration was undertaken in this EA and concluded that the project is considered to comply with the requirements of LEP 1991.

The project requires approval under section 75J of the EP&A Act, an Environment Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997*, and a Section 138 approval under the *Roads Act 1993*. As outlined in the Environmental Assessment (EA) report prepared by ENSR Australia Pty Ltd (HLA ENSR), a subsidiary of ENSR Corporation, an AECOM company, the following statutory requirements and approvals apply.

The proposed development has been declared by the NSW Minister for Planning (the Minister) as a 'major project' under the provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and *State Environmental Planning Policy (Major Projects) 2005* (SEPP 2005), and is therefore subject to the provisions of Part 3A of the EP&A Act with the Minister being the approval authority. A project approval under section 75J of the EP&A Act is therefore being sought for the proposed IOPBP.

Other regulations that are applicable to the development are as follows:

- Wagga Wagga Rural Local Environmental Plan 1991
- Wagga Wagga Development Control Plan 2005
- State Environmental Planning Policy 2005 – Major Projects (Major Projects SEPP)
- State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33)
- State Environmental Planning Policy 11 – Traffic Generating Development (SEPP 11)
- Protection of the Environment Operations Act, 1997
- Roads Act 1993

There are three approvals required for the proposed project, being:

- Project approval under section 75J of the EP&A Act;
- EPL under the POEO Act; and
- Section 138 approval under the *Roads Act 1993*.

1.4 EP&A Act Approval

As outlined in section 75J of the EP&A Act, Schedule 3, Environmental Management and Monitoring, Condition 56 of the NSW Government Department of Planning Project Approval (Application No: 07_0146) for the Riverina Oils and Bio Energy Biodiesel Facility requires RIverina Oils and Bio Energy Pty Ltd to prepare and implement a Soil and Water Management Plan to the satisfaction of the Director-General.

Schedules 19 to 22 are as follows:

Soil and Water Management Plan

19. Proponent shall prepare and implement a Soil and Water Management Plan for the project to the satisfaction of the Director-General. This plan must:

a) be submitted to the Director-General for approval prior to construction;
b) be prepared by a suitably qualified and experienced expert in consultation with the Department of Environment, Climate Change and Water (DECCW) and Council;
c) include:
    - a Stormwater Management Scheme;
    - a Wastewater and Irrigation Management Plan; and

- Groundwater Management Plan.

20. The Stormwater Management Scheme must:
    a) Be consistent with the guidance in the latest version of *Managing Urban Stormwater: Council Handbook* (DECCW);
    b) Mitigate the impacts of stormwater from and within the site; and
    c) Include detailed plans of the stormwater system.

21. The Wastewater and Irrigation Management Plan must:
    a) Be consistent with the *Environmental Guidelines Use of Effluent by Irrigation* (DECCW);
    b) Outline the design and management of the irrigation and crop system, including measures to minimise soil degradation and nutrient and salt accumulation; and
    c) Include:
        - the wastewater and soil quality impact assessment criteria and the effluent treatment and irrigation system performance measures;
        - details of the wastewater , soil and vegetation monitoring program;
        - procedures for reporting the monitoring results against the criteria, and to determine the annual site nutrient and salt balance and the trigger levels for nitrogen and phosphorus in the soil;
        - contingency measures to address exceedances, pollution triggers and problems with wastewater management systems; and
        - a description of the effectiveness of actions and measures would be monitored over time.

22. The Groundwater Management Plan must:
    a) identify all activities that could impact groundwater quality;
    b) identify management measures to ensure compliance with groundwater impact criteria; and
    c) include:
        - baseline data of groundwater quality, levels and flow prior to the commencement of construction;
        - the groundwater impact assessment criteria, including nutrient, salt and groundwater levels that would trigger an investigation and/or application of specified contingency measures;
        - details of the off-site groundwater monitoring program;
        - contingency measures to address potential groundwater contamination; and
        - procedures for reporting the monitoring results.

1.5 EPL under the PEOE Act

At the time of writing of this document a draft EPL had been received from the DECCW but contained no wastewater irrigation limits or monitoring points.

1.6 Section 138 approvals under the *Roads Act 1993*

At the time of writing of this document the application has not been submitted.

1.7 Soil and Water Management Plan

The Soil and Water Management Plan is a component of the site's Environmental Management Strategy. The Environmental Management Strategy consisting of the Operation Environmental Management Plans, operational and environment procedures, and detailed monitoring and auditing program, aims to maintain compliance with Environmental regulations and achieve best-practice standards through a system of continual review and improvement.

2. OBJECTIVES

The objectives and performance outcomes for Soil and Water Management are described in the following table.

Table 1: Objectives of the Soil & Water Management Plan

Objectives	**Performance Outcomes**
To comply with all statutory requirements. To minimise adverse impacts on the environment.	• Ongoing monitoring for assessing environmental impact. • Establishment of benchmarks for the implementation of wastewater and soil amelioration measures. • Establish methodologies for wastewater and soil improvement. • The results and analysis of wastewater and soil monitoring is reviewed and compared to historical levels to assess any adverse trends developing. • All results, analysis and interpretation are included in the Annual Environmental Compliance Report.

3. WASTEWATER AND IRRIGATION MANAGEMENT

Approximately 125 Megalitres (ML) of wastewater is to be treated each year and stored in a 40 ML storage dam. This gives a total irrigation amount of up to 125ML per year. Irrigation of lucerne, pasture, wheat and canola with a crop water requirement of 141ML is planned to be irrigated on 25 hectares of adjoining land.

3.1 Irrigation and crop system

A Southern Cross soft hose travelling gun irrigator is proposed for the wastewater application. The maximum output of the unit is 0.9ML in 24 hours. The irrigator sprays over a 100 metre diameter and the travel length is a maximum of 500 metres per pass.

This type of irrigation:

- Suits a wide range of crop types (pasture, legumes, cereals)
- Can have excellent water application uniformity (no wind conditions)
- Reliable with low maintenance costs
- Versatile allowing high range of application rates (30 to 150mm) and wide variety of flow rates (4 to 15L/s)
- Application Efficiency of 80 - 90%
- Adaptable for any crop height
- Is labour intensive but provides re-use scheme flexibility
- limited to field elevation/slopes
- has a high working pressure

A perennial such as lucerne or ryegrass pasture will be 50% of the irrigated crop program with wheat and canola in rotation on the balance. Lucerne and pasture can typically can be irrigated from September through to April whilst wheat and canola are typically irrigated to aid crop establishment in autumn and then to finish the crops in the spring months.

As follows are the Crop Water Requirements (CRW) for lucerne, pasture, canola and wheat. The weather data is from the Bureau of Meteorology Weather Station 073127 Wagga Wagga Agricultural Institute. The rainfall and evaporation data are the long term monthly mean. Rainfall records are available from 1898 to present whilst evaporation is available from 1959 to 2007. The weather station was selected due to it being the closet weather station to the site and sharing a similar elevation and topography. Crop factors have been obtained from the DEC guidelines and Meyer et al. It is important to note the actual amount of irrigation will vary depending on seasonal conditions and crop management and the below CRW's should be used as a guide.

Table 2: Crop Water Requirement Lucerne

Month	Monthly Rainfall	Monthly Evaporation	Crop Factor (lucerne)	Monthly CWR	Monthly Water Deficit
January	37.7	285.2	0.95	270.9	-233.2
February	35.4	226.8	0.90	204.1	-168.7
March	35.2	198.4	0.85	168.6	-133.4
April	39.2	117	0.80	93.6	-54.4
May	43.8	58.9	0.70	41.2	2.6
June	50.5	42	0.55	23.1	27.4
July	49.4	37.2	0.55	20.5	28.9
August	48.1	55.8	0.65	36.3	11.8
September	48.5	84	0.75	63.0	-14.5
October	52.2	136.4	0.85	115.9	-63.7
November	39.8	198	0.95	188.1	-148.3
December	39.8	272.8	1.00	272.8	-233.0
	519.6	1712.5		1498.2	-978.6
Total Crop Water Requirement LUCERNE = 978.6mm = 9.8 ML/ha					

Table 3: Crop Water Requirement Pasture

Month	Monthly Rainfall	Monthly Evaporation	Crop Factor (pasture)	Monthly CWR	Monthly Water Deficit
January	37.7	285.2	0.70	199.6	-161.9
February	35.4	226.8	0.70	158.8	-123.4
March	35.2	198.4	0.70	138.9	-103.7
April	39.2	117	0.60	70.2	-31.0
May	43.8	58.9	0.50	29.5	14.4
June	50.5	42	0.45	18.9	31.6
July	49.4	37.2	0.40	14.9	34.5
August	48.1	55.8	0.45	25.1	23.0
September	48.5	84	0.55	46.2	2.3
October	52.2	136.4	0.65	88.7	-36.5
November	39.8	198	0.70	138.6	-98.8
December	39.8	272.8	0.70	191.0	-151.2
	519.6	1712.5		1120.24	-600.64
Total Crop Water Requirement PASTURE = 600.6mm = 6.0 ML/ha					

Table 4: Crop Water Requirement Wheat

Month	Monthly Rainfall	Monthly Evaporation	Crop Factor (wheat)	Monthly CWR	Monthly Water Deficit
January	37.7	285.2	0.20	57.0	-19.3
February	35.4	226.8	0.20	45.4	-10.0
March	35.2	198.4	0.20	39.7	-4.5
April	39.2	117	0.30	35.1	4.1
May	43.8	58.9	0.40	23.6	20.2
June	50.5	42	0.60	25.2	25.3
July	49.4	37.2	0.90	33.5	15.9
August	48.1	55.8	1.05	58.6	-10.5
September	48.5	84	1.05	88.2	-39.7
October	52.2	136.4	0.80	109.1	-56.9
November	39.8	198	0.50	99.0	-59.2
December	39.8	272.8	0.20	54.6	-14.8
	519.6	1712.5		668.89	-149.29
Total Crop Water Requirement WHEAT = 149.3mm = 1.5 ML/ha					

Table 5: Crop Water Requirement Canola

Month	Monthly Rainfall	Monthly Evaporation	Crop Factor (canola)	Monthly CWR	Monthly Water Deficit
January	37.7	285.2	0.20	57.0	-19.3
February	35.4	226.8	0.20	45.4	-10.0
March	35.2	198.4	0.20	39.7	-4.5
April	39.2	117	0.30	35.1	4.1
May	43.8	58.9	0.40	23.6	20.2
June	50.5	42	0.60	25.2	25.3
July	49.4	37.2	0.70	26.0	23.4
August	48.1	55.8	0.75	41.9	6.3
September	48.5	84	0.75	63.0	-14.5
October	52.2	136.4	0.70	95.5	-43.3
November	39.8	198	0.40	79.2	-39.4
December	39.8	272.8	0.20	54.6	-14.8
	519.6	1712.5		586.07	-66.47
Total Crop Water Requirement CANOLA = 66.5mm = 0.7 ML/ha					

Based on the above crop water requirement (CRW) estimates with a typical 50% lucerne 50% wheat crop mix planted across the 25 hectare irrigation area up to 141 ML of wastewater can be utilised each year. This CRW of 141ML is above the anticipated wastewater supply of 125ML per year which indicates the area is sufficient in size to readily use the waste water supplied with a 16ML buffer.

3.1.1 Irrigation design

The irrigation design will be finalised on the commissioning of the OPP but as follows is a concept plan of the irrigation system, **figure 1**.

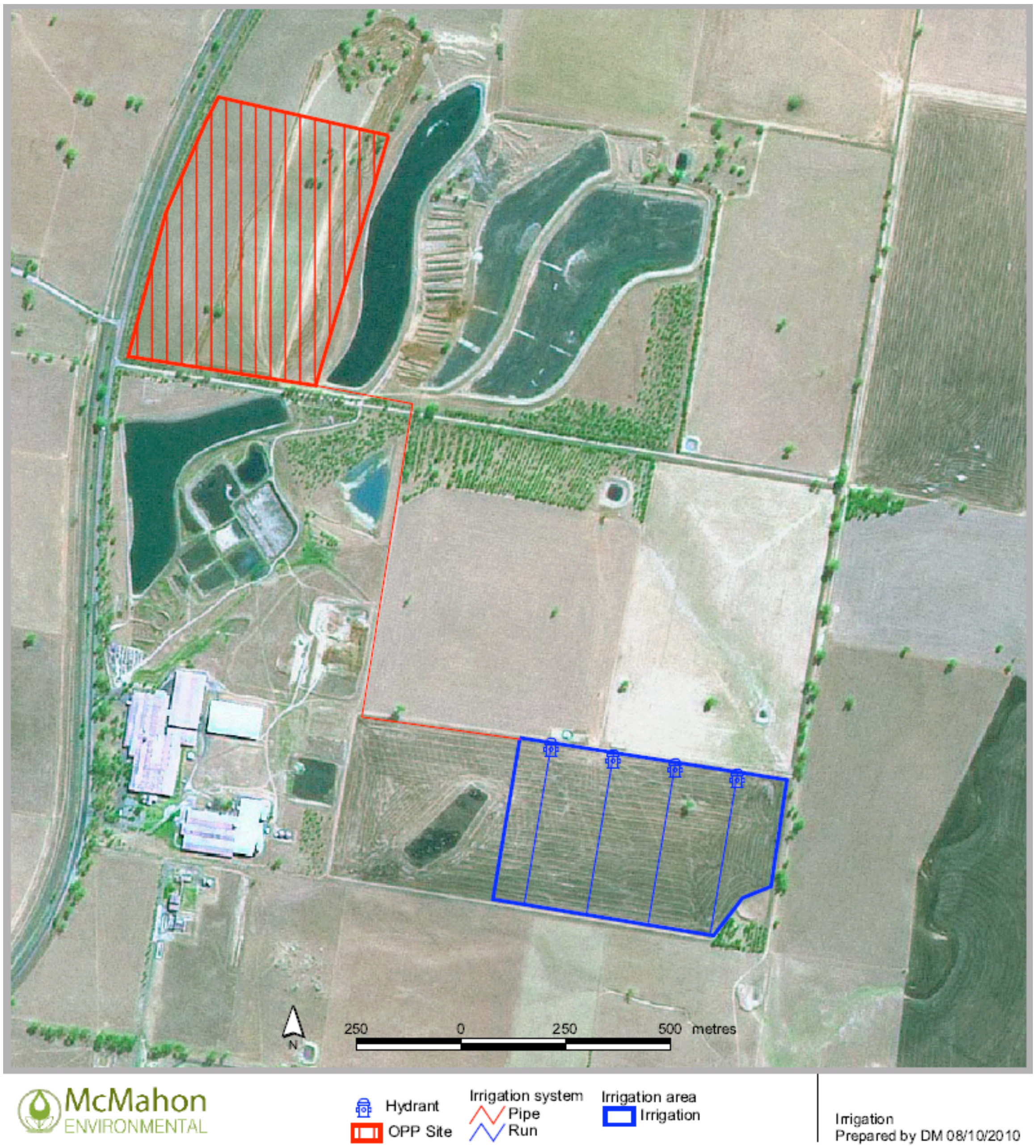

Figure 1: Proposed irrigation layout

3.1.2 Irrigation scheduling

By reviewing the irrigation scheduling and actual weather conditions a water balance can be calculated which will verify irrigation efficiency and nutrient assimilation. Wastewater application rates are aimed to match crop types to ensure sustainable and efficient plant water use.

When irrigation is taking place, scheduling is reviewed daily taking into account weather conditions, soil moisture, crop performance and available irrigation resource. The correlation between crop daily water requirements, based on ET_o, and actual water use will be assessed on a daily basis during irrigation. The ET_o values will be accessed from the from a site specific weather station or the SILO Data Drill for Lat, Long: -35.05 148.45 (DECIMAL DEGREES). This value is interpolated from surrounding BOM (Bureau of Meteorology) weather stations with adjustments made for elevation. Wind speed is capped at two metres per second, which would exclude the extremely high ET_o days from the data. Potential ET_o is calculated as per *FAO Irrigation and Drainage paper 56*. Effective rainfall has been calculated on the assumption that during the spring, summer and autumn periods, rainfalls of 5mm or less are non-significant (zero).

Water balances will be regularly calculated to ensure irrigation supply is matched to crop demands. This is to demonstrate that sustainable irrigation is taking place, with applications not exceeding crop water demand. Irrigation efficiency is commonly 85 to 90%, therefore the amount irrigated will sometimes be slightly more than the plants water requirement. Water losses include drift, evaporation, runoff and deep drainage.

By irrigating smaller amounts on a daily basis the risk of surface runoff or through drainage occurring is greatly minimised, therefore reducing any environmental impacts. Runoff is monitored by a visual inspection of the irrigation areas. Runoff and through drainage can occur when irrigation is scheduled in larger amounts of water at a lesser interval. Some spray irrigation systems are extremely versatile in the amount of water able to be irrigated by altering the speed of the unit and droplet size through pressure variation.

3.1.3 Installation

The hydrants, piping and irrigation runs will be finalised on commissioning of the IOPP. As identified in the EA new pipeline routes will be establish for reticulation of effluent water across parts of the proposed irrigation land from the pump house at the Effluent Storage Dam.

The pipelines and mainlines would consist of 150mm, 100mm PVC Class 9 pipe work and 150mm PVC Class 12 pipe work. Wastewater to be irrigation area would be drawn from the Storage Dam through a suction line by an electronically driven centrifugal pumps fitted with anti-siphon valves that prevent siphoning of the irrigation water on loss of pressure from the pumps.

3.1.4 Operation and management

The operation of the irrigation system is ultimately the responsibly of the Environmental Engineer. Irrigation scheduling will take place in liaison with the farm manager to ensure appropriate volume and quality of supply.

As identified in the EA runoff would be controlled on site to ensure that ground and surface waters do not become contaminated by any flow from irrigation areas.

Runoff diversion bunds would be constructed to divert uncontaminated runoff away from the irrigation area. Run-off and tail water from the irrigation area would be collected in a tail water dam.

A series of catch drains would direct tail water and stormwater to a collection pond where it would evaporate or be re-irrigated. The tail water pond would be of sufficient length and depth to allow some settlement of any solids.

The proposed tail water dam and bunds proposed on the site will be at the lowest level in the irrigation area.

The following measures would be implemented to manage runoff:

- All uncontaminated stormwater would be prevented from entering the irrigation area by use of diversion banks;
- All irrigation tail water and stormwater from the irrigation area would be directed to the tail water dam;
- All bunds, supply channels and drains would be maintained in good condition, especially at the end of the wet season;
- All bunds, supply channels and drains would be inspected at least once per month;
- The dams and spillways would be maintained in good condition at all times, particularly at the start of winter; and
- Maximum freeboard would be maintained at all times. This means that the dams should be practically empty during summer.
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3.1.5 Statutory approvals

As well as the statutory approvals outlined in section 1.3 of this document, there may be additional approvals required for the irrigation of wastewater outside of the ROBE site. These approvals would be from the Department of Environment and Climate Change and Water (DECCW) and Wagga Wagga City Council (WWCC). The DECCW may require individual EPL's for each irrigation site or that they be noted on ROBE's EPL. The DECCW will have to be liaised with throughout this process. The DECCW will have to be notified under the Water Management Act 2000. This mainly concerns the protection of surface and groundwaters in and around the planned irrigation site. WWCC approval may be required for development consent for the establishment of a wastewater irrigation system.

4. EFFLUENT TREATMENT SYSTEM

The treatment plant is designed for an output flow of 349 m^3 per day.

Influent Streams
The wastewater influent to the Effluent Treatment Plant flows as three distinct streams, with following principal characteristics (max. levels), **table 6**:

Table 6: Input untreated effluent characteristics

Sr.	Parameter	Unit	Stream – 1	Stream – 2	Stream – 3
01	Source	-	SEP & Prep	Refinery	Utilities
02	Daily Flow	m^3/day	106	123	120
03	Peak Flow	m^3/hr	6.63	7.69	7.5
04	pH	-	4 – 7	3 – 11	7 – 11
05	TSS	mg/L	900	Nil	10
06	TDS	mg/L	1500	1500	1080
07	COD	mg/L	9736	20920	Nil
08	BOD-3 (20ºC)	mg/L	5842	12552	Nil
09	Total O & G	mg/L	1000	7058	Nil
10	Total N	mg/L	900	Nil	Nil
11	Temperature	ºC	35 – 65	Ambient	Ambient

Primary Treatment
The process streams # 1 & 2, from SEP / Prep and Refinery resp., shall be first subjected to removal of free oil and floating matters in gravity oil separators designed on lines of API separators. The oil separator shall be a long channel with horizontal velocity of 0.12 m/min and vertical velocity of just 0.5 m/hour. Each channel shall have two mechanical belt-type oil skimmers, which will operate periodically based on set time interval and duration. The oily water collected in the adjoining sump shall be hauled out periodically for disposal. Both streams, after oil removal, shall be collected under gravity into an Equalization Tank. The EQ Tank will be employed to attain uniformity in terms of flow and quality, prior to subsequent treatment. The contents shall be mixed using diffused aeration system in the form of coarse bubble grid. The equalized effluent shall be pumped to primary physicochemical treatment using an automatic flow control arrangement set at constant flow over 24- hour period based on incoming load.

The equalized effluent shall be first neutralized in an on-line neutralization tank. Automated pH control system shall be used to add either caustic or sulphuric acid, depending on whether the incoming liquid, is acidic or alkaline. The neutralized effluent shall be subjected to dosing of alum and polyelectrolyte to de-emulsify the emulsified oil and to promote formation of flocs. The floatation oil / scum and settleable solids will be removed in a Dissolved Air Floatation System. The DAF will employ micro-bubble floatation system wherein recycled effluent will be mixed with compressed air under about 4 – 5 bar pressure and released in the DAF basin. The resultant micro-bubbles will induce floatation of even smaller oil droplets, resulting into higher oil removal efficiency compared to gravity separators. The settled sludge will be mixed with floating scum and sent for dewatering, while the clarified effluent will be let into the biological (secondary) treatment system.

Secondary Treatment
The primary treated process effluent is estimated to exert about 8383 mg/L COD and 6707 mg/L BOD while containing about 415 mg/L nitrogen. For efficient removal of organics as well as nitrogen, an advanced biological treatment system employing nitrification/denitrification combination based on activated sludge process is proposed. This system will ensure near-complete removal of biodegradable organics while optimizing on power consumption and alkalinity make-up. A detailed description of this system is provided in the article attached herewith. The excess biomass from the bioreactor shall be pumped out to sludge dewatering system at operator controlled frequency and duration based on biomass level (MLVSS) in the basin and influent BOD and Nitrogen load.

Tertiary Treatment
The bio-treated effluent will be collected in a Tertiary Equalization Tank and blended with utility effluent stream # 3. The mixed effluent will be subjected to polishing treatment using Pressure Sand Filter and Activated Carbon Filter. These units will remove suspended solids and carbon will adsorb escaping organics to provide further reduction in levels of COD, BOD and O & G before final disposal. The PSF and ACF will be periodically backwashed at operator-controlled frequency and duration. The backwash water will flow to the Primary Equalization Tank. Activated Carbon shall have to be replaced once the iodine value reduced by 50% of the initial 800 – 850 mg/mg level.

Sludge Dewatering
Sludge from both primary and secondary treatment operations shall be combined and dewatered in a common system. Primary sludge from DAF unit and excess biomass from AIS will be pumped out by operator to the Sludge Thickener, which shall be a circular tank having sloped bottom and a scrapper mechanism. The thickened sludge from bottom shall be pumped out to Decanter Centrifuge for dewatering. Conditioning polymer shall be dosed in-line prior to the decanter to promote formation of flocs and thus achieve higher solid content in the wet cake. The wet cake shall have to be hauled out in trucks to landfill or as per local regulations. The centrate liquor from decanter will contain some solids and hence will be channeled back to the Primary Equalization Tank.

The treated effluent characteristics are as follows, **tables 7 & 8**.

It can be seen from this section that the irrigated water quality presented will be suitable to apply to the irrigation area and complies with relevant DECCW guidelines.

Table 7: Treated effluent characteristics

Sr.	Parameter	Units	Plant Effluent	After Primary	After Biological	Final Effluent
01	Daily Flow	m^3/day	229	229	229	349
02	Peak Flow	m^3/hour	14.4	9.6	9.6	15
03	pH	-	3-11	6-8	6-8	6-8.5
04	Temperature	° C	20-65	<35	<38	< 36
05	Total O & G (incl FM)	mg / L	9521	1904	~25	< 5
06	TSS	mg / L	415	75	75	< 30
07	TDS (Inorganic)	mg / L	<500	<500	<500	< 700
08	COD	mg / L	15743	6300	~150	< 90
09	BOD	mg / L	9446	3780	~50	< 30
10	Total Nitrogen	mg / L	415	150	~50	< 50
11	Phosphorus	mg/L	29	29	< 15	< 10

Table 8: Treated effluent characteristics from the wastewater treatment plant.

Parameter	Value
Flow	349 m^3/day
pH	6 to 8.5
BOD	< 30mg/L
COD	< 90 mg/L
TDS	< 700 mg/L
SS	30 mg/L
Oil & Grease	< 5 mg/L
Total Nitrogen	< 50 mg/L
Total Phosphorus	< 10 mg/L

The effluent will be classified as medium strength effluent under the DECCW guidelines owing to TDS value of < 700 mg/L, **table 9**.

Table 9: DECCW Classification of effluent based on average concentration

Constituent	Low mg/L	Medium mg/L	High mg/L
BOD	<50	40-1,500	>1,500
Total Nitrogen	<50	50-100	>100
Total Phosphorus	<10	10-20	>20

Total Dissolved Solids	<600	600-1,000	>1,000-2,500

As follows is the flow diagram of the wastewater treatment system, **figure 2**.

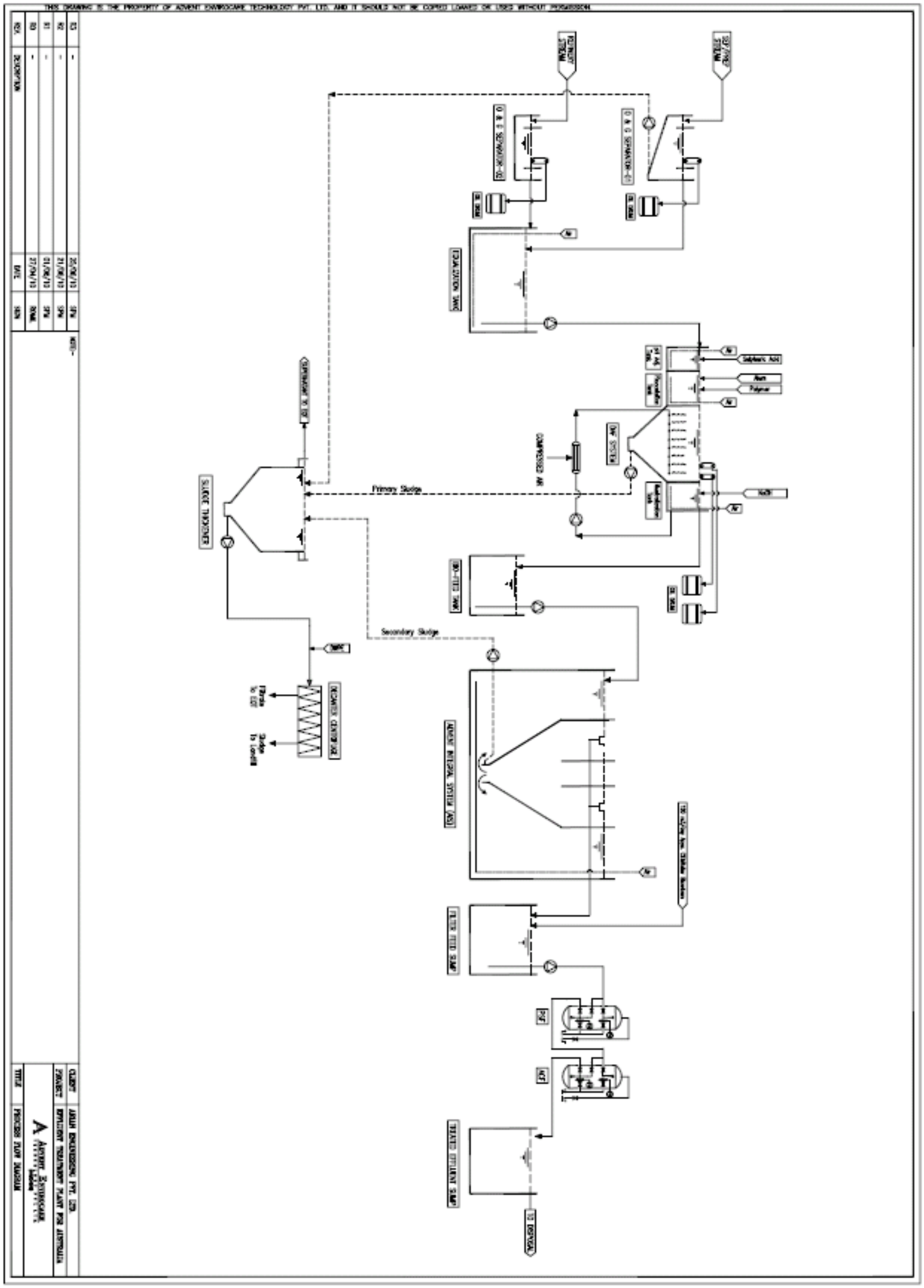

Figure 2: Flow diagram of wastewater treatment

5. CONTROLS AND MEASURES

The input characteristics to the WWTP are defined by contract with the process technology provider. The output characteristics of the WWTP are defined by contract with the WWTP designer.

IOPP operations will monitor the volume of treated water within the storage pond at any point in time to compare this with the anticipated volumes of the Irrigation plan.

As identified in the EA, the control system for the irrigation systems and WWTP will be designed to minimise risks of environmental pollution which may be caused by, human error, weather conditions, or faulty equipment. The application of irrigation water would be controlled manually by the irrigation manager.

5.1 Contingency measures

Process wastewater continues to flow to the treatment plant whenever the plant is in operation. Critical items of equipment within the WWTP are duplicated as redundant spares minimising the likelihood of discharging untreated effluent in the event of WWTP component failure. Sufficient storage is to be provided to accept untreated effluent within the system in the event of total power failure.

Where the monitoring of the storage pond indicates that the capacity of the dam may be exceeded within the irrigating cycle, the following contingency measures will be actioned;

- Increase irrigation rates if crop and ground conditions are acceptable,
- Reduce production rate in order to correct irrigation outlook
- Establish additional irrigation lots
- Transfer treated effluent to alternative approved irrigation lot
- Short term cease of production.

Should production be continually interrupted due to limitations to irrigation then additional technologies may be considered to increase the re-use of effluent for process purposes.

5.2 Wastewater and soil impact criteria

Wastewater and soil impact criteria will be largely based on the monitoring system being in place to correctly detect and identify any problems that may emerge. The management system will be able to take action to rectify any problems before agronomic or environmental impacts occur.

Specific impact criteria are outlined below.

Application

The effluent application will be managed in such a way to minimise potential impacts, therefore the following measures will be put into place:

- Effluent irrigation will only be applied to the defined irrigation area;
- Effluent irrigation will not cause surface runoff;
- Spray from effluent application will not drift beyond the defined irrigation area; and
- Warning notices, identifying the treated effluent irrigation system will be erected on the site.

Wastewater

The aim of any wastewater treatment system is for the effluent to be classified as low strength as per the DECCW guidelines. If wastewater exceeds this guideline it is viewed as having potential environmental impact. This is applicable for Biological Oxygen Demand, Nitrogen, Phosphorus and Total Dissolved Solids. The WWTP supplier is guaranteeing a TDS of <700 mg/L. In normal operations it is possible that the TDS within effluent leaving the WWTP will be within the DEC guidelines of <600mg/L. On commissioning and testing of the WWTP, test results will indicate the requirement for continued investment and improvements of the WWTP.

ANZECC 2000 trigger values can also be used as a guide to further assess potential impact for nitrogen and phosphorus, **table 10**. It is important to note the nitrogen values are for the protection of groundwater and are not agronomic whilst the phosphorous is based on balancing inputs and output and aims to prevent excess nutrient entering waterways.

Table 10: Trigger values for nitrogen and phosphorus

LTV in irrigation water (long term up to 100 years) mg/L.
Nitrogen 5
Phosphorus 0.05^{B}
STV in irrigation water (short term – up to 20 years) mg/L.
Nitrogen 25-125^{A}
Phosphorus 0.2-12^{A}
^{A} requires site specific assessment
^{B} to minimise bio-clogging of irrigation equipment only

Effluent with an SAR (sodium adsorption ratio) of greater than 6 is likely to raise ESP in non sodic soils, whereas effluent with a SAR of less than 3 may lower ESP in sodic soils, DEC 2004. Therefore effluent with an SAR of above 6 would be viewed as having potential environmental impact.

Nutrient loading calculations will be reviewed annually with reference to the DEC guidelines.

Soil

There are certain conditions that would trigger the need for soil amelioration. These conditions would include soil chemical and physical factors. Soil chemical factors include: acidity; sodicity; nutrient deficiency/imbalance; and salinity. Soil physical factors include: water logging; compaction (structural); erosion; and organic component.

Acidity
Once top soil pH falls below 5.5 $CaCl_2$ liming will be considered to counter soil acidity. pH should be maintained at between 5.5 and 6.5 for optimal plant growth.

Sodicity
If topsoil sodicity levels rise to be consistently above 6% Exchangeable Sodium Percentage (ESP) then the application of gypsum will be considered to increase calcium content to aggregate clay particles and decrease relative sodium levels.
Nutrient deficiency or imbalance
In the case of nutrient deficiency or imbalance detected in the course of the soil and pant monitoring, fertiliser will be applied as required after consultation with an agronomist or consultant.

Salinity
If salinity levels in the topsoil rise to above 1,000 µS/cm corrective action will be taken that may include: deep ripping, application or gypsum or irrigation review,

Water logging
If persistence water logging is observed in the irrigation area and irrigation scheduling is not the cause then amelioration action may be undertaken. This would include deep ripping within and upslope of the affected area.

Compaction and structural decline
As with water logging deep ripping would be considered if compaction and structural decline is observed within the irrigation area.

Organic component
If the organic component in the soil is in decline amelioration measures such as the application of compost or the growing of a green manure crop will be considered.

5.3 Monitoring Program

The basis for the monitoring methodology will follow by reference the DECCW environmental guidelines as *Use of effluent by Irrigation, 2004*. The basic concept is to establish a monitoring program and review process pertaining to the following:

- The quality and amount of effluent being utilised/disposed;
- The metrological condition experienced during irrigation;
- The nutrient status of the soil to which the effluent is being applied; and
- Annual review of irrigation and nutrient utilisation efficiency.

In addition any monitoring points and parameters specified in the EPL will be adhered to.

Wastewater

The volume of wastewater irrigated will be monitored at a designated point. The quality of the wastewater will be monitored monthly during irrigation or as specified in the EPL. The wastewater will be monitored for the following analytes:

- Total Suspended Solids
- Biological Oxygen Demand
- pH
- Electrical Conductivity
- Total Dissolved Solids
- Cations
- Sodium Adsorption Ratio
- Oil & Grease
- Total Phosphorus
- Total Nitrogen

Soil

Recommended soil sampling locations are to be distributed at one per 2 to 20ha, depending on the geological complexity of the site, DECCW 2004. Owing to the homogenous nature of the site one monitoring location is recommended. The soil sampling location will be located using global positioning system (GPS) for future management.

The following soil sampling strategy is based on the DECCW guidelines and is as follows:

- A composite topsoil sample of 40 soil cores per site, taken at a depth of 0-10 cm;
- Topsoil sampling to be carried out annually;
- Composite subsoil samples of 5 cores at four depth intervals to 1 metre, within a 5 metre diameter plot. The four depths should fall within 10 -30, 30-60 and 60–100 cm depth increments; and
- Subsoil sampling will be carried out before the commencement of irrigation and every three years thereafter.

The soil will be analysed for:

- pH (no units)
- Electrical conductivity (EC)
- Nitrate-N
- Ammonia as N
- Total N
- Available P - Bray

- Total P
- P sorption capacity (kg/ha)
- Exchangeable sodium %
- Cation Exchange Capacity
- Organic Carbon %

Plant

Plant tissue analysis will be collected annually to calculate mass balance of nutrients and salts removed in relation to dry matter yield. Crop growth stages and general agronomy will also be recorded during the irrigation period.

Nutrient and salt balance

Annual nutrient balances will be calculated based on:

- the amount of nutrient applied in the wastewater;
- the amount of nutrient removed by plants
- the amount of nutrient sorbed in the soil; and
- pre and post irrigation soil nutrient levels.

This will determine whether all nutrients applied in the effluent are being effectively used by the plants or may pose an environmental risk.

In addition a rolling 5 year forward management plan will be completed to compare proposed nutrient uptake against actual figures. The nutrient budget will be updated and reviewed annually to benchmark sustainable assimilation of nutrients

Salt accumulation will be monitored by assessing salt load applied in the wastewater and the take up by plants. The leaching fraction is an important measurement to predict soil root zone salinity and subsequently plant response. This will from part of a sustainable irrigation management plan.

The detail soil survey has identified soil types and their properties within the irrigation area and the average root zone salinity and leachable fraction have been calculated. Therefore an ongoing mass balance of salinity inputs and outputs over time can be calculated.

Long term monitoring

Ongoing improvement to the irrigation system will occur on a yearly basis. All historical monitoring data will be recorded and presented both graphically and as tabulated data sets. This will be presented in the Annual Environmental Monitoring Report (AEMR). The graphics shall also show the 50 percentile, 90 percentile and 100 percentile limits of the data.

6. GROUNDWATER MANAGEMENT PLAN

6.1 Activities that could impact groundwater quality

Irrigation and wastewater storage are the primary activities that could affect groundwater quality. The implementation of the soil and water management plan aims to minimise deep drainage that could adversely affecting groundwater. This will be achieved by best practice irrigation and crop management, treatment of the wastewater to a low strength effluent level and ongoing improvements to the soil and water management plan.

As identified in the EA in order to minimise the impact on groundwater the wastewater storage pond will be constructed using:

- a welded 2.5mm poly liner underlying the dam (to be agreed by the DECCW);
- a leakage detection system; and
- solid waste storage areas have impermeable pads, and are located in controlled drainage areas on the site.

6.2 Groundwater management measures

Groundwater management measures include the measurement and monitoring of groundwater prior to and during irrigation and the commissioning of the wastewater storage pond. Monitoring bores will be installed in the irrigation site, in consultation with the DECCW. The monitoring bores will be located up gradient of within and down gradient of the irrigation area. In consultation with the DECCW, monitoring bores will be installed around the wastewater storage pond as a leakage detection system. The bores will be monitored annually for depth to groundwater and chemical analytes as follows:

- pH
- Electrical Conductivity
- Total Nitrogen
- Total Phosphorus
- SAR
- Potassium
- Sodium
- Magnesium
- Calcium

Groundwater baseline conditions will be measured before any irrigation occurs or commissioning of the wastewater storage pond. Any other bores that are able to be accessed off site, i.e. stock and domestic bores on neighbouring properties will be monitored as well if access can be arranged.

- Two monitoring wells located down-hydraulic gradient of the irrigation area; and
- One monitoring well located down-hydraulic gradient of the wastewater storage pond.

The wells will be located in liaison with the DECCW and baseline groundwater levels, quality and flow will be recorded prior to the commencement of operation.

6.3 Impact assessment criteria

Groundwater impact assessment criteria will be based on a change in groundwater height and/or quality and specific benchmarks. If groundwater height is measured to within 3 metres of the surface level or an average rise of 20cm per year over a five year period a full groundwater study be carried out to determine the cause in consultation with the DECCW.

Following is the criteria levels presented in the EA from ANZECC 2000 for Primary Industries (Irrigation) Water, **table 11**. Trigger levels represent the best current estimates of the concentrations of chemicals that should have no significant adverse effects on the aquatic ecosystem. Where trigger levels are not provided, an assessment of the variation between the years was undertaken. If groundwater quality within the irrigation area or wastewater storage pond exceeds the irrigation criteria or varies from baseline levels over time then a full groundwater study will be carried out in consultation with the DWE to determine the cause.

Table 11: Groundwater quality assessment criteria

Groundwater Quality Assessment Criteria	
Indicator	**Irrigation Criteria**
pH	>6.5 and <8.5
Conductivity (EC)	No criteria available
Total Dissolved Solids (TDS)	<13,000 mg/L
Sodium (Na)	<460 mg/L
Potassium (K)	No criteria available
Calcium (Ca)	<1000 mg/L
Magnesium (Mg)	No criteria available
Chloride (Cl)	<700 mg/L
Bicarbonate (HCO3)	No criteria available
Nitrate (NO3)	<400 mg/L
Sulfate (SO4)	<1000 mg/ L
Hardness	<350 mg/L as CaCO3

6.4 Contingency measures

In the event of a site experiencing unsatisfactory impact on groundwater that cannot be resolved by altering irrigation and crop management then additional/alternative irrigation land will be sought.

6.5 Baseline information

Based on reported water bearing zone information detailed in registered groundwater bore data from the DECCW website (http://test.nratlas.nsw.gov.au) indicative depth to groundwater reported within the study area varies considerably from 4 to over 100 metres below ground level. The groundwater is classed as low/moderate to moderate vulnerability which is described as follows: Maps providing an assessment of an area's groundwater vulnerability relative to other areas within the study. They include details of geology, depth of groundwater and aquifer details and soils (where available).

From the Geoscience Australia hydrogeology dataset the groundwater beneath the site is described as fractured or fissured extensive aquifers of low to moderate productivity.

From a review of licensed bores in the locale the following have been identified and are displayed in map format, **figure 3**. As follows are details of the bores, **table 12**.

Table 12: DNR bore details

Bore	Use	Drilled depth (metres)
GW010925	Stock	59.1
GW010900	Stock Domestic	32.9
GW024160	Stock Domestic	16.5
GW045371	Stock Domestic	34.1
GW401827	Domestic Irrigation	41.2
GW037631	Stock Domestic	40.2
GW019939	Stock Domestic Irrigation Farming	91.4
GW022006	Stock Domestic	36.6

In addition to the DECCW bores surrounding the site there is a network of 39 monitoring bores located on the adjacent Riverina Wool Combing site. Of these bores there are 10 paired bores located directly up-gradient of the planned irrigation area. These bores range in drilled depth from 1.8 to 11.05 metres depth below ground level. The piezometric depth of these bores from 2006 to 2008 have varied between <2 metres and <11 metres below ground level.

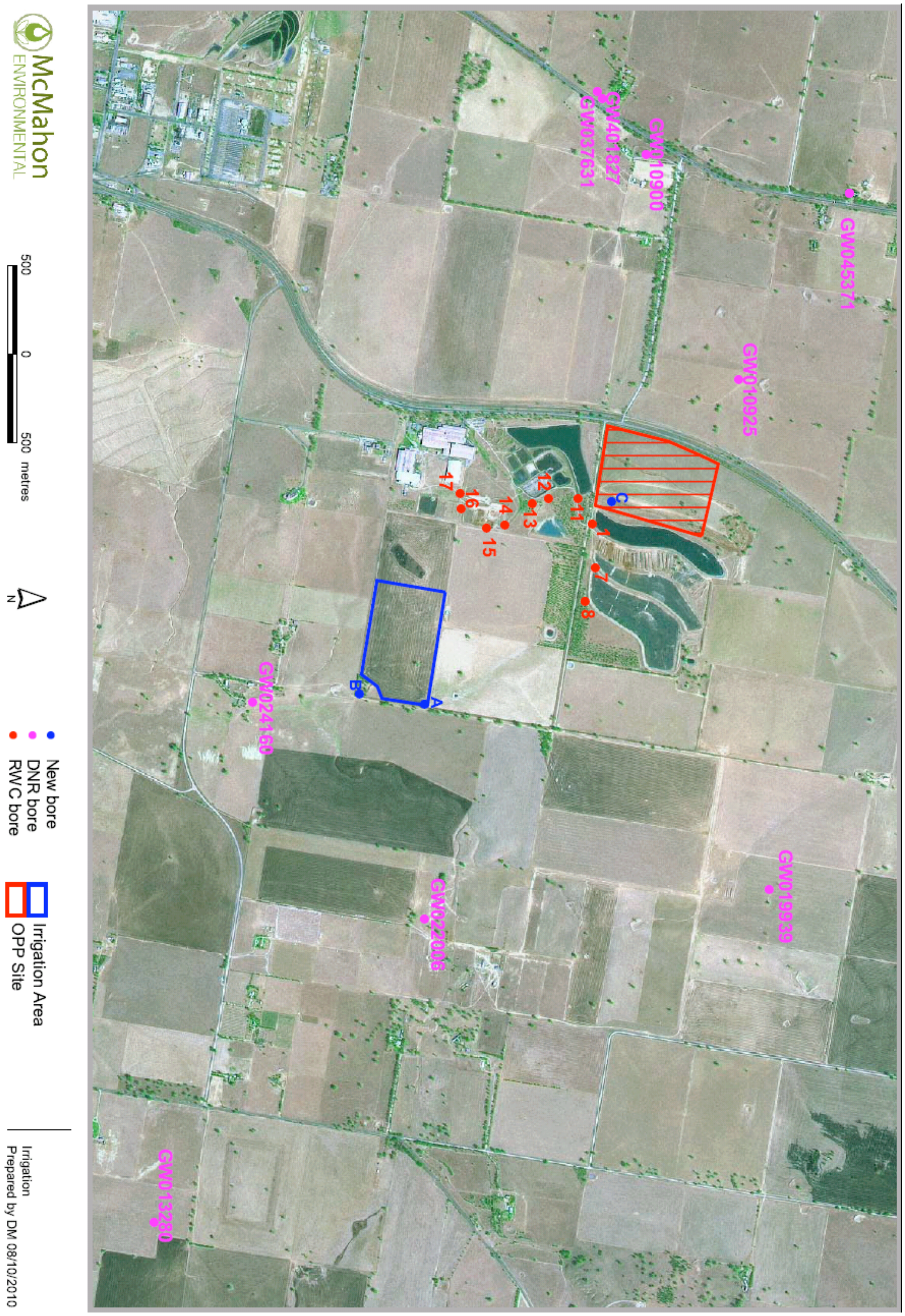

Figure 3: Groundwater bores

7. REPORTING

7.1. Legal reporting requirements

7.1.1. Incident and Complaint reporting

The senior production engineer or environmental engineer is informed immediately of any incidents to ensure that appropriate and immediate actions are undertaken to mitigate the issue.

7.1.2 Responsibility of Personnel

The Environmental engineer will implement the SWMP and oversee the environmental monitoring. All staff and subcontractors will also be trained in general soil and water management and environmental awareness and reporting procedures. Shift managers and foreman will oversee that staff implement the SWMP and where necessary undertake additional training to inform staff and subcontractors of waste management procedures. The wastewater treatment, irrigation and stormwater system will be overseen by the shift supervisors but the overall supervision of the work is the Environmental engineer's responsibility. The Plant Manager is ultimately responsible for overseeing the Environmental Engineers work and the implementation of the EMS and environmental compliance.

Environmental / production Engineer will be responsible for:

- Compiling monthly internal reports for presented to the plant manager;
- Compiling the AEMR;
- Management / Monitoring Plans/Programs identify accountabilities and responsibilities relevant to the tasks presented in that plan;
- These accountabilities and responsibilities will be relayed to each employee/contractor through site inductions, and where necessary, through training;
- Procedures would be in place to assess each employee's or contractor's competency for the relevant task(s);
- Ensure compliance to limits imposed in the EPL;
- Compile EPL annual return;
- Incident and complaints recording and relevant follow up action;
- Communicating with landholder and relevant government agencies;
- Establishing and administering the CCC;
- Implementing the environmental audit; and
- Update EMS as required.

7.1.3 Annual Environment and Compliance Report

In accordance with Schedule 4, Condition 63, ROBE will submit an Annual Environmental Monitoring Report (AEMR) to the:

- Department of Planning (DoP);
- Department of Environment, Climate Change and Water;
- Wagga Wagga City Council (WWCC); and

- Be made available to the Community Consultative Committee and any interested party.

The AEMR will:

a) identify the standards and performance measures that apply to the project;
b) describe the works carried out in the next 12 months;
c) describe the works that will be carried out in the next 12 months;
d) include a summary of the complaints received during the project during the past year;
e) include a summary of the summary of the monitoring results for the project during the last year;
f) include an analysis of these monitoring results against the relevant:
   - impact assessment criteria/limits;
   - monitoring results from the previous years; and
   - predictions in the EA.
g) identify any trends in the monitoring results over the life of the project;
h) identify any non-compliance during the previous year; and
i) describe what actions were, or are being, taken to ensure compliance.

The AEMR is requested to be submitted to the DoP within 12 months of the date of the Project Approval, being 8 November 2008, and annually thereafter. Ultimately the AEMR compilation date would ideally coincide with the reporting period of the EPL. This will ensure that the AEMR is relevant to the compliance conditions and criteria contained within the EPL annual return. Submission to the DoP to have the AEMR and EPL annual return dates coincide will be made once the EPL is received from the DECC.

7.2. Internal reporting

Monthly environmental reports are to be prepared by the production or environmental engineer and reviewed by the Plant Manager. The monthly environmental reports include key performance indicators for such items as:

- wastewater treatment volumes and quality;
- irrigation volumes, location and quality; and
- crop production and management;

The report will also include a summary of any incidents, complaints or environmental issues experienced during the month. This data is to be collected, verified and reviewed by the Environmental Representative in preparation for the AEMR.

8. AUDITING

Schedule 4, Condition 64 requires an independent external audit of the operation within 12 months years of the commencement of operations and every three years thereafter.

In compliance with Condition 64, 65 and 66 the audit will:

a) be conducted by a suitably qualified, experienced, and independent team of experts whose appointment has been endorsed by the Director-General;
b) be undertaken in consultation with DECCW and Council;
c) include a Hazard Audit in accordance with the Department's *Hazardous Industry Planning Advisory Paper No.5 – Hazard Audit Guidelines*. The audit shall include a review of the Safety Management System and of all incidents recorded and be accompanied by a program for the implementation of all recommendations made in the audit report. If the Proponent intends to defer the implementation of a recommendation, justification must be included;
d) assess whether the project is being carried out in accordance with industry best practice;
e) assess the environmental performance of the project, and its effects on the surrounding environment and sensitive receivers;
f) assess whether the project is complying with the relevant standards, performance measures, and statutory requirements;
g) review the adequacy of any strategy/plan/program required under this approval; and if necessary,
h) recommend measures or actions to improve the environmental performance of the project, and/or any strategy/plan/program required under this approval.

Within 6 weeks of completing this audit, or as otherwise agreed by the Director-General, the proponent shall review and if necessary revise the strategy/plans/programs required under this approval to the satisfaction of the Director-General.

Within 3 months of submitting an audit report to the Director General, the Proponent shall review and if necessary revise the strategy/plans/programs required under this approval to the satisfaction of the Director-General.

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