Norske Skog
Albury

NORSKE SKOG ALBURY MILL

Revised Treated Process Water Management Strategies

STATEMENT OF ENVIRONMENTAL EFFECTS

October 2008

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ALBURY MILL
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EXECUTIVE SUMMARY

Norske Skog Albury seeks to implement a number of changes to its existing treated process water management strategies and processes. NSW Department of Planning (DoP) approval is sought to allow the mill to modify the following Development Consents:

- 1992 Development Consent DA 41/92
- 2004 Development Consent DA 389-8-2003-i

The Norske Skog Albury mill is a modern newsprint mill that produces 265,000 tonnes of newsprint per annum. It is located in the Upper Murray River catchment 12km north east of Albury and operates under a variety of consents relating to operation of a recycled fibre plant, wastewater reuse scheme and expanded newsprint manufacturing and licences relating to environment protection and water access.

Some 5000 ML of water is withdrawn annually from the Murray River, of which 1100 mega-litres (ML) is returned after use in various cooling applications. Of the remaining 3800 ML, some 1100 ML is consumed in the process, and 2700 ML is transferred to a wastewater reuse scheme.

The Albury mill reviewed its water management strategy in 2002-03 in order that a sustainable water management plan could be developed to underpin the mill's future operation and development. The strategy review incorporated the following elements:

- Reduction of water and chemical use through 'standard' technologies
- Expansion of the Wastewater Reuse Scheme (WWRS)
- Assessment of Desalination Technology
- Assessment of Evaporation Technology
- Implementation of Green Offsets
- Third Party Irrigation of Cooling Water and Treated Process Water via the mill's return water pipeline

As a result of this review the following were concluded:

- The mill operates better than European best practice with respect to water use, and has modified its pulp brightening and deinking process so that less chemicals are used.
- There is no suitable land available for expansion of the WWRS and greater operational flexibility would come from having another option available.
- Desalination technology provides a possible solution to remove dissolved solids from the treated process water. However, issues such as waste brine disposal in an inland setting, high energy usage and running costs mean that implementation of this type of technology may not be feasible in the foreseeable future.
- Evaporation technology requires high capital expenditure, incurs high energy costs and is uneconomic.
- A Green Offset has the advantage that it will achieve a salinity reduction in the Murray River catchment whilst improving operational flexibility
- Third party irrigation is viable, with additional third party re-use options, such as for watering sporting fields and parks, made possible if effluent discharge is approved under a Green Offset arrangement.

It was therefore concluded by Norske Skog Albury that a Green Offset for salinity in which treated process water is returned to the Murray River should be explored, along with the opportunity for third party re-use.

The impacts of returning treated process water to the Murray River have been studied in detail over many years and a significant body of knowledge has been accumulated. The impact in the Murray River at Albury of treated process water discharged by the Albury Mill was comprehensively studied between 1992 and 1996 by the Murray Darling Freshwater Research Centre whilst all mill effluent was still being discharged to the river. A range of ecotoxicological tests, water and sediment analyses and biota surveys demonstrated that the treated process water produced by the mill over that period of time had no discernible impact within or beyond the mixing zone of the effluent.

Treated process water parameters have been compared against Australian New Zealand Environment Conservation Council (ANZECC) guidelines and relevant trigger values for protection of aquatic ecosystems. This demonstrated that the only measurable change to water quality would be in the concentration of dissolved salts. This increase would be compensated for through operation of the salt interception scheme under the proposed Green Offset plan.

Recent ecotoxicological tests were conducted on a range of species, as set out by the NSW Department of Environment & Climate Change (DECC). No acute or chronic toxic responses were observed in any test at any concentration of treated process water. This indicates that there should be no adverse ecotoxicological effect from discharging the treated process water that the mill currently produces to the Murray River.

The proposed water management plan under a Green Offset plan will increase the amount of water returned to the Murray River from the current 1100 ML to 2200 ML per year. Benefits of the proposal include more flexible water and wastewater reuse management arrangements for the mill, increased environmental flow to the Murray River, increased economic benefit to the Murray Darling Basin by adding value to the water cycle, decreased salinity in both Billabong Creek and the Murray Darling Catchment as measured at Morgan South Australia and a failsafe methodology to implement a Green Offset for salinity.

Norske Skog is therefore applying to have the 1992 Development Consent DA 41/92 and the 2004 Development Consent DA 389-8-2003-i modified to allow the following to occur:

1. The implementation of a Green Offset for salinity that will result in an overall reduction in salinity for the Murray Darling Basin. A salinity offset would be produced by operation of the Billabong Creek Salt Interception Scheme (BCSIS) which is located near Walla Walla. The BCSIS will be financially supported by Norske Skog and operated by the NSW Department of Water & Energy (DWE). For every two tonnes of salt removed by operation of the BCSIS, Norske Skog would be allowed to discharge one tonne of salt to the Murray River in the form of treated process water. This means the salinity offset will be implemented with a 2:1 ratio.

   In total the BCSIS will remove 3,000 tonnes of salt per annum and will result in a net environmental benefit of 1,500 tonnes of salt after allowing for the annual return of treated process water at the Albury Mill containing ~1,500 tonnes of salt.

All water quality parameters will remain within limits specified by DECC. Effluent discharges will continue to be subjected to the existing minimum dilution of 600:1 with Murray River water. The volume of effluent that may be discharged under this criterion will vary, but will typically be 3 ML/day.

2. Permit a quantity of treated process water (of a quality determined by DECC), cooling water, or a combination of both, to be available to interested third parties for reuse where non-potable water quality is an acceptable application. This water will be obtained via the Albury Mill return water pipeline to the Murray River. The distribution, management and monitoring of water provided to third parties will be the responsibility of the relevant third party and subject to separate approval processes.

The likelihood of adverse environmental effects from returning treated process water to the Murray River are very low and to confirm this, an ecotoxicological testing regime will be devised in consultation with DECC and carried out once every six months for the first two years of the "Proof of Concept" period, and once every year thereafter in the event that no adverse effects are found. Should adverse effects be found from the ecotoxicological testing, an ecological monitoring program based on the BACI (Before, After, Control, Impact) design will be implemented. Adverse impacts from the ecological monitoring would trigger consultation with DECC, and if required by them, discharge of treated process water to the Murray River would cease.

Verification of the performance of the BCSIS in removing salt will be determined by a number of measures, including gauging stations to monitor salinity and stream flow, quality and quantity of water pumped into Billabong Creek, groundwater depths as measured by the monitoring bores and pump hours of operation. A range of key performance indicators based on these parameters will be developed and reported at either monthly or annual intervals. This information will be compiled into an annual report that will be submitted to DECC in August each year. The Albury Mill will measure and record a range of parameters in relation to its treated process water discharge to the Murray River in order to verify that the offset of two tonnes of total dissolved solids removed for one of total dissolved solids discharged has been achieved.

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Appendix 1. DA 389-8-2003-i Upgrade of existing paper machine to 265,000 tonnes pa

Appendix 2. Environmental Protection Licence No 1272

Appendix 3. Albury Wodonga Development Corporation, Return Water Line from ANM Mill, Preliminary Design Report Ref No 1361/64, Section 11 Diffuser. Gutteridge, Haskins and Davey Jan 1979**.**

Appendix 4. "The Billabong Creek Salt Interception Scheme: A summary of investigations, modelling and recommended operational parameters.", Chris Ribbons, Michael Williams, Department of Water & Energy, NSW Government, August 2007.

Appendix 5. Background and summary of Murray River salinity modelling for a potential Norske Skog Albury Mill 'salinity offset' project

Appendix 6. Soil Properties and Nutrition of Radiata Pine Irrigated with Paper Mill Effluent at Albury in 2006. Peter Hopmans Report 2007/07, June 2007 Timberlands Research Pty. Ltd

Appendix 7. Biomonitoring of Newsprint Mill Wastewater for Norske Skog. CSIRO & MDFRC.

Part 1. Collation of Annual Reports 1992-1999. Helen Gigney 2002

Appendix 8. Biomonitoring of Newsprint Mill Wastewater for Norske Skog. CSIRO & MDFRC

Part 2. Collation of Presentations and Scientific Publications 1992-2001 including Lake Ettamogah and Eight Mile Creek Studies. Helen Gigney 2002

Appendix 9 "Toxicity Assessment of a Final Outfall Sample from the Albury Pulp Mill. Norske Skog Paper Mills (Australia) Ltd." Test Report, May 2008, Ecotox Services Australia.

Appendix 10 Proposal for an Assessment of River Health and River Monitoring Surveys of the Murray River at Albury for Norske Skog.

ACRONYMS

ACC	Albury City Council
ANM	Australian Newsprint Mills Ltd
ANZECC	Australian & New Zealand Environment Conservation Council
ARMCANZ	Agriculture & Resource Ministers Council of Australia & New Zealand
BAT	Best Available Technology
BCSIS	Billabong Creek Salt Interception Scheme
BOD	Biochemical Oxygen Demand
CMA	Catchment Management Authority
DEC	Department of Environment and Conservation
DECC	Department of Environment & Climate Change
DIPNR	Department of Infrastructure, Planning & Natural Resources
DLWC	Department of Land & Water Conservation
DNR	Department of Natural Resources
DTPA	Diethylenetriaminepenta-acetic acid
DWE	Department of Water & Energy
EC	Electrical Conductivity, expressed as micro-Siemens per centimetre (µS cm^{-1})
EDTA	Ethylenediaminetetra-acetic acid
EIS	Environment Impact Study
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ha	Hectares
HU	Hazen Units, a measure of colour in water
KPI	Key Performance Indicator
MDB	Murray Darling Basin
MDBC	Murray Darling Basin Commission
MDBMC	Murray-Darling Basin Ministerial Council
MDFRC	Murray Darling Freshwater Research Centre
mg L^{-1}	Milligrams per litre
ML	Mega litres
NHMRC	National Health & Medical Research Council
NLWRA	National Land & Water Resources Audit
NWQMS	National Water Quality Management Strategy
NTU	Nephelometric Turbidity Units, a measure of turbidity in water
PDF	Pulp Dewatering facility
POEO	Protection of Environment Operations Act
PM1	Paper Machine number 1 at Albury mill
RCF	Recycled Fibre
RTA	Road Traffic Authority
SEE	Statement of Environmental Effects
TDS	Total dissolved solids, a measure of dissolved salts in water
tpa	Tonnes per annum
TMP	Thermo Mechanical Pulp
WWRS	Wastewater Reuse Scheme (also referred to as the irrigation scheme)
WWTP	Wastewater Treatment Plant

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CHAPTER ONE

1. INTRODUCTION

Norske Skog Albury seeks to implement a number of changes to its existing treated process water management strategies and processes. NSW Department of Planning (DoP) approval is sought to allow the mill to modify the following Development Consents:

- 1978 Development Permission NA56/78.959. (To Australian Newsprint Mills to develop a pulp and paper mill. Issued by the Albury Wodonga Development Corporation).
- 1991 Development Consent N687. (Brightening Facility)
- 1992 Development Consent DA 41/92. (Wastewater Reuse Scheme)
- 1992 Development Consent DA 147/92. (Recycled Fibre Facility)
- 2004 Development Consent DA 389-8-2003-i. (Papermachine Upgrade)

The modifications sought will allow the following to occur:

1. The implementation of a Green Offset for salinity that will result in an overall reduction in salinity for the Murray Darling Basin. A salinity offset would be produced by operation of the Billabong Creek Salt Interception Scheme (BCSIS) which is located near Walla Walla. The BCSIS will be financially supported by Norske Skog and operated by the NSW Department of Water & Energy (DWE). For every two tonnes of salt removed by operation of the BCSIS, Norske Skog would be allowed to discharge one tonne of salt to the Murray River in the form of treated process water. This means the salinity offset will be implemented with 2:1 ratio.

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2. Permit a quantity of treated process water (of a quality determined by DECC), cooling water, or a combination of both, to be available to interested third parties for reuse where non-potable water quality is an acceptable application. This water will be obtained via the Albury Mill return water pipeline to the Murray River. The distribution, management and monitoring of water provided to third parties will be the responsibility of the relevant third party and subject to separate approval processes.

The Albury Mill has and will continue to manage and explore water management initiatives that will provide continuously improving environmental and community outcomes. Over the past five years the mill has carried out extensive reviews of its water and waste water management strategies, reviewed the impacts that treated process water will have on the environment, accessed the performance of the waste water reuse scheme and been engaged with both the Departments of Environment and Climate Change and the Department of Water and Energy in developing this innovative offset scheme.

This application contains the background and context that the modification is requested including a description of the elements and justification for the proposed changes. Development work and detailed discussions have been held with DWE and DECC in developing the concepts for this proposal.

CHAPTER TWO

2. ALBURY MILL BACKGROUND

2.1 OVERVIEW

Norske Skog Paper Mills (Australia) Ltd is Australia's only manufacturer of newsprint and is owned by Norske Skogindustrier ASA, a Norwegian based company. Norske Skog is one of the largest newsprint producer in the world with 15 mills in 11 countries. The company specialises in the production of newsprint and magazine grades of paper.

Norske Skog operates mills at Boyer in Tasmania and at Albury in New South Wales. The Albury Mill has one paper machine with a capacity of 265,000 tonnes of newsprint per annum and also manufactures approximately 45,000 tonnes per annum of de-inked recycled fibre pulp for use at the Boyer Mill.

The Albury Mill is one of the largest employers in the region employing 260 people directly and approximately 750 people indirectly. The Boyer Mill contains two paper machines having a combined capacity of 385,000 tonnes per annum.

Norske Skog also operates the Tasman Mill at Kawerau in New Zealand, the third mill in the Australasian region. This mill has two machines producing 315,000 tonnes per annum, of which 120,000 tonnes is sold to Australian customers. The total sales from all mills represent approximately 90% of the newsprint and related grades of paper consumed in Australia. The Albury Mill production represents about 40% of the Australian consumption.

The Albury Mill has its foundations in the development of newsprint as an industry in Australia. The original owners were Australian Newsprint Mills Ltd (ANM) who established the Boyer Mill in 1941. The company then expanded their manufacturing facilities to mainland Australia in 1979 with the construction of the Albury Mill between 1979 and 1981.

The Albury Mill was commissioned in 1981 and has operated continuously since that time. In 1997 Fletcher Challenge Ltd, a New Zealand based company, acquired ANM and continued the mill operations until mid 2000 when it was sold to Norske Skog.

2.1.1 MILL LOCATION

The mill is located approximately 12 km north-east of the centre of Albury in NSW. The site is adjacent to the main Sydney – Melbourne standard gauge railway line and extends between the Hume Highway and the Olympic Way immediately north of where the two roads meet. ***Figure 1*** shows the location of the mill site in relation to the cities of Albury &

Wodonga. The mill site lies within the boundaries of the city of Albury, for which the planning authority is the Albury City Council.

Adjacent to the mill plant are large areas of irrigated plantation and pasture utilised for the disposal of the mills treated process waters and some agricultural activities. The plantations and pastures have been progressively established since 1991. ***Figure 2*** shows the location of all adjacent mill property owned by Norske Skog which totals ~1,800 ha. The mill maintains 450 ha of active irrigation with a total area of ~480 ha under either plantation or pastures.

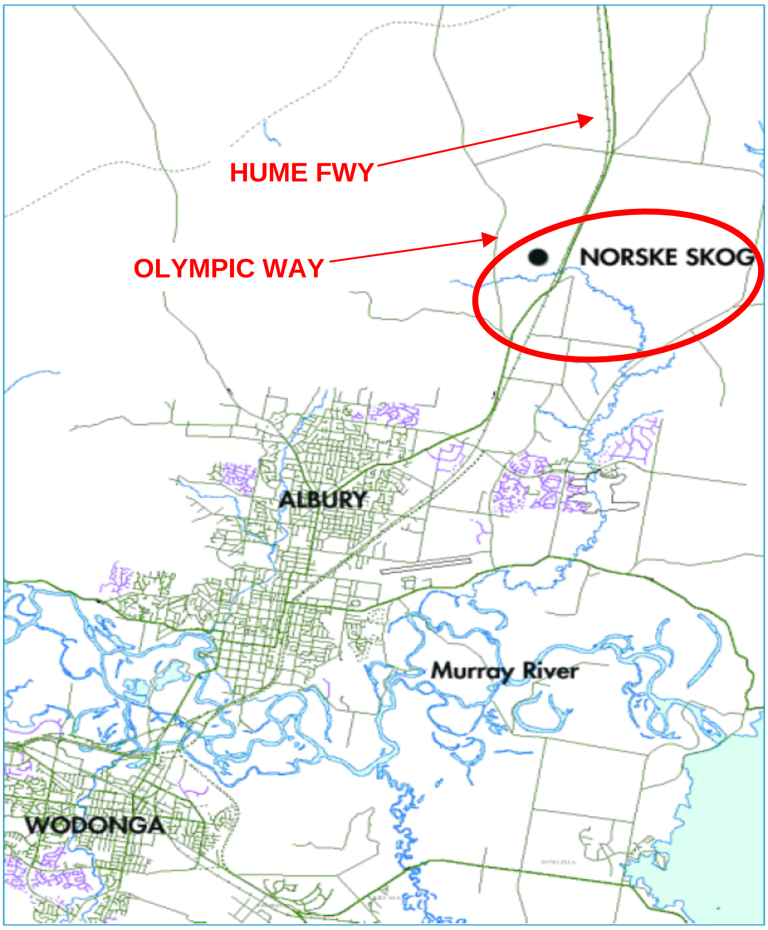

Figure 1 REGIONAL LOCATION MAP

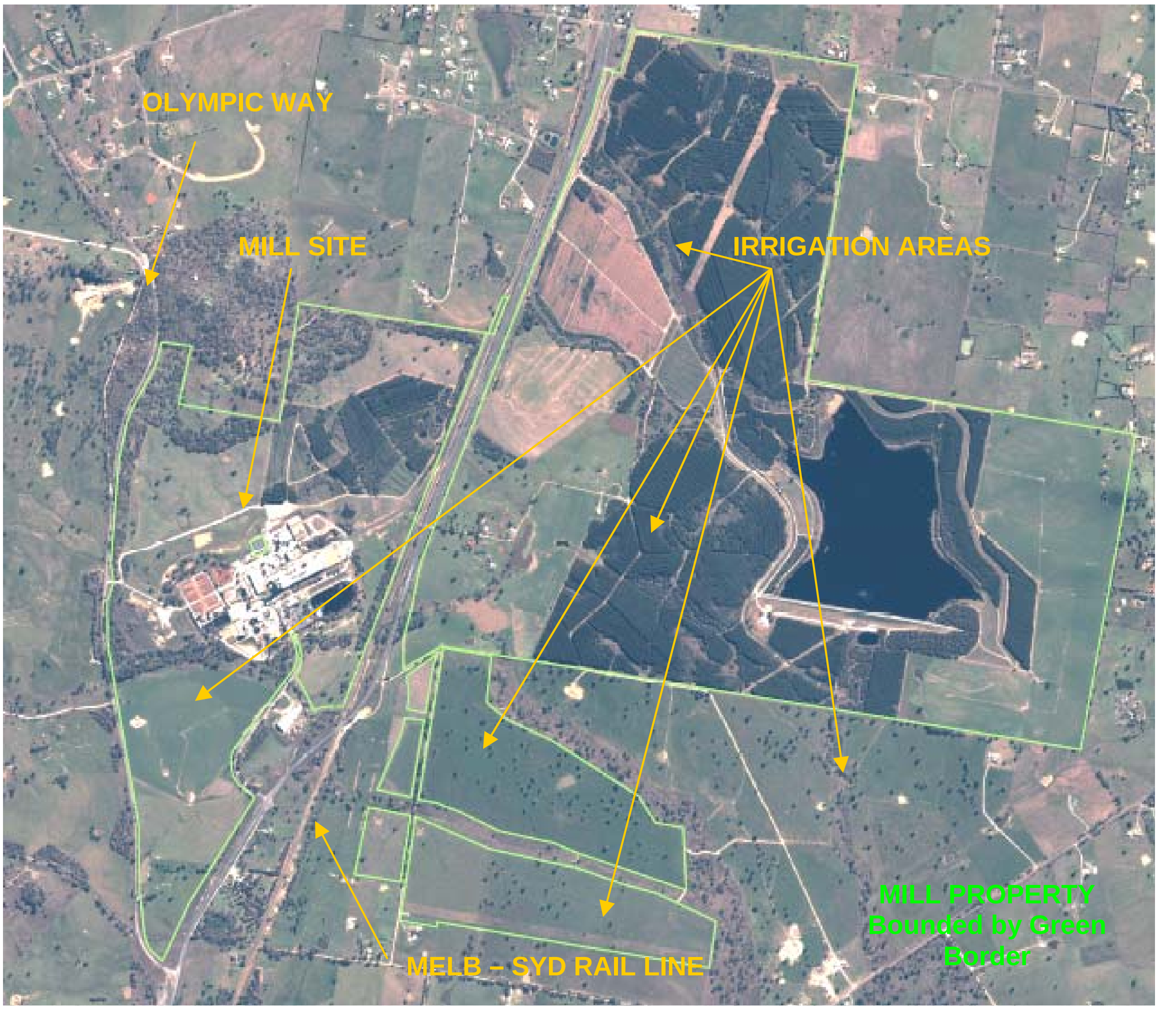

Figure 2. ALBURY MILL – Aerial View of Mill Site

2.1.2 PROCESS OVERVIEW OF EXISTING MILL

The Albury Mill is an integrated mechanical pulp mill, recycled fibre plant and high speed paper machine. ***Figure 3*** shows the mill layout. The following sections describe the mill in terms of the major process blocks. A schematic representation of the pulp and paper making processes is shown in ***Figure 4*** including:

- Log storage, handling and preparation
- Thermo-mechanical pulp (TMP)
- Recycled fibre (RCF)
- Paper machine
- Warehouse and Distribution
- Water and wastewater treatment plant
- Pulp Dewatering Facility (PDF)

- Steam Plant
- Auxiliary Activities

Log Storage, Handling and Preparation

Pulp logs sourced from plantation forests are delivered to the mill 24 hours per day six days per week. The delivered logs are unloaded and stored in a paved wood-yard to provide a stockpile for the process. Stocks are managed to control wood age (since harvesting) and quality. The logs are passed through a drum de-barker where the tumbling and rubbing of the logs against each other removes the bark.

The debarked logs are processed through a chipper with the chips being stored in a silo ready for use in the mechanical pulping process. The chip supply from logs is augmented by chips purchased from saw-milling operations in the region. These are unloaded and mixed with the pulp log chips.

The bark and other wood waste, such as sawdust and small chips are passed through a hammer mill to reduce the particle size and are then sent to the boiler to be used as an auxiliary fuel for steam generation.

Thermo-mechanical Pulping (TMP)

The wood chips are washed to remove grit and other contaminants and heated with steam to soften them. The chips are then fed to two refiners in series where they pass between one stationary and one rotating grooved steel disc. The mechanical action in the refiner separates the fibres from each other to make pulp. There are eight refiners in total, each driven at 1,500 rpm by a 9,000 kW electric motor.

Being a mechanical pulping process, the conversion rate of chips to pulp is approximately 95% on a dry weight basis. The pulp undergoes further processing using screening and cleaning devices to remove short and damaged fibres and those that have not been adequately refined. The pulp is then brightened using sodium hydrosulphite at an average rate of 6 kg/tonne of pulp. It is then pumped into large storage tanks before being blended with RCF pulp and dyes and converted to paper.

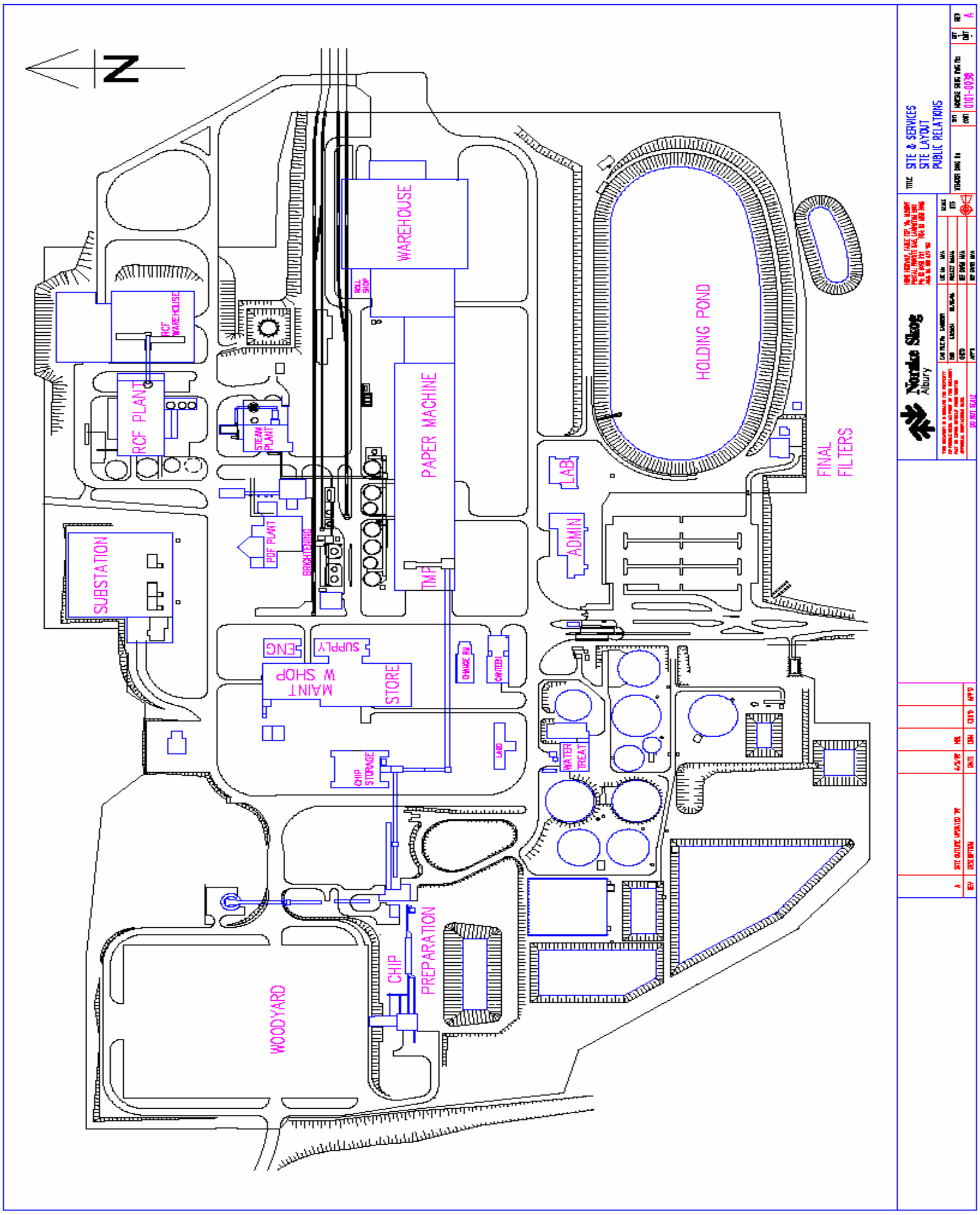

Figure 3 ALBURY MILL – Site Layout

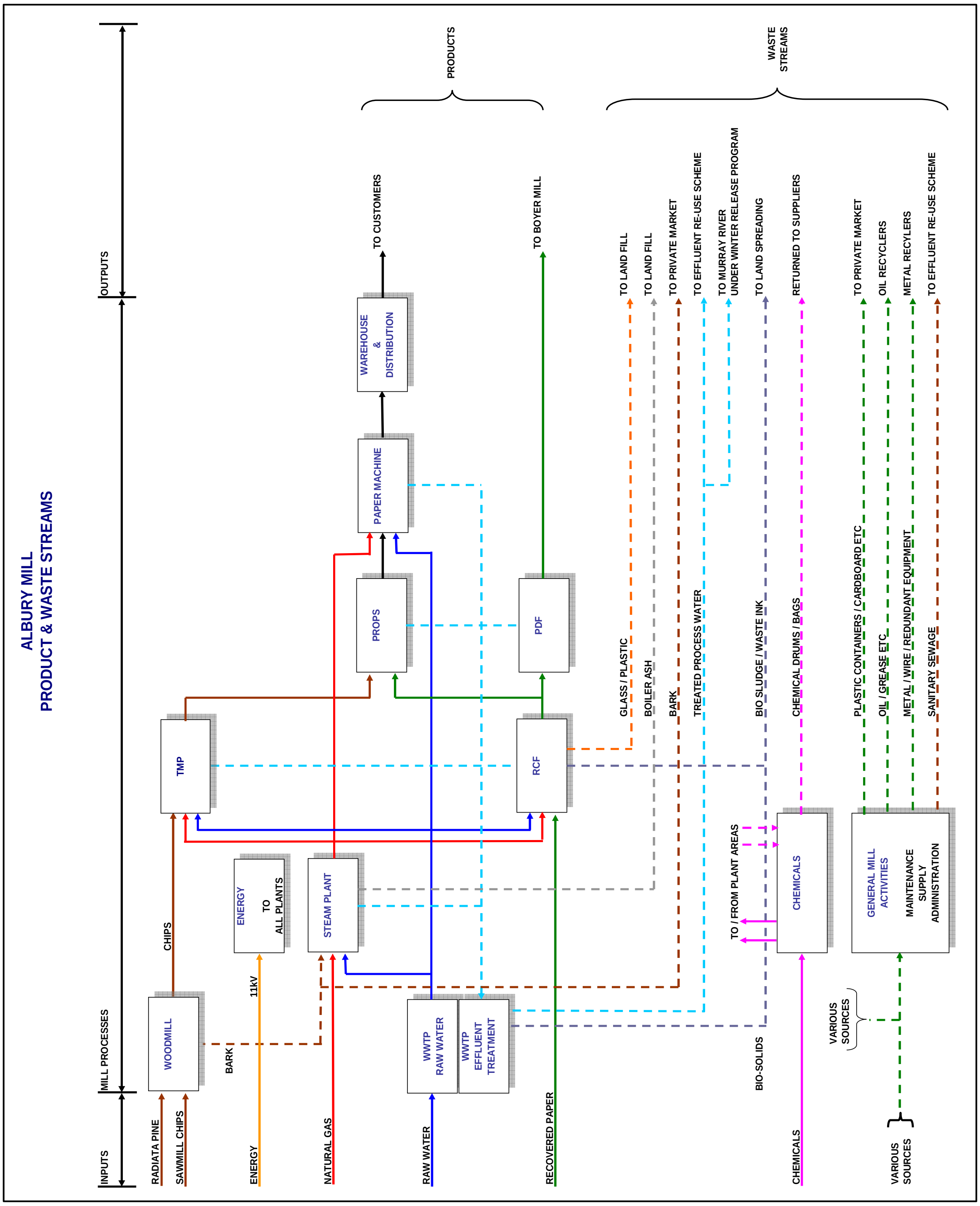

Figure 4 ALBURY MILL – Process Overview

Recycled Fibre (RCF)

This plant is operated at a rate of 150,000 tonnes per annum to supply sufficient fibre to the paper machine and to the Boyer Mill in Tasmania. The rated plant capacity is 160,000 tonnes per annum of recovered paper.

Recovered paper consisting of old newspapers and magazines is loaded onto conveyors in the warehouse and sent to the batch pulper. The pulper acts like a very large blender, mixing the paper with recycled water from the paper machine. Chemicals to provide ink removal are also added, including surfactant, hydrogen peroxide, sodium silicate and soap.

After approximately 10 minutes the recovered paper has been pulped and it is passed through a large screen to remove coarse contaminants such as plastic, metal, computer discs, and bottles. The pulp is sent to one of two storage tanks from where it is used to feed the rest of the process which operates on a continuous basis.

The remainder of the process consists of unit operations designed to remove contaminants such as glass, sand, small pieces of plastic and ink to leave a clean pulp suitable for newsprint manufacture. The ink is removed by causing it to attach to soap bubbles and float to the surface of the pulp mixture where it is skimmed off.

Approximately 17% of the recovered paper brought into the mill is discharged as reject material. It consists of glass, plastic, metal and other contaminants as well as the ink and filler particles removed from the newspapers and magazines. The inert materials (glass, plastic and metal) are taken to a landfill site and the other rejects (un-usable fibre, ink and fillers) are processed and semi-dried, mixed with other solid waste containing organic material and nutrients and spread on farm land in the local area.

Paper Machine

The paper machine was originally manufactured in Finland and various components have been replaced or rebuilt to improve quality and efficiency since the machine began operating in 1981. The latest upgrade was in 2006 when major components were replaced by Voith Paper. It produces a sheet of paper 8.6 m wide at an average speed of 1540 m/min. Daily production is approximately 800 tonnes and an annual capacity of 265,000 tonnes per annum.

Papermaking consists of four stages; forming, pressing, drying and finishing. In the forming stage a pulp mixture of 60% TMP and 40% RCF is mixed with some dyes (to produce the correct shade of newsprint) and chemicals (to enhance the retention of the pulp fibres. This mixture is diluted is diluted and pumped on to the paper machine where it forms a thin wet sheet on the first section of the paper machine. Various devices are used to begin removing water.

With a moisture content of approximately 84%, the sheet enters the press section of the paper machine where vacuum and pressure between large heavy rolls removes more water so that the sheet enters the drying stage with a moisture content of approximately 58%.

The drying section consists of a large number of hollow cylindrical drums heated by passing steam through them. The paper sheet passes alternately over and under these drums slowly becoming drier. At the end of this section the moisture content is 9%. The sheet passes through a group of polished steel rolls called the calender stack where the sheet thickness is controlled and the sheet surface becomes smoother.

The paper is then wound onto a large spool and forms a jumbo reel of paper approximately 35 tonnes in weight.

Warehouse and Distribution

The paper from the paper machine is then transported and converted into finished rolls of various sizes for customers, wound onto new reels, wrapped, labelled and sent to the warehouse to await dispatch by road to the customer.

Water and Wastewater Treatment Plant

The Albury Mill ranks as one of the best newsprint production facilities in the world with respect to water consumption and wastewater generation. Despite being more than 27 years old, it has a specific water consumption of less than 17 kL/tonne of newsprint produced and a wastewater generation rate of approximately 9 kL/tonne of newsprint produced.

Water entering the mill is first used in applications where low temperature and cleanliness are required such as in cooling towers and in fine sprays where contaminants could cause blockages. As the water becomes hotter and contaminated with things such as paper fibres, it is used for process purposes where it is in contact with pulp and chemicals.

Various techniques are used to clean the water at different stages in the process so that it can be reused numerous times including dissolved air flotation and various types of screening and filtration.

Eventually the water is no longer suitable for use in papermaking because of the dissolved organic and inorganic materials which affect the efficiency of some processes. The water is then sent to the Wastewater Treatment Plant (WWTP) for treatment to remove the dissolved organics, measured as Biochemical Oxygen Demand (BOD). After treatment it is used for irrigating the pine plantation or annual crops as part of the Ettamogah wastewater reuse scheme.

Pulp Dewatering Facility

The Albury Mill operates a Pulp De-watering Facility which press dries recycled fibre to moisture content of ~50% in order to provide the Boyer Mill with approximately 45,000 tonnes pa of recycled fibre.

Steam Plant

Steam for the plant (mainly for paper drying) is produced in a boiler fuelled by a mixture of natural gas and wood waste. Distillate can also be used as an emergency fuel. There is a standby boiler which is powered by gas or distillate. Both boilers are of 80t/hr capacity. In the calendar year 2007, the gas consumption was 1500 TJ and more than 11,000 tonnes of wood waste were burnt.

Auxiliary Activities

The mill undertakes auxiliary services that include the management of chemicals used in the papermaking process, energy distribution, hazardous goods management, maintenance and capital works. The mill holds a dangerous goods licence and all chemicals are stored in accordance with the Dangerous Goods Act 1975 and the Dangerous Goods Storage and Handling (General) Regulation 2000.

Chemical Usage Details

Chemicals are used in the deinking process, for bleaching and brightening pulp, retention and colour control on the paper machine and in the water and wastewater treatment plant. Supplies are held on site in various forms and replacement amounts are brought in regularly. The chemicals used are summarised in ***Table 1***.

Chemical	Purpose
Sodium hydroxide	Pulping of RCF
Sodium silicate	Pulping of RCF
Hydrogen peroxide	Bleaching of RCF
DTPA	Pulping of RCF
Sulphuric acid	pH control on PM
Sodium hydroxide	Headbox cleaning PM
Alum	Water treatment
Urea	Nutrient for activated sludge in WWTP
Soap	Ink flotation in RCF
Sodium hydrosulphite	Brightening of TMP
Phosphoric acid	Nutrient for activated sludge in WWTP
Slimicides	Anti-slime agents in TMP and PM
Dyes	Shade control in PM
Chlorine	Sterilisation in water treatment
Retention chemicals	Fibre retention on PM
Bentonite	Internal water clarification
Polymer	Water clarification and sludge treatment
Lime	pH control in WWTP
Cleaning solvents	Various

Table 1 ALBURY MILL – Chemical currently used on site

2.2 APPROVALS AND ENVIRONMENT PROTECTION LICENCE

2.2.1 Current Approvals

The Albury Mill operates under a variety of consents and licences which include:

- Development consents were granted by the NSW Minister for Planning and dated 12th October 1992, being:
  - DA 147/92 to Australian Newsprint Mills Ltd to install a recycled fibre plant and associated work
  - DA 41/92 to Australian Newsprint Mills Ltd to establish a wastewater reuse scheme

- Development consent was granted by the NSW Minister for Infrastructure, Planning and Natural Resources and dated 7th January 2004, being:
  - DA-389-8-2003-i to Norske Skog Paper Mills (Australia Ltd) for an upgrade to the existing paper machine to increase production from 215,000 tpa to 265,000 tpa and associated works

- NSW Environment Protection Licence No 1272 with a renewal date of 16th February 2011.

- Current Water Access Licence's (WAL005346) with 6250 unit shares of High Security water and (WAL502057) 50 Unit Shares of Domestic water.

2.2.2 Historical Consent Approvals

During the Albury Mill's operating life, three additional consent conditions have been granted and have not been relinquished, being:

- Development permission was granted by the Chief Administrative Officer for the Albury Wodonga Development Corporation to Australian Newsprint Mills Ltd. dated 14th December 1978, being:
  - N56/78.959 to construct a pulp and paper mill

- Development consent was granted by the NSW Minister for Planning and dated 19th June 1991, being:
  - N687 to Australian Newsprint Mills Ltd for the modification to an existing pulp and paper mill by the installation of a newsprint brightening facility

- Development consent was granted by the NSW Acting Minister for Urban Affairs and Planning and dated 23rd January 1996, being:
  - DA 42/95 to Australian Newsprint Mills Ltd for the installation of a second paper machine on the Albury site. The consent was never activated and so the mill continues to operate under the previous consent S92/00191

2.3 WASTE MINIMISATION AND OPERATIONAL EFFICIENCY

2.3.1 Reduce, Reuse, Recycle

The Albury Mill has engaged in a long history of utilising the principles of sustainable manufacturing in Reduce, Reuse, Recycle. This principle is utilised in most areas of the manufacturing process including:

- Forestry Practices
- Renewable Boiler Fuel
- Recovered Paper
- Paper Manufacturing
- Water Efficiency
- Bio-solid Management
- Energy Consumption and Efficiency
- Transportation

Forestry Practices

The Albury Mill has been at the forefront of innovative developments in sustainable forest practices since its inception. These include establishment and tending of dry land and irrigated plantations to the highest standards and development of low environmental impact logging techniques such as wide tyred logging equipment. This has had a dramatic improvement on soil disturbance and turbid runoff from road surfaces. These developments have become wide spread practice in the industry making significant contributions to the high standards of forest practices required by the Albury mill of its pulpwood suppliers.

Renewable Boiler Fuel

The main 80t/hour boiler at the Albury Mill is fuelled by gas with hog (bark from *Pinus radiata*) utilised as an auxiliary fuel. This auxiliary fuel contributes to the reduction of gas consumption by up to 20% depending upon the time of year, as in winter the hog contains more moisture and therefore has lower calorific value.

Recovered Paper

The Albury Mill operates a large scale recovered paper facility which recovers 160,000 tonnes of old newsprint and old magazine grade paper from both post consumer and publisher waste streams. In the early 1990's, the Albury Mill with its publishing partners, pioneered the paper recovery systems and concepts within Australia with the country now achieving a newsprint recovery rate of ~75% which is one of the highest recovery rates globally.

Paper Manufacturing

Paper that does not meet the customer specifications. is recycled back through the process to enable the paper to be repulped and then reused.

Water Efficiency

The Albury Mill operates one the most water efficient paper mills by world standards. Water is used throughout the mill to transport pulp fibre through the various processes. In the TMP and RCF pulp is stored at 10% consistency. The fibre is conveyed onto the paper machine at 1% consistency which requires the paper machine to remove the remaining water to a sheet moisture level of 9%. Throughout these processes, water is recovered, either cleaned or reused in a counter-current manner. This means the cleanest water is used on the paper machine and then reused in the TMP and the then the RCF plant. This allows the mill to operate at very low total water consumption levels.

Bio-solid Management

Bio-solids are a mixture of wastes produced at the mill as by-products of the pulping, recycling and paper making operations and the wastewater treatment process. During the pulping and recycling processes some fibres are produced that are not suitable for use in the paper making process because they are damaged or are the wrong size. These fibres are removed by various processes such as screening. Other materials such as clays and printing ink are removed in the recycling and deinking process and are rejected. All of these rejects are pressed to remove most of the water and the semi-dry material makes up one part of the material known as bio-solids.

Water used in the mill processes is treated to remove dissolved organic matter by a natural process called activated sludge. Bacteria and other micro-organisms consume the organic matter as well as nitrogen and phosphorus added as a food source. The excess bacteria and other micro-organisms are removed and pressed to remove some of the water and this semi-dry material makes up the other component of the material known as bio-solids.

Soils in the Albury region are generally red earths, red podzolics or yellow podzolics and originate from weathered granite. As a result of their origin and age, they are generally lacking in organic material (humus) and nutrients such as nitrogen and phosphorus and they tend to be acidic (have a low pH).

Bio-solids contain about 50% organic matter, reasonable levels of nitrogen and phosphorus as well as amounts of potassium, calcium and magnesium and have a higher pH than most soils in the district. Consequently they are a valuable soil additive.

The Albury Mill has developed a bio-solids land spreading program in conjunction with DECC and local landholders. Land selected for the programme is generally within 35km of the mill on the north side of the Murray River. Dry land is used in winter (lucerne country and sandy soils), while red rising arable land is used for autumn, summer and spring application. Other low lying pasture country may be used for summer and autumn application.

To date the bio-solid application to land has avoided an annual landfill volume of >100,000 tonnes, the management systems used for the bio-solids spreading programme also have avoided the need for long term stockpiles. Occasionally, short term stockpiles have been used for up to one week.

Energy Consumption and Efficiency

The Albury Mill continues to focus and improve its electricity consumption since 1990. Electricity consumption per tonne of paper produced has been reduced from over 3 MWh per tonne to approximately 2.5. This has been as a result of improvements in process efficiency, as well as the introduction of recycled fibre The thermo-mechanical pulping process requires the highest portion of the site's consumption, this process is in contrast with a chemical pulping process whereby energy use is lower but other chemical challenges need to be managed.

The mill has implemented a site-wide power measurement and monitoring system which forms the basis of good power management. The mill has currently a forward energy plan to reduce its total energy consumption by 2% in 2008 and 0.5% in each subsequent year to 2020.

Transportation

In order to deliver finished product to the customer and return recovered paper to the mill, the Albury Mill operates a sophisticated logistics system. This system allows the mill to achieve highly balanced transport loads. This entails the transport of finished product and the back-freighting of recovered paper on the same truck and during the same transport cycle. The balanced load achievement to the Albury Mill is ~90% of all loads

2.4 CURRENT WATER AND WASTEWATER MANAGEMENT

The Albury Mill holds a High Security water allocation of 6250 unit shares to extract raw water directly from the Murray River at Albury. This licence calculates water usage on the net balance of water removed from the Murray River[1].

Currently the mill's net water use is ~3,800 ML pa. Water is supplied to the Albury Mill from the Murray River at Hawksview via a 10km pipeline with a 14km return pipeline to the Murray River discharging at a point adjacent to the Hume Freeway, refer **Figure 5.** The pumps and piping infrastructure used are owned and operated by the Albury City Council (ACC). However, this water infrastructure is separate from the general water infrastructure for the city. The Albury Mill treats the raw water supplied through this infrastructure to papermaking and potable water standards prior to use on the site.

The water supplied to the Albury mill is used within the papermaking processes in a variety of ways. Water use can be categorised as cooling water, process water and potable water. Cooling water is used to cool equipment and processes in a number of parts of the mill and is directly returned to the river. Process water is water used directly in the processes of pulping and paper making It is recycled and re-used a number of times, then it is ultimately processed via a Waste Water Treatment Plant (WWTP) before being transferred to a storage dam adjacent to the mill site, refer **Figure 6.**

Water from the storage dam is then used for the irrigation of ~450ha of plantation pines and perennial pastures[2] as per DA 389-8-2003-I, refer **Appendix 1**. The Wastewater Reuse Scheme (WWRS) normally operates in irrigation mode throughout the late spring, summer and early autumn months (~6-7 months per year) with the treated process water being held in a 2200ML winter storage dam over the cooler parts of the season when irrigation is not possible. In most years irrigation potential for the scheme is ~7ML/ha/year and achieves the reuse of the treated process water produced by the mill operations. After more than 10 years of operation, it has become clear that greater flexibility in how to operate the irrigation scheme is needed in order to deal with issues such as re-use water application rate vs rainfall, soil salt profiles, crop type and crop rotation/harvesting cycles.

Provisions are made within DA 389-8-2003-i Section 3.6 (a), (b), (c), (d) to allow discharge of treated process water to the river under a Winter Release Program[3], refer **Appendix 1**. This condition is reflected in the mill's EPL to be used when either high winter or late spring rains are experienced[4], with the intent of preventing the winter storage dam from overflowing, refer **Appendix 1**.

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[1] net water balance = total water extracted, less, the water returned to the river (currently Cooling Water)
[2] DA 389-8-2003-i Section 3.5
[3] DA 389-8-2003-i Section 3.6 (a), (b), (c), (d)
[4] NSW Environment Protection Licence No 1272. Special Conditions - Section E1 Effluent Discharge Program

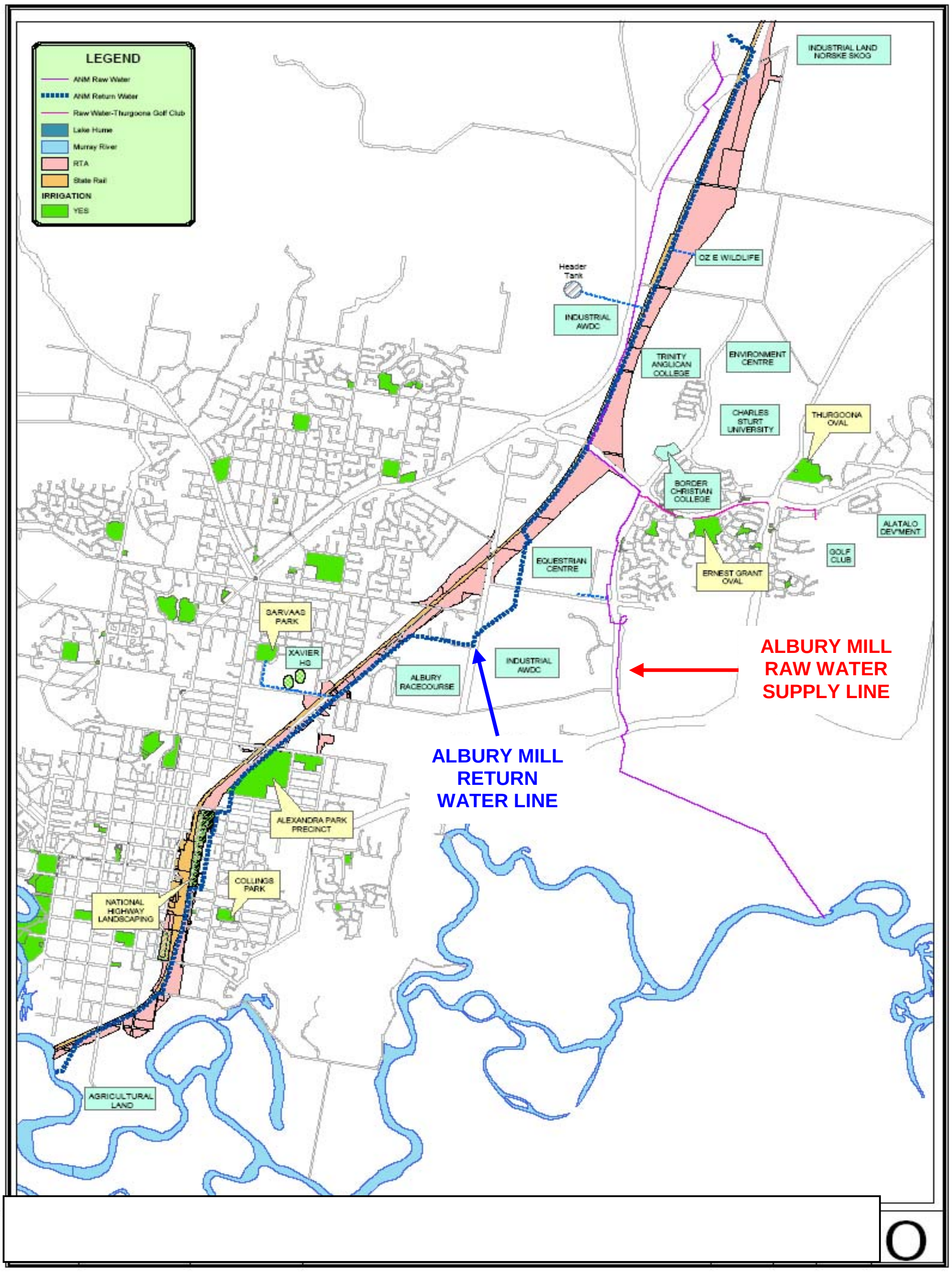

Figure 5 ALBURY MILL – Raw and Return Water Pipelines

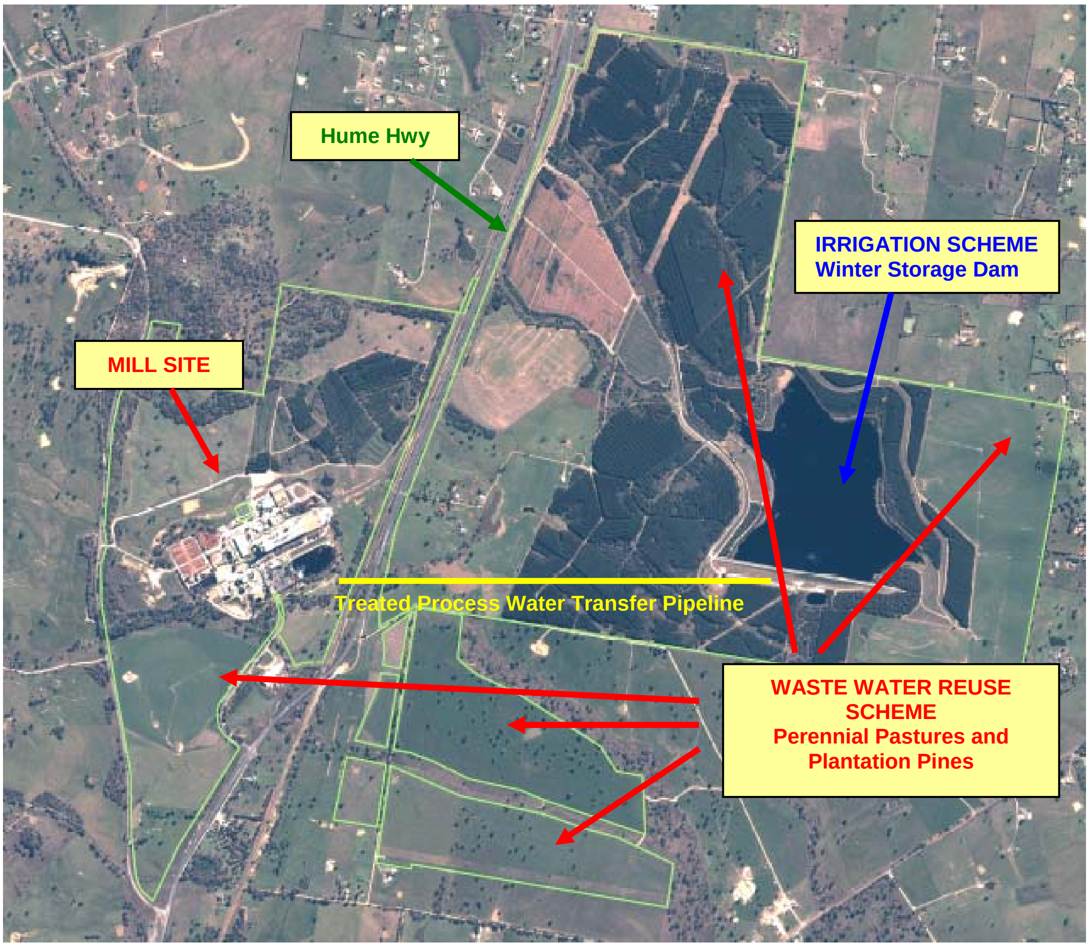

Figure 6 ALBURY MILL - Site and Adjacent Waste Water Reuse Scheme

The Albury Mill is currently operating at better than 'World's Best Practice' in total water use and water efficiency for paper mills[5], refer ***Reference 1***. The performance of the Albury Mill in the area of water use is second to none within the Norske Skog group The water usage per tome of production of all mills is compared in ***Figure 7***, with the Albury Mill being the most efficient. Water management at the Albury Mill is a key operating parameter which is reviewed at all layers within the organisation. The 2007 water mass balance is contained in ***Table 2***. The data in this table show that ≈ 5000 ML is withdrawn annually from the Murray River, of which ≈ 1100 ML is used as cooling water, a further ≈ 1100 ML is used to raise steam, for potable use and to adjust paper sheet moisture, and ≈ 2700 ML is classified as treated process water. The ≈ 1100 ML of cooling water is returned to the Murray River, leaving a net river water usage of ≈ 3800 ML. Of this latter volume, ≈ 2700ML is transferred to the wastewater reuse scheme to irrigate a mixture of plantation

[5] European Integrated Pollution Prevention and Control Bureau (EIPPCB), 2001. Reference Document on Best Available Techniques in the Pulp and Paper Industry, Chapter 4

Pinus radiata and agricultural crops. Logs are being harvested from the plantation and acceptable yields are being returned from the agricultural crops.

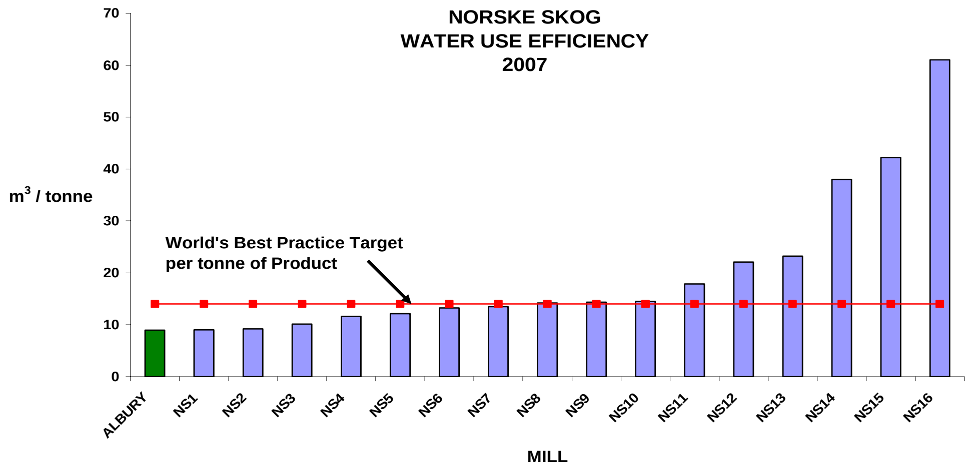

Figure 7 NORSKE SKOG - Water Efficiency by All Mills

NSA WATER MANAGEMENT PLAN		MURRAY RIVER NET VOLUMES		NORSKE SKOG TOTAL VOLUMES USED		NORSKE SKOG TOTAL VOLUMES TO WWRS	
		Daily ML	Annual ML	Daily ML	Annual ML	Daily ML	Annual ML
Current Operations	**Water drawn from Murray River**	**13.5**	**4928**	**13.5**	**4928**		
	Cooling Water			3.0	1095		
	General water (Steam, Potable, Sheet Moisture)			3.0	1095		
	Treated Process Water Used			7.5	2738		
	Treated Process Water transferred to Reuse Scheme					7.5	2738
	Cooling Water returned to Murray River	3.0	1095				
	Treated Process Water returned to Murray River	0.0	0				
	Total Net Water Use	**10.5**	**3833**	**13.5**	**4928**	**7.5**	**2738**

Table 2 ALBURY MILL - 2007 Water Mass Balance

2.5 BIOREGIONAL CONTEXT

2.5.1 The Region

The Murray Region comprises a land area of 122,200 km² and covers substantial areas of both Victoria and NSW. The region is defined by the presence of the iconic Murray River which flows 1460 km from the Hume Dam, west to the South Australian border.

The border between NSW and Victoria is located on the top of the bank on the Victorian side of the river. The Region and 17 local government areas defining the Region are shown in ***Figure 8***.

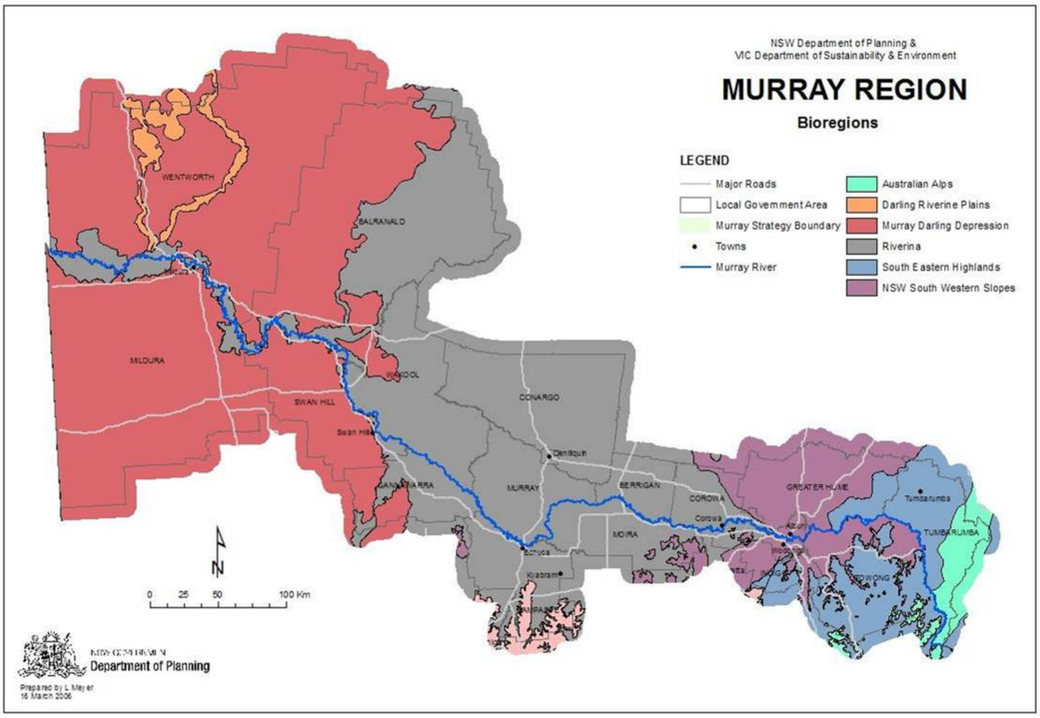

Figure 8 MURRAY REGION - Source NSW Department of Planning

The population of the Murray region is ≈286,000. It had been growing at a rate of 0.4% per annum in the ten year period 1991-2001. The major towns and cities are Albury/Wodonga, Yarrawonga/Mulwala, Echuca/Moama, Swan Hill and Mildura. Anecdotally, the river based communities have been experiencing strong growth since the last census.

Agriculture is the largest employer and the traditional basis of the Region's industry. Large tracts of fertile land and well developed irrigation systems sustain a large and diverse range of agricultural activity. Over half of Australia's rice crop is produced in the Murray

Region, and it is a traditional home for cereals, dairy farming, fruits and vegetables and wool.

Tourism is also a major contributor to the economy. Towns along the river and lakes experience significant population increases during the holiday periods. Industries such as Norske Skog are major employment generators in rural communities and play an important role in local economies.

2.5.2 The Physical Character of the River Murray

The hydrological regime of the River Murray has been heavily modified by human activity. Large dams constructed in the headwaters (such as Hume Weir and Dartmouth Dam) as well as smaller weirs, further downstream, all allow for the controlled release of water downstream for domestic and agricultural purposes. These changes have modified the Murray's naturally variable hydrology, producing more stable flows, both at high and low flow levels, as well as a change in the seasonality of flows. These changes have had significant influence on the physical, chemical and biological nature of the Murray (Thoms *et al*. 2000[6], refer **Reference 2**).

In recent times, flows in the Murray have been held at constant levels for long periods of time during the irrigation period over the summer months. This is perhaps the most important aspect of hydrological change. Constant flow levels are thought to have increased instability of the river channel banks, causing a subsequent reduction of in-channel complexity and habitat diversity due to erosion and sedimentation (Thoms *et al*. 2000). This has made the habitat provided by the off-channel wetlands more important as a refuge and breeding ground for native aquatic fauna.

The River Murray in its natural state had a seasonal cycle of high flows in Spring and low flows in late Summer and Autumn. In very dry years, the river dried up to a series of waterholes made salty by groundwater entering them. In flood years water spread out for large distances over the floodplains, flushing backwaters and billabongs before draining back into the main stream.

In 1917 the River Murray Commission was established to control the rivers flow and ensure that South Australia received guaranteed minimum flows throughout the year.

By 1930 six (6) weirs had been built along the river to regulate water flow and help with irrigation and navigation. Locks form part of the weir structures.

By 1940 five (5) barrages had also been built at the Murray Mouth. These reduce the amount of seawater moving in and out of the mouth due to tidal movement and control the water level in the Lower Lakes and River Murray below the first lock and weir at Blanchtown.

The building of the barrages allowed the construction of pipelines delivering water from Mannum and Murray Bridge to Adelaide and other towns (called the River Murray Urban Users Region).

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[6] Thoms, M.C., Suter, P., Roberts, J., Koehn, J., Jones, G., Hillman, T.J. and Close, A. (2000). Report of the River Murray scientific panel on environmental flows: River Murray - Dartmouth to Wellington and the Lower Darling River. Murray-Darling Basin Commission, Canberra: 168 pp.

2.6 THE EXTENT OF SALINITY IN THE MURRAY DARLING BASIN

Salt is a recognised problem in the Murray Darling Basin and in particular, the Murray River, as salt accumulates through the basin which ultimately feeds the Murray. In 1999, the Murray Darling Basin Ministerial Council commissioned a Salinity Audit of the Basin. The audit provides a comprehensive account of the main sources of salinity in the Basin and predicts potential salinisation over the coming 100 years.

The findings of the audit are that substantial economic and environmental damage will continue to occur in the Murray Darling Basin without radical changes to land and water management. The audit found that:

- 3 to 5 million hectares will become salinised by 2100
- Salinity in the Lower Murray will increase 50% by 2050
- Salt loads in the Macquarie Namoi, Loddon, Lachlan and Avoca catchments will more than double by 2050
- Agricultural productivity decline and infrastructure losses in the Basin will cost $1 billion per year by 2100
- The Macquarie Marshes, Great Cumbungi Swamp, Avoca Marshes, the Chowilla complex and other wetlands will suffer major environmental damage.

Less than half of the salt mobilised in the Basin is flushed out to sea. Most is deposited within the Murray Darling region, mainly in irrigation areas and floodplain wetlands.

While irrigation areas have been the source of large volumes of salt, effective management systems are being put in place to arrest this trend. In future, the Salinity Audit shows, the main source of increased River Murray salinity will be dryland farming and grazing rather than irrigation.

According to technical evidence collected during the audit, 60% of increased salinity predicted for the Lower Murray will come from dryland areas. More than half of this (37%), will come from the Mallee region of the Lower and Middle Murray. The rest will come from dryland catchments in Victoria, New South Wales and Queensland.

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CHAPTER THREE

3 PROJECT PROPOSAL – 'GREEN OFFSET' SCHEME

3.1 BACKGROUND

Green offsets are a way of having both economic development and environmental protection. A green offset is action taken outside a development site (but near it) to reduce pollution. The developers either take action themselves or pay for others to do it on their behalf. A green offset scheme ensures that there is 'no net impact' from development. Any additional pollution that is generated by a development is offset by action taken off-site that reduces at leats that amount of the same pollutants, refer ***Reference 3***.

The Albury Mill is applying to implement a 'green offset' for salinity. The mill proposes to take part in a 'salinity offset' by funding the operational and maintenance component of a salinity abatement scheme located at Walla Walla NSW and commencing a partial discharge of its treated process water to the Murray River at Albury. The offset will be calculated at a 2:1 ratio whereby for every one tonne of salt discharged at Albury two tonnes will be abated at Walla Walla, thereby providing an overall benefit to the Murray Darling Basin.

Coupled with the introduction of this arrangement will be the ability of third parties to access a combination of cooling water and treated process water from the mill's return water pipeline for irrigation purposes only.

It is proposed that these arrangements by placed under a 'proof of concept' stage for five years allowing for further technical analysis, trials and community input to be sought. In essence the proposal will be applied research. The following headings help guide the discussion through the topic.

- Green Offset Principles and NSW Government Policy
- Albury Mill Discharge at the Murray River
- Billabong Creek Salt Interception Scheme
- What are the Salinity Impacts at Morgan
- Proof of Concept – Salinity Offset Arrangement between Norske Skog and DWE
- How does the Proposal fit with current NSW Government Policy
- Proposed Albury Mill Water Management Regime
- Third Party Irrigation Systems
- Changes to the Albury Mill Wastewater Treatment Plant
- Changes to the Wastewater Reuse Scheme Irrigation Scheme
- Benefits of the Proposal
- Project Staging
- Project Proposal Summary

3.2 GREEN OFFSET PRINCIPLES AND NSW GOVERNMENT POLICY

In 2002, the NSW government investigated and ultimately developed a policy on Green Offsets[7], refer ***Reference 3.*** This policy set out several principles for the operation of offsets, including:

- On-site pollution reduction should be optimised;
- Offsets must not reward poor environmental performance;
- Offsets must be consistent with and complement broad environmental objectives;
- The pollutant must be suitable for an offset and the offset must be for the pollutant discharged;
- They must offset the impact in the same area;
- They must offset the impact of the development for the period that the impact occurs;
- The pollution impacts and offset benefits must be reliably estimated;
- The offset should result in net environmental improvement;
- The offset must be enforceable using licence conditions;
- Design of an offset should maximise community acceptance and environmental benefit.

In 2005, the Commonwealth Government introduced a National Market-Based Instruments Pilot Program, under the National Action Plan for Salinity and Water Quality, to evaluate pilot offsets. The then Department of Environment and Conservation (DEC) / NSW Environment Protection Authority (EPA) was successful in its application for pilot program funding and subsequently undertook an investigation into the feasibility of green offsets at three separate locations. Norske Skog Albury Mill was one of the chosen locations for a pilot study. The pilot studies and investigations[8], refer ***Reference 4,*** resulted in the development of the DEC 'Institutional Framework'[9] for implementing salinity offsets refer ***Reference 5.*** This current policy sets out the Guiding Principles[10] for the operation of offsets.

3.3 ALBURY MILL DISCHARGE AT THE MURRAY RIVER

It is proposed to discharge a quantity of treated process water via the mill's current return water pipeline to the Murray River on a daily basis. The treated process water will be combined with the current cooling water discharge via this same pipeline. The volume of treated process water to be discharged will be ≈ 3ML /day containing a maximum of 5 tonnes of salt.

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[7] Green Offsets for Sustainable Regional Development – Concept Paper NSW Government, May 2002

[8] Green Offsets for Sustainable Regional Development – ID16 Final Report, August 2005

[9] Institutional framework for implementing salinity offsets under the Protection of the Environment Operations Act 1997

[10] Institutional framework for implementing salinity offsets under the Protection of the Environment Operations Act 1997. Guiding Principles Section 2.1

The mill discharge water enters the Murray River adjacent to the new Hume Freeway river crossing at Albury. ***Figure 9*** shows the location of the discharge pipe in relation to the Hume Freeway river crossing.

Figure 9

Location of the mill return water discharge pipeline to the Murray River, shown by red arrow.

The mill discharge is via the current multi-point diffuser located at a point which ensures the rapid mixing of the treated process water and cooling water with the river water. The design criteria and installation for the diffuser used is as per a study[11] (refer **Appendix 3**) carried out in January 1979 and in part is as follows:

> *"Purpose and NSW State Pollution Control Commission Requirements*
> It is proposed that a diffuser be constructed at the point of discharge to ensure rapid mixing of the treated effluent with the river water. It is desirable that at minimum river flow the diffuser should not be visible and that it should not present a hazard to navigation by small craft.
>
> The degree of initial mixing achieved is largely a function of exit velocity, port diameter and number and spacing of ports. The minimum river flow in the stretch of the river in which the water is to be discharged is estimated to be about 800 ML/d and hence the maximum possible dilution of the 20 ML/d discharge will be 40 to 1. The SPCC have not as yet determined the licence conditions for discharge to the river and therefore it is not possible at the stage to finalise the diffuser design. The following sections discuss possible approaches.
>
> *Location*
> The diffuser is to be located on a bend in the river immediately upstream of the Sydney-Melbourne railway bridge[12], [**refer *Figure 10***]. No information is available regarding river cross section or bed stability at this point. It is recommended that prior to detail design a survey be made of bed movement. However river cross sections have been obtained for the Doctors Point and the Union Bridge gauging stations and these have been used for dispersion analysis."

[11] Albury Wodonga Development Corporation, Return Water Line from ANM Mill, Preliminary Design Report Ref No 1361/64, Section 11 Diffuser. Gutteridge, Haskins and Davey Jan 1979.
[12] Albury Wodonga Development Corporation, Dwg No 1361-66/2 ANM Return Water Line, Diffuser Plan and Section. Norske Skog DWG No 0181-0032/A

"Multi-port Diffuser
This consists of a header pipe laid beneath the river bed with several smaller diameter branches projecting above the bed[13] [refer ***Figure 11***]. Normally the branches or ports terminate in a right angle reducing bend which acts as a nozzle. Some form of deflection system may be desirable on the upstream side of each port to encourage logs to ride over them. Construction would obviously have to be carried out at a time of low river flow.

The theoretical aspects of multi-port diffusers[14] is given in [**Appendix 3**], which is taken from an internal GHD Technical Bulletin. The theory is generally used for ocean outfalls but, with restrictions because of boundary conditions, the principles apply for a riverine situation.

The basic theory is that the initial momentum of the effluent is rapidly dissipated by turbulent mixing with the surrounding river water. The momentum effect is dependant upon port diameter and exit velocity. With this energy gone the effluent plume will rise to the surface if its density is less than that of the river water. The diluted effluent forms a surface field which is further dispersed by means of diffusion and natural turbulence in the river, [refer ***Figure 12***].

The temperature of the effluent will be higher than that of the river. Even a small temperature difference can have a significant effect on the rate of rise of the effluent plumes.

A preliminary analysis was made on the basis of vertical ports and using the following data:

Effluent discharge	20 ML/d
River flow	800 ML/d
River velocity	0.1 m/s
River depth	2.5 m
Diffuser	6 x 150 diameter ports @ 1.5m spacing
Effluent temperature	20° above that of the river

The calculated results were:

Average dilution of the surface field	10 to 1
Centreline dilution 200 metres downstream	33 to 1

The maximum dilution possible of a flow of 20 ML/d into one of 800 ML/d is 40:1."

***Figure* 12** shows details of the mixing process.

It is noted that the diffuser was designed for up to 20ML/day discharge of a combination of cooling water and treated process water. The proposed discharge for this current application, excluding cooling water, will vary according to that required to achieve the

[13] Albury Wodonga Development Corporation, Dwg No 1361-66 - 43 ANM Return Water Line, Diffuser Details. Norske Skog DWG No 0181-0033/A

[14] Albury Wodonga Development Corporation, Return Water Line from ANM Mill, Preliminary Design Report Ref No 1361/64, Appendix 3, Theory of Multiple Port Diffuser. Gutteridge, Haskins and Davey Jan 1979.

minimum dilution of 600:1, but for the purpose of calculations, an average of 3ML/day discharge is used. It is therefore assumed in subsequent sections of this application that the minimum dilution at the surface field will be 60:1.

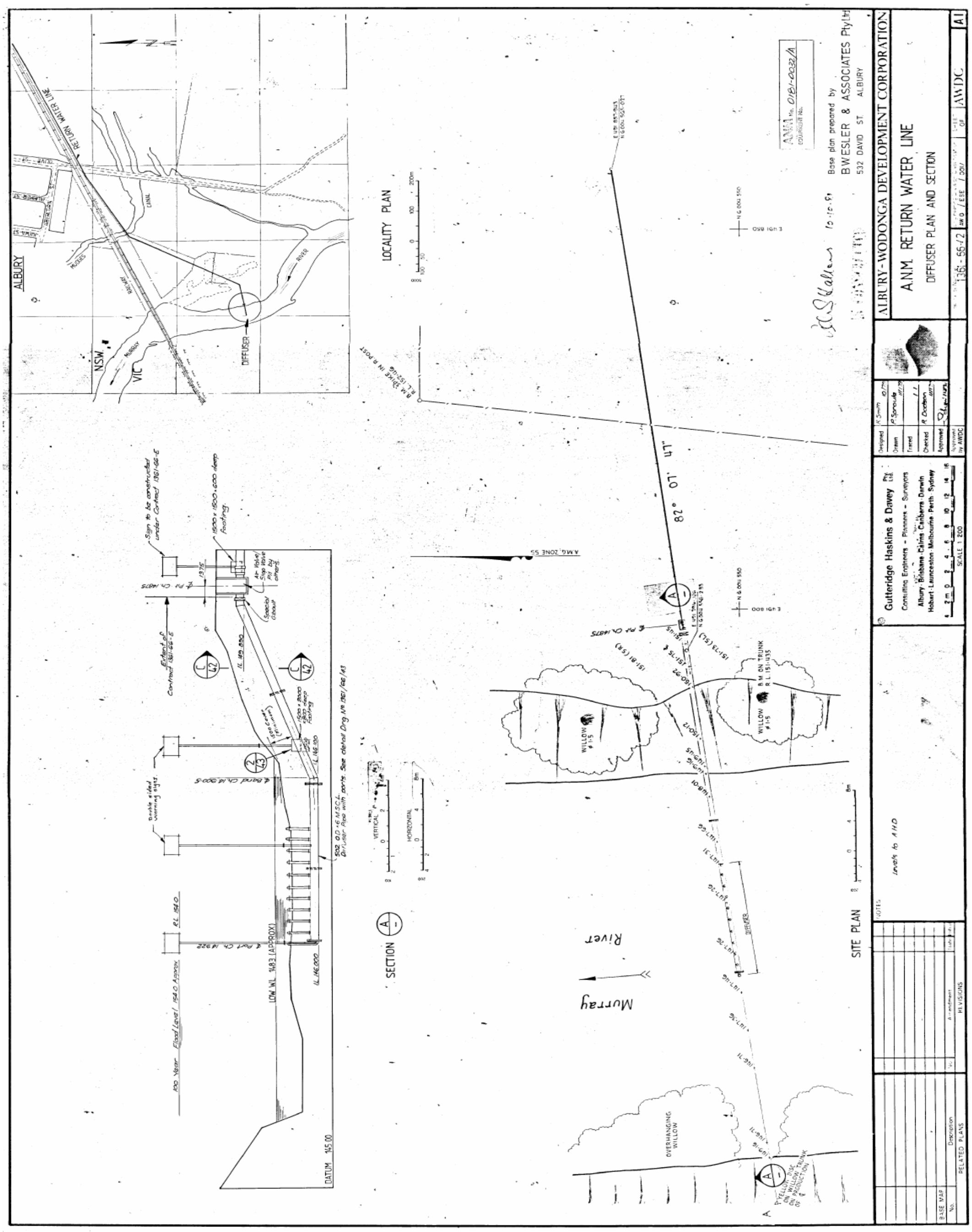

Figure 10 ALBURY MILL - Location of Return Pipeline Diffuser in Murray River

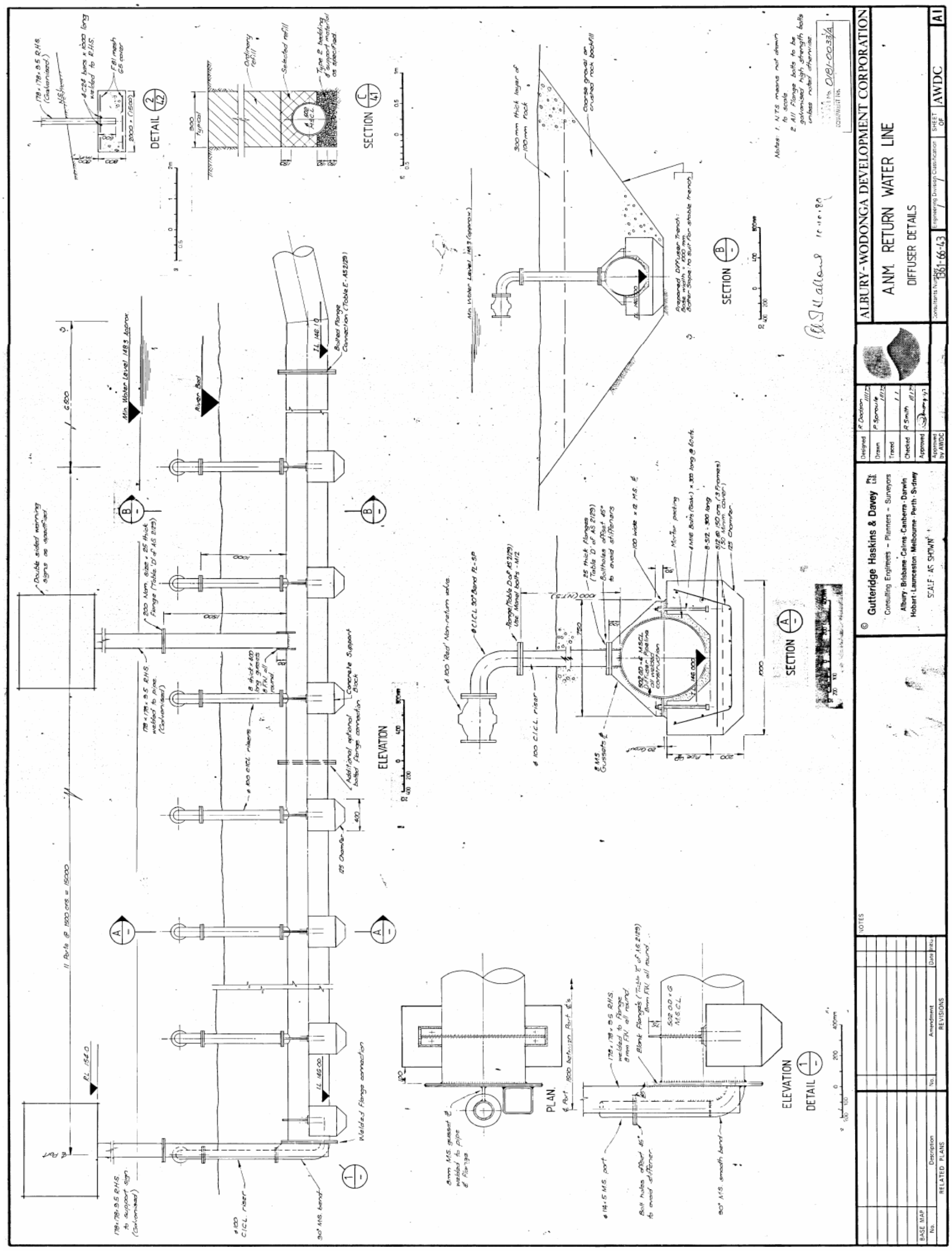

Figure 11 ALBURY MILL – Section Details of Return Pipeline Diffuser in Murray River

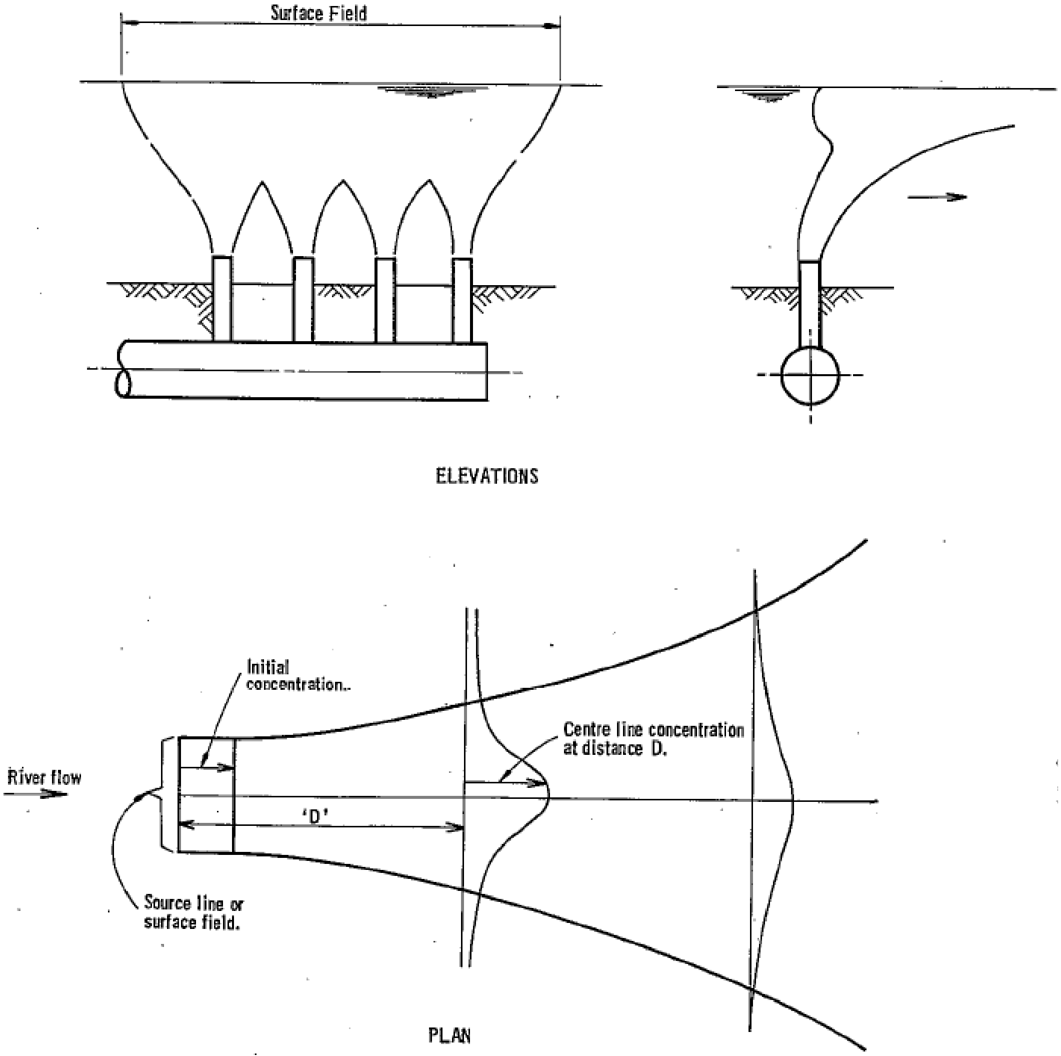

Figure 12 ALBURY MILL – Return Waterline from mill - Diffusion of the Effluent Report Ref No 1361/64

Murray Darling Freshwater Research Centre re Diffuser Mixing Zone

Between 1992 and 1999, a comprehensive wastewater monitoring program was conducted by the Murray Darling Freshwater Research centre for Norske Skog. The program was designed to comply with the mill's wastewater discharge licence conditions issued by the NSW EPA and was reviewed annually by the NSW EPA, DLWC and NSW Fisheries. A part of the program was designed to understand the mixing zone area at the Murray River adjacent to the diffuser.

The annual reports show in general that no detectable difference can be seen in water quality either above or below the mixing zones. Extracts from those reports, (refer **Appendix 7**), conclude that:

> "Generally, most of the data show little (if any) variation between sites although, there may be significant variation over time (seasonal effects)[15]".

> "The quality of ANM's discharged wastewater is best described by its conductivity for the purposes of this study. Conductivity measurements were reliable, reflect hardness and alkalinity and indicate changes to wastewater processing… The mean conductivity of the river over both periods was stable at 60uS, the influence of the discharge on the physio-chemical parameters undetectable even at low flow periods[16]".

> "There was no measurable difference between the sites before, during or after the discharge[17]".

The sites referred to are the 6 monitoring sites used during the program. The sites are located ~1-3km upstream, 200m and 1km downstream of the discharge point. In other words, at the site 200m downstream from the discharge point, the treated process water was fully mixed with the river water, even when the river flow was low.

Conclusion

It is concluded that the original discharge diffuser design, which is still in current use, will operate in a successful manner when discharging a combination of cooling water and treated process water. This is supported by its successful utilisation until 1996 with a permanent discharge of both cooling water and treated process water, from 1996 to the current time with permanent discharge of cooling water and an intermittent discharge combination including treated process water. It is planned to implement periodic monitoring of the mixing zone on the successful approval of this application.

3.4 BILLABONG CREEK SALT INTERCEPTION SCHEME

Norske Skog Albury Mill proposes to fund the operations and maintenance of the Billabong Creek Salt Interception Scheme (BCSIS). The BCSIS is an existing scheme development by the Department of Water and Energy and is located on the Billabong Creek adjacent to the township of Walla Walla NSW, refer ***Figure 13***, on a property called Longerenong, refer ***Figure 14.*** An aerial photo of Longerenong is shown in ***Figure 15***.

The impacts from the operation of the scheme are not part of this assessment as the BCSIS was assessed and approved by DWE under Part 5 of the Environmental Planning

[15] Murray Darling Freshwater research Centre, H M King, 1994 Annual Report – Biological and Chemical Monitoring, Section 3.2.1 Water. Ref YH/6/21/1

[16] Murray Darling Freshwater research Centre, H M King, 1997 Annual Report – Biological and Chemical Monitoring, Section 3.2.3 Response to Alteration of Discharged Wastewater Quality. Ref YH/6/21/1

[17] Murray Darling Freshwater research Centre, H M King, 1999 Annual Reports of Biological Monitoring, Section 5 Discussion. Ref YH/6/21/1

and Assessment Act 1979, and a groundwater licence (50BL199858) was subsequently issued. The scheme has been in intermittent operation since 2003 due to the requirements to maintain water flows during the current drought conditions.

3.4.1 Location

The BCSIS will prevent 10 tonnes of salt/day or approximately 3,000 tonnes of salt/year from entering the Billabong Creek and ultimately the Murray River. Modelling work undertaken as part of the work described in **Appendix 4** indicates that the impact at Morgan is to lower Murray River salinity levels by 0.1 EC units. (Note: Morgan is located on the Murray River in South Australia and is the nationally accepted benchmark location for the measurement of salinity within the MDB), refer ***Figure 16.***

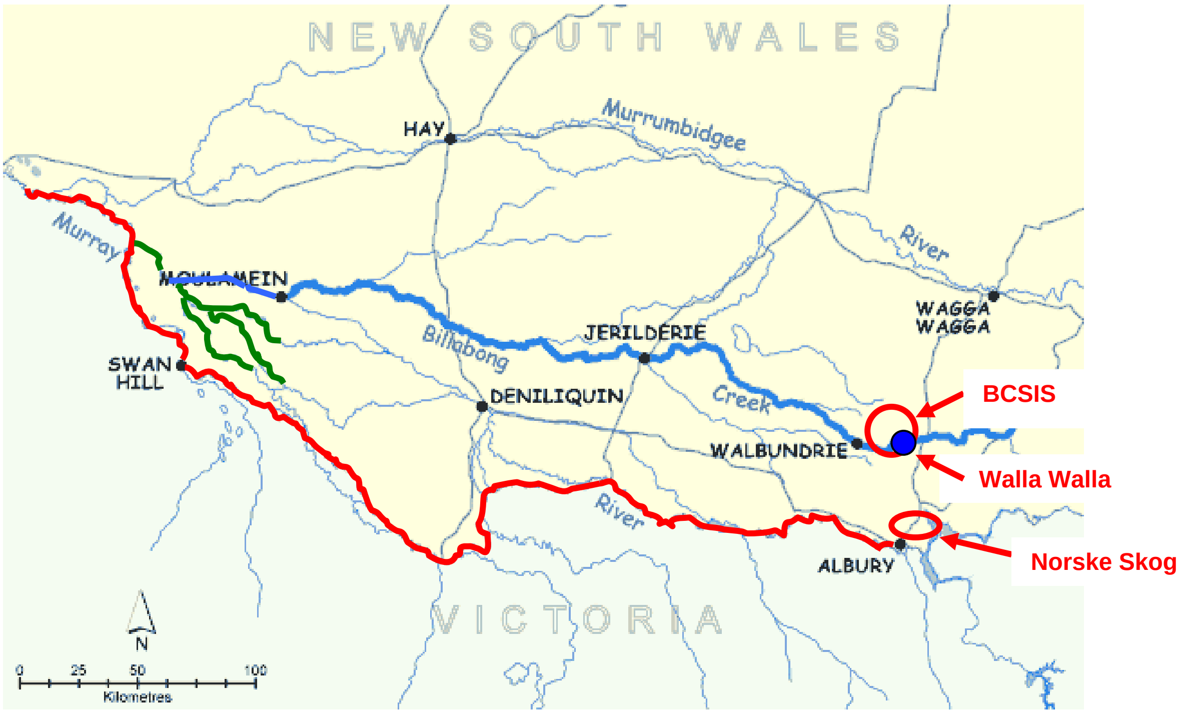

Figure 13 Location of Billabong Creek Salt Interception Scheme

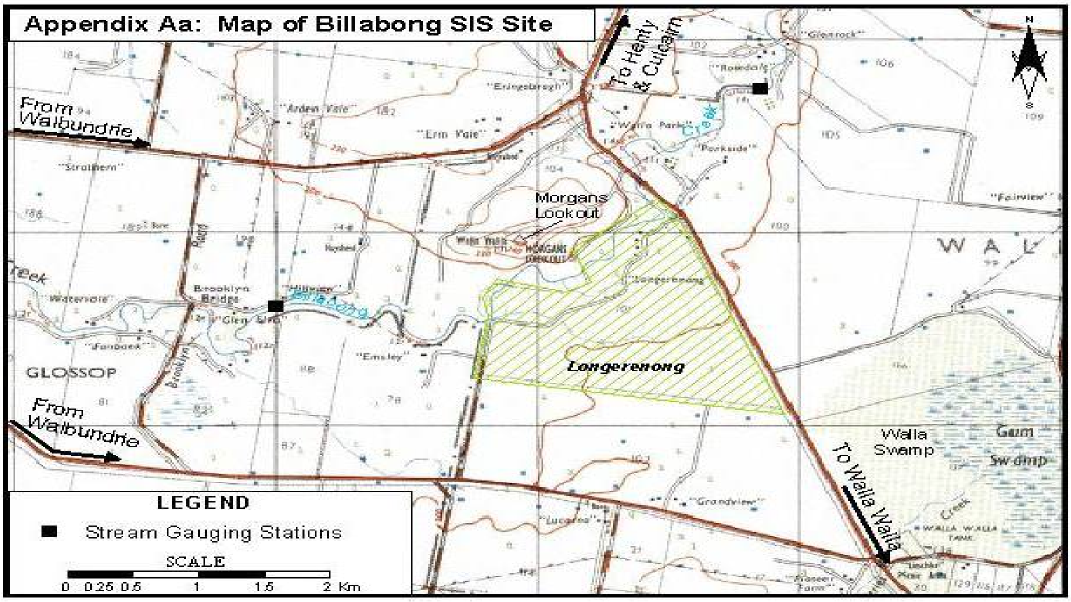

Figure 14 Location Map of Longerenong

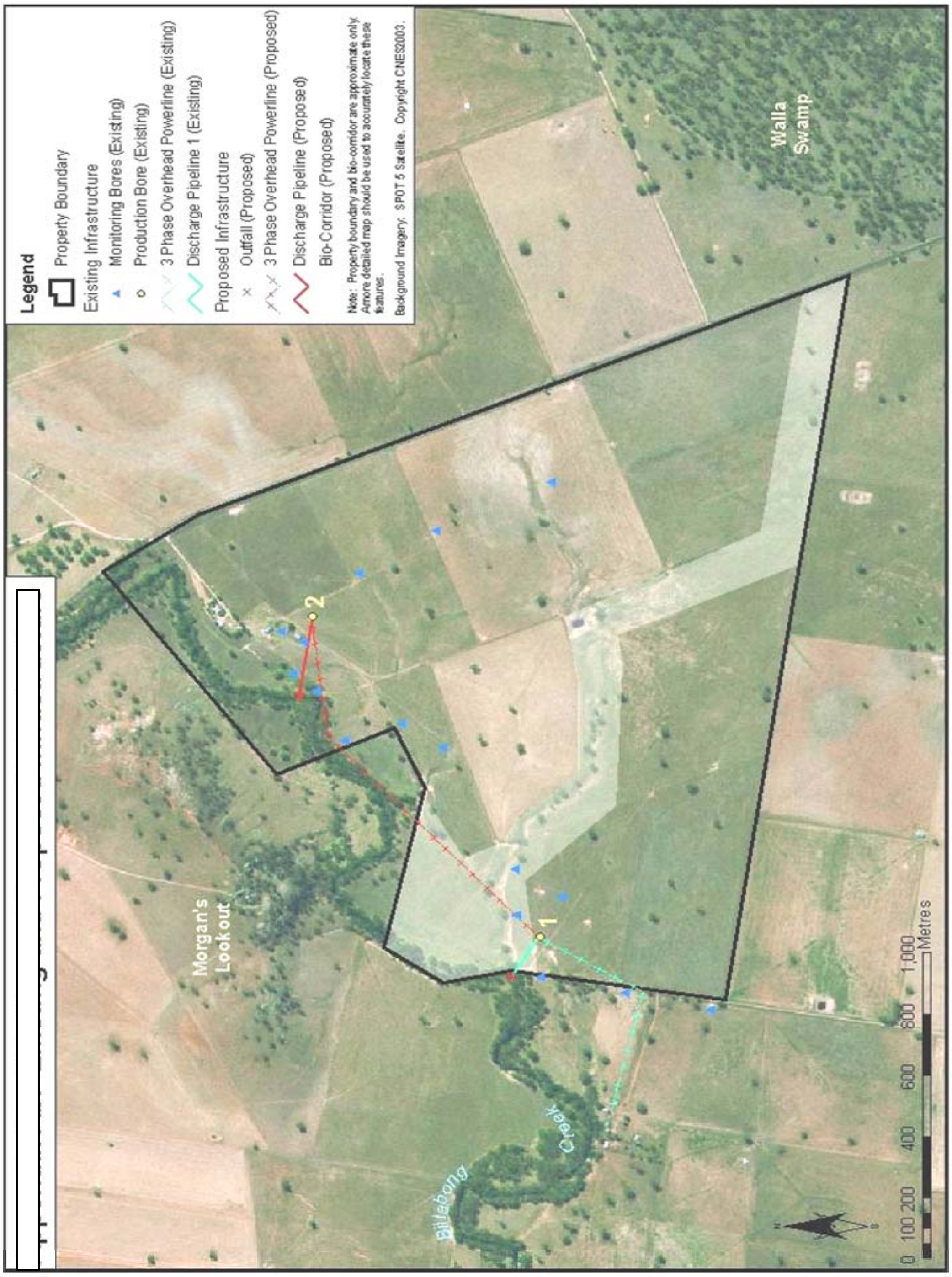

Figure 15 Aerial Photo of Longerenong

Figure 16 Murray Darling Basin

3.4.2 Billabong Creek Salt Interception Scheme Description

The Billabong Creek catchment is located between the Murrumbidgee and Murray catchments in southern NSW and has been identified as having a high salt load in its upper catchment, refer **Appendix 4**. Its upper reaches flow through a rainfall region of 500-800 mm/year, which has been identified as a zone of high risk with respect to salinisation, and where salinity levels can increase significantly[18], refer ***Reference 6.***

Salinity levels at Walbundrie have been reported to be increasing from approximately 1,300 $\mu S\ cm^{-1}$ by about 4.7% per year, by far the highest increase in the Riverina-Murrumbidgee region[19], refer ***Reference 7.*** Studies of salinity levels in Billabong Creek have identified several reaches of the creek where substantial inflows of saline groundwater occur, with a 1,000µS/cm increase in salinity attributed to one particular section[20], refer ***Reference 8.***

Approximately 40 km to the NNW of Albury, Billabong Creek passes a feature known as Morgan's Lookout on its way to join firstly the Edward River and eventually the Murray River almost 400 km to the NW of Albury.

There are significant geological features in the Morgan's Lookout vicinity that have been demonstrated to favour removal of salt from the catchment. The area near Morgan's Lookout has been the subject of substantial government scientific investigation over a number of years by the MDBC and DWE. These investigations have been summarised in a report prepared by DWE and reproduced in full in **Appendix 4**. A groundwater interception and pumping scheme has been established on the property known as "Longerenong" and is currently being operated by DWE under emergency conditions due to the region's enduring drought conditions. Long term funding arrangements are subject to this application process. An explanation of how the BCSIS works is as follows:

Figure 17 shows a conceptual plan view of a section of Billabong Creek, near Morgan's Lookout. It is bounded to the north and south by a granite outcrop and subcrop. **Figure 18** shows a conceptual cross section of an approximately north-south transect in that region. The construction of both of these conceptual diagrams is based on information obtained from Williams and Kulatunga[21], refer ***Reference 9.***

The granite subcrop provides an impervious under layer to a palaeochannel[22] that has been laterally constricted to the south of Morgan's Lookout. This lateral constriction has lead to a shallow saline aquifer releasing its salt load into Billabong creek in this region.

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[18] D.R. Williamson, G. Gates, G. Robinson, G.K. Linke, M.P. Seker and W.R. Evans, "Salt Trends – Historic trend in Salt Concentration and Saltload of Stream Flow in the Murray – Darling Drainage Division", MDBC Dryland Technical Report No1, 1997

[19] Pauline English, Peter Richardson, Mirko Stauffacher, "Groundwater & Salinity Processes in Simmons Creek sub-catchment, Billabong Creek, NSW." Technical report 24/02, CSIRO Land and Water, Canberra, 2002

[20] I.D. Jolly,et al, Historical stream salinity trends and catchment salt balances in the Murray-Darling Basin Australia, Marine and Freshwater Research, 52(1) 53-63 (2001).

[21] Michael Williams, Nimal Kulatunga, "Morgan's Lookout Salt Interception Scheme – Hydrogeological Framework." CNR 2001.080, Department of Land & Water Conservation, 2001

[22] Definition of Palaeochannel: An old river bed formed at a time when the geology and climate of an area was different, with generally higher rainfall. Subsequent changes have seen the river bed, which would be mostly sand and gravels, buried by further cover sediment. The sands and clays (in minor amounts) are inter-layered and are generally highly variable and difficult to characterise.

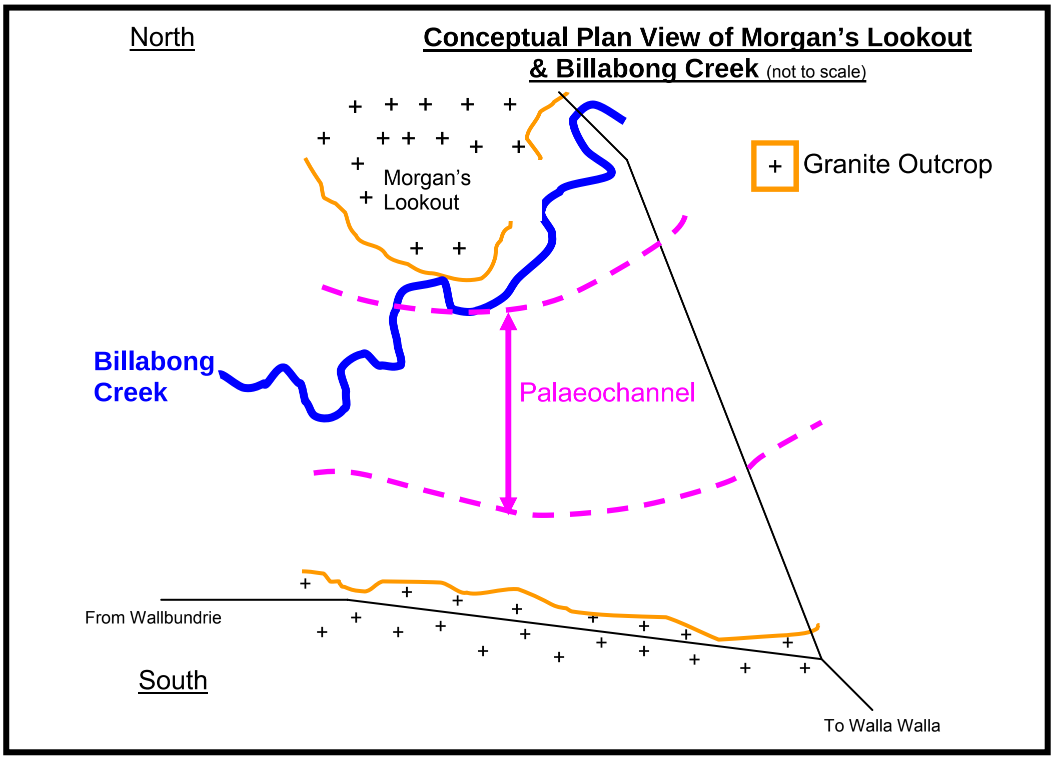

Figure 17 BCSIS - Conceptual Plan View of Morgan's Lookout

Two aquifers occupy the palaeochannel below Billabong Creek. The Cowra formation is a shallow upper aquifer that contains pockets of salt that result in salinity levels between 400 and 10,000 µS cm^{-1}. Near Morgan's lookout, the Cowra formation narrows significantly, resulting in its saline ground water seeping into Billabong Creek. An additional contributing factor to this incursion of saline water into the creek is the upward pressure from the underlying Lachlan formation of lower salinity, ranging from 400 – 1,600 µS cm^{-1}. Its water pressure level is currently above the saline water table of the more saline Cowra formation and therefore forces the overlying saline groundwater into the creek.

The reduction of salt entering Billabong Creek is achieved through the manipulation of water levels in the underlying aquifers. Lowering the pressure level of the lower, fresher aquifer will reduce the pressure currently forcing the saline water from the shallow Cowra formation into Billabong Creek. This is the basis for the salt interception scheme, and is illustrated conceptually in **Figure 19.** One production bore has been drilled to pump sufficient low salinity water from the deeper aquifer to lower its pressure level, thus easing the pressure on the shallow saline aquifer. It was operated in 2003 and more recently in 2006. Excessive drawdown in a single location could result in downward leakage of saline water from the Cowra to the Lachlan formation, so an additional bore could be installed, should the need arise, to withdraw the required volume over a sufficient area to prevent downward salt leakage. The proposed location of this second bore, should it be needed, is also indicated in **Figure 19**.

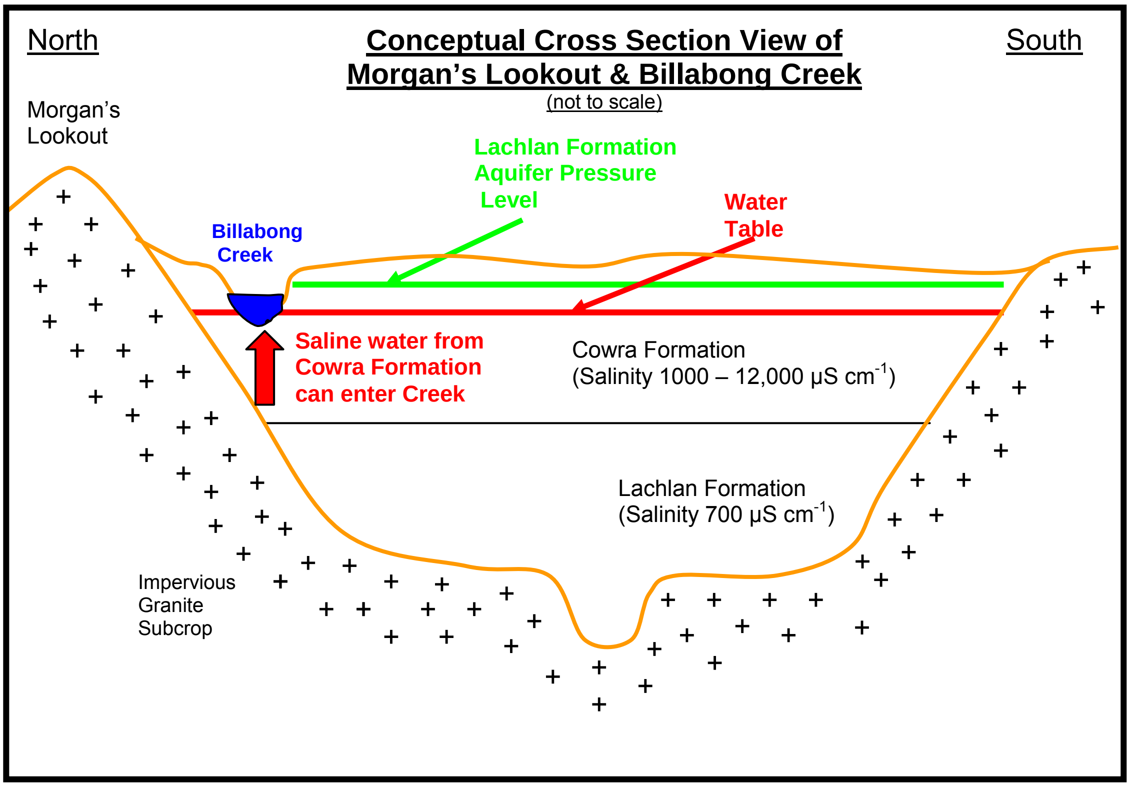

Figure 18 Conceptual Cross Section View of Morgan's Lookout & Billabong Creek

Salt seepage into Billabong Creek is greater when creek flows are less than 320 ML/day, refer **Appendix 4**, so pumping will only occur on these days (around 300 days per year). As the salinity level of the Lachlan formation aquifer can also vary, pumping is to be restricted to days when the salinity is below 930 µS cm^{-1}.

It will be necessary to demonstrate compliance of the BCSIS against the targets of removing 3,000 tonnes of salt. This will be achieved by monitoring a variety of parameters and through the analysis of operational data. The operational and monitoring requirements to be followed by DWE are described in detail in **Appendix 4**. These environmental and operational monitoring requirements will be incorporated into the agreement between DWE and Norske Skog as key performance indicators.

Environmental monitoring of the BCSIS scheme impact will be undertaken by DWE through in-stream salinity measurements, groundwater levels and comparison with long term records. Operational monitoring will include pump operational data and groundwater level and quality.

Analysis and reporting on the data will be undertaken on an annual basis by DWE and will be included in Norske Skog's annual report to DECC. The annual compliance report will show the salinity and water balances achieved by the BCSIS and Norske Skog discharges as well as the offset ratio achieved.

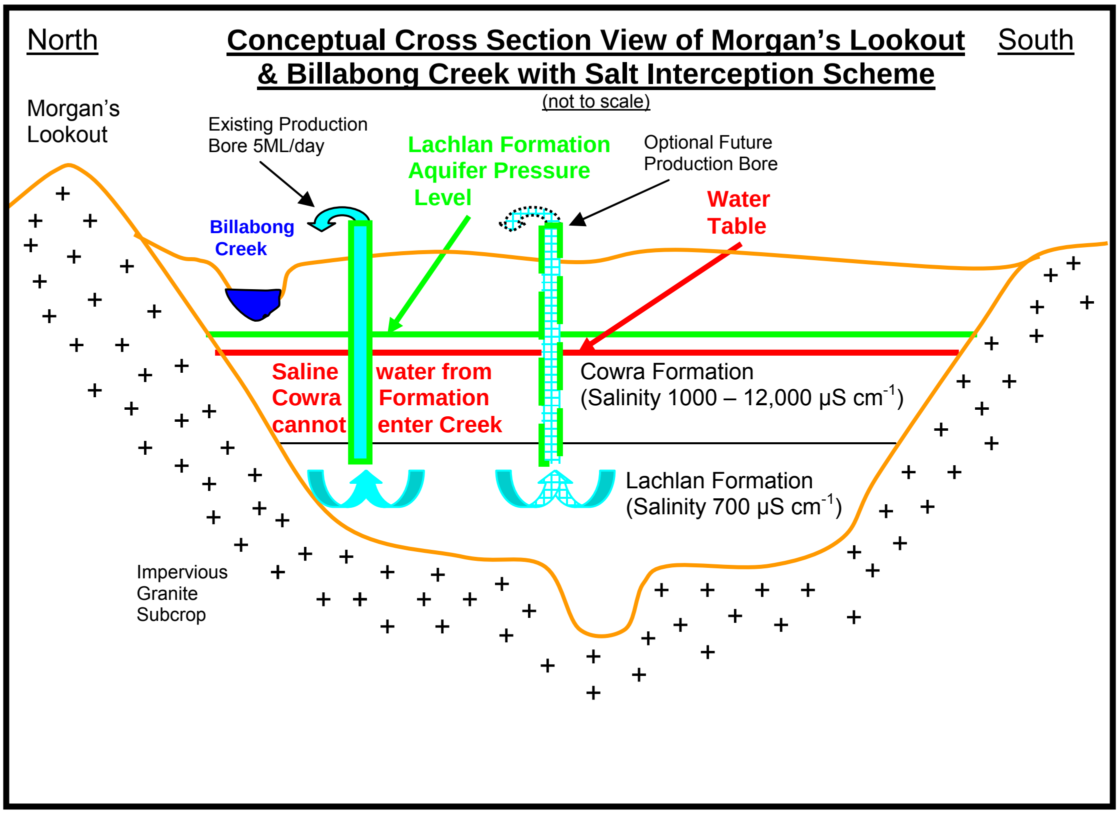

Figure 19 Conceptual Cross Section View of Morgan's Lookout & Billabong Creek Including the Salt Interception Scheme

3.5 WHAT ARE THE SALINITY IMPACTS AT MORGAN?

Many factors affect the salinity of the Murray River. The MDBC uses salinity (measured in EC units) at Morgan SA as the benchmark for assessing the impact of salt remediation works on the salinity of the Murray River. The salinity reduction at Morgan achieved by the BCSIS currently operated at Longerenong is around 3,000 tonne of salt per year. This is considered equivalent to 0.1 EC units, refer **Appendix 4**.

A modelling study was jointly undertaken by DWE, Norske Skog and the Murray Darling Basin Commission (MDBC) in which the impact of various water discharge scenarios on Murray River salinity at Morgan SA was assessed[23], refer **Appendix 5**. Various other constraints were also applied, including a dilution criteria for the water at the point of entry to the Murray River at Albury ranging from no dilution, to 600:1 to 1,000:1.
These various conditions were modelled using the MDBC benchmark 25 year river flow model. The results of these models are summarised in **Figure 20** and **Figure 21. Figure 20** plots the salinity impact (in EC units at Morgan) against the actual treated process water

[23] Background and summary of Murray River salinity modelling for a potential Norske Skog Albury Mill 'salinity offset' project.

flow that can be released under various scenarios. **Figure 21** plots the same information against the associated salt load contained in the respective treated process water flows.

For any given maximum river water flow, the amount of treated process water that can actually be discharged is constrained by the allowable in-river dilution. If no treated process water in-river dilution is imposed, then close to the maximum volume can be released, with the consequential larger impact on EC. As the in-river dilution requirement increases, less treated process water can be released with the consequential lowering of the amount of salt and hence impact on EC at Morgan.

The crucial information from **Figure 20** and **Figure 21** in so far as this application is concerned, is that at the lowest modelled treated process water discharge flow (4ML/day), the impact on salinity at Morgan is negligible, regardless of the treated process water dilution constraint. This additional treated process water will result in an average maximum of 5 tonnes/day of salt entering the river, whilst the BCSIS will prevent double this amount entering the Murray River on a daily basis. The impact of the additional salt load released in treated process water may be mitigated further by timing releases to coincide with high summer flows in the river which are experienced when water is released for downstream irrigation.

It is proposed that the offset calculations will be aggregated over a twelve month period with the anticipated operational days for the BCSIS being 300 days and the discharge of treated process water from the Albury Mill being 275 days.

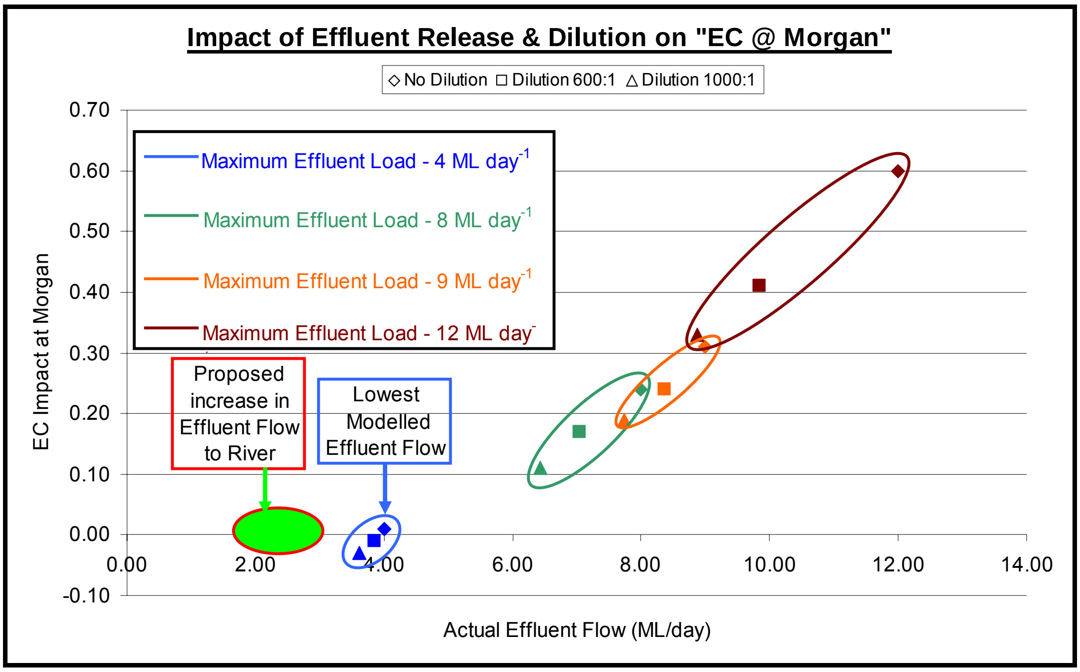

Figure 20 Impact of Treated Process Water Volume on EC at Morgan For Various Treated Process Water Dilution Constraints and Volumes Discharged

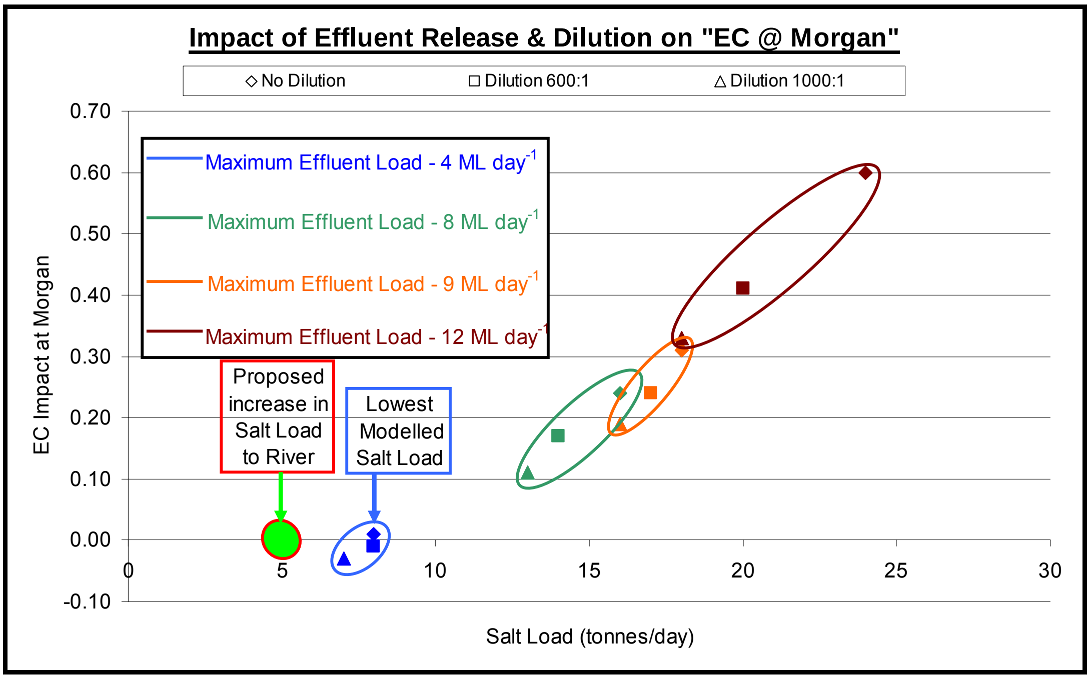

Figure 21 Impact of Salt Load on EC at Morgan for Various Treated Process Water Dilution Constraints and Volumes Discharged.

3.6 PROOF OF CONCEPT - SALINITY OFFSET ARRANGEMENT BETWEEN NORSKE SKOG & DWE

Norske Skog proposes to discharge treated process water containing up to 1,500 tonnes of salt per year to the Murray River at its current discharge point at the Murray River in Albury. The modelling work carried out by DWE and Norske Skog indicates that the Murray River salinity impact of this quantity of water discharge under the arrangements proposed will be negligible at Morgan (around -0.01EC). The tonnes of salt discharged in the Albury Mill's treated process water would be up to half of the tonnes of salt intercepted by the BCSIS, (an offset ratio of 2:1).

It is proposed that Norske Skog and NSW DWE enter into an agreement for the operation of the BCSIS. The contractual arrangements will be for an initial period of 5 years with the intent to move to a rolling 10 year agreement. The initial 5 year period will be regarded as a ***'Proof of Concept'*** with a review being carried out by Norske Skog, DWE and DECC at the conclusion of this period. If successful then contractual arrangements would then continue with the original agreement and other offset projects may also be evaluated.

Under the proposed agreement the BCSIS would be operated and maintained by NSW DWE with agreed operational funding provided by Norske Skog Albury. DWE is to provide an annual report on the performance of the BCSIS to Norske Skog and DECC. This report will become part of the Albury Mill EPA licence compliance and reporting process. Any additional capital development required for the BCSIS at Longerenong will be the responsibility of DWE.

The net impact of the green offset obtained from BCSIS is summarised in ***Table 3***

Parameter	Units	Billabong Ck Output	Albury Mill Input *	Net Impact
Water	ML/year	1,200	1,000 [24]	+2200ML
Salt	Tonnes/year	3,000	Up to 1,500	-1500 tonnes
Salt Offset Ratio	(Out:In)	2:1		

Table 3 Summary of Green Offset Proposal on Salt and Water Quantities.

3.7 HOW DOES THE PROPOSAL FIT WITH CURRENT NSW GOVERNMENT POLICY?

The change proposed to the Albury Mill's consent conditions with respect to a 'green offset' is that the mill's environmental approvals and licence will be altered to allow discharge of treated process water containing dissolved salts such that for every tonne of salt discharged to the Murray River, two tonnes of salt is removed from the Murray River catchment. The quality of all waters discharged from the site will remain within limits specified by DECC.

Table 4 describes how this modification proposal complies with the requirements set out within the NSW DECC Institutional Frameworks document.

[24] This is an estimate of the indicative average annual flow based on the salinity of the current treated process water. Actual volume will be determined by the salt content of the treated process water.

QUESTIONS	ANSWERS
What is the environmental standard that needs to be met and how is this required?	Reduction in the amount of salt in the Murray River measured at Morgan.
Why is this standard required?	Norske Skog's treated process water discharge has the potential to increase Murray River salinity at Morgan. NSW Department of Planning Conditions of Consent for the PM1 Rebuild Project require 'investigations into alternative management options for the treated process water, including the feasibility of a green offset scheme….'
Where does the scheme apply?	Norske Skog Albury Mill (licensed premises #1272) and "Longerenong" Walbundrie. Future schemes may also be identified.
What types of developments are included?	To be undertaken as part of current DECC licensed activities.
What are the target pollutants or impacts?	Salt – salinity. The quality of all waters discharged from the site will remain within limits specified by the EPA.
What units of measure will be used?	kg of salt Note: Interstate salinity credits and abatement project assessments are based on ec units
How will the offset requirements be enforced?	Via amended licence conditions – special condition on licence – under the Protection of Environment Operations Act 1997 POEO Act
Is participation in the scheme voluntary or mandatory?	Voluntary – Norske Skog has developed the proposal in order to achieve a more sustainable, balanced and cost effective option for dealing with the treated process water volumes generated by the mill.
How will the baseline and the likely benefit of the offset program be determined or estimated?	Baseline conditions and impacts are determined from MDBC and DWE modelling. Background monitoring data on the Murray River and Billabong Creek also exists. Benefits from operation of the BCSIS are determined from DWE and MDBC modelling.
What offset ratios will be used to account for uncertainties?	An offset ratio of 2:1 is proposed.
How will the estimated benefits be verified?	Billabong Creek Salt Interception Scheme (BCSIS) – cost effective modelling and collection of monitoring data to verify original model predictions or assumptions. 'Weight of evidence' approach. DWE annual report against Key Performance Indicators. External audit or verification of modelling process will be undertaken.

QUESTIONS	ANSWERS
What sort of offset measures will be used and are they acceptable for the pollutant being offset?	Reduction in salt (tonnes/annum) entering the Billabong Creek and downstream river system.
What measures will be used to ensure accountability and transparency?	• Annual reporting on BCSIS operations undertaken by DWE. • Annual reporting in Norske Skog's Annual EPA compliance report. • Annual review meeting with relevant stakeholders and 5 yearly review and audit. Review of the 'proof of concept' after five years of operation.
What is the relationship to other government programs?	• DECC - Institutional framework for implementing green offsets under the Protection of Environment Operations Act 1997 • Murray Darling Basin Commission (MDBC) – Murray-Darling Basin Salinity Management Strategy, Murray-Darling Basin Initiative • DWE - National Water Initiative – use of market based measures • Murray Catchment Management Authority (CMA) – Murray Catchment Action Plan – BCSIS will contribute to Salinity targets set out in the Murray Catchment Action Plan 2007 (Reference 9).
Would a scheme manager be needed and who might that be?	No. Agreement between DWE and Norske Skog will specify operational and reporting requirements for BCSIS. DWE will operate the BCSIS.

Table 4 Comparison of the Norske Skog 'Green Offset' Proposal with the DECC Institutional Framework.

3.8 PROPOSED ALBURY MILL WATER MANAGEMENT REGIME

The Albury Mill will alter its water management plan to fit the model which includes:

- A combination of cooling water and treated process water being returned to the river via the return water pipeline, plus
- The remaining treated process water would be transferred to the WWRS for irrigation as is current practice.

The proposed water regime under a Green Offsets Scheme is presented in ***Table 5***

NSA WATER MANAGEMENT PLAN		MURRAY RIVER NET VOLUMES		NORSKE SKOG TOTAL VOLUMES USED		NORSKE SKOG TOTAL VOLUMES TO WWRS	
		Daily ML	Annual ML	Daily ML	Annual ML	Daily ML	Annual ML
Green Offsets Plan	Water drawn from Murray River	13.5	4928	13.5	4928		
	Cooling Water			3.0	1095		
	General water (Steam, Potable, Sheet Moisture)			3.0	1095		
	Treated Process Water Used			7.5	2738		
	Treated Process Water transferred to Reuse Scheme					4.5	1643
	Cooling Water returned to Murray River	3.0	1095				
	Treated Process Water returned to Murray River	3.0	1095				
	Total Net Water Use	**6.0**	**2190**	**13.5**	4928	**4.5**	**1643**

Table 5 Proposed Albury Mill Water Management Plan Under a Green Offsets Plan

3.9 THIRD PARTY IRRIGATION SYSTEMS

As part of a review of its process water management strategies, the Albury Mill has identified that an opportunity exists to supply third parties with water from the existing pipeline which currently takes water discharges from the mill site to the Murray River. The water in the pipeline will be cooling water (warm fresh water), treated process water, or most likely a combination of both. It will not contain treated sanitary sewage.

The return water pipeline is owned by the Albury City Council. It is proposed that water discharged into this pipeline will be made available to the Albury City Council and other third parties, primarily for the irrigation of playing fields and parkland. It should be noted that this application for consent condition modification seeks to confirm the principle of third party reuse and the “ultimate reuse development” concept proposed in the 1992 EIS. It does not seek approval for water reuse in specific locations. Any required reuse approvals will be sought in separate and subsequent applications by the third parties.

An initial ‘concept’ plan showing the location of the Albury Mill raw water (influent) and return water (effluent) pipelines, parklands and potential sites for water use, is presented in **Figure 22**. Several potential users, including Albury City Council are within easy access of the return water line. Discharge from the pipeline occurs immediately upstream of the NSW RTA and State Rail crossings of the Murray River (bottom left hand corner of drawing).

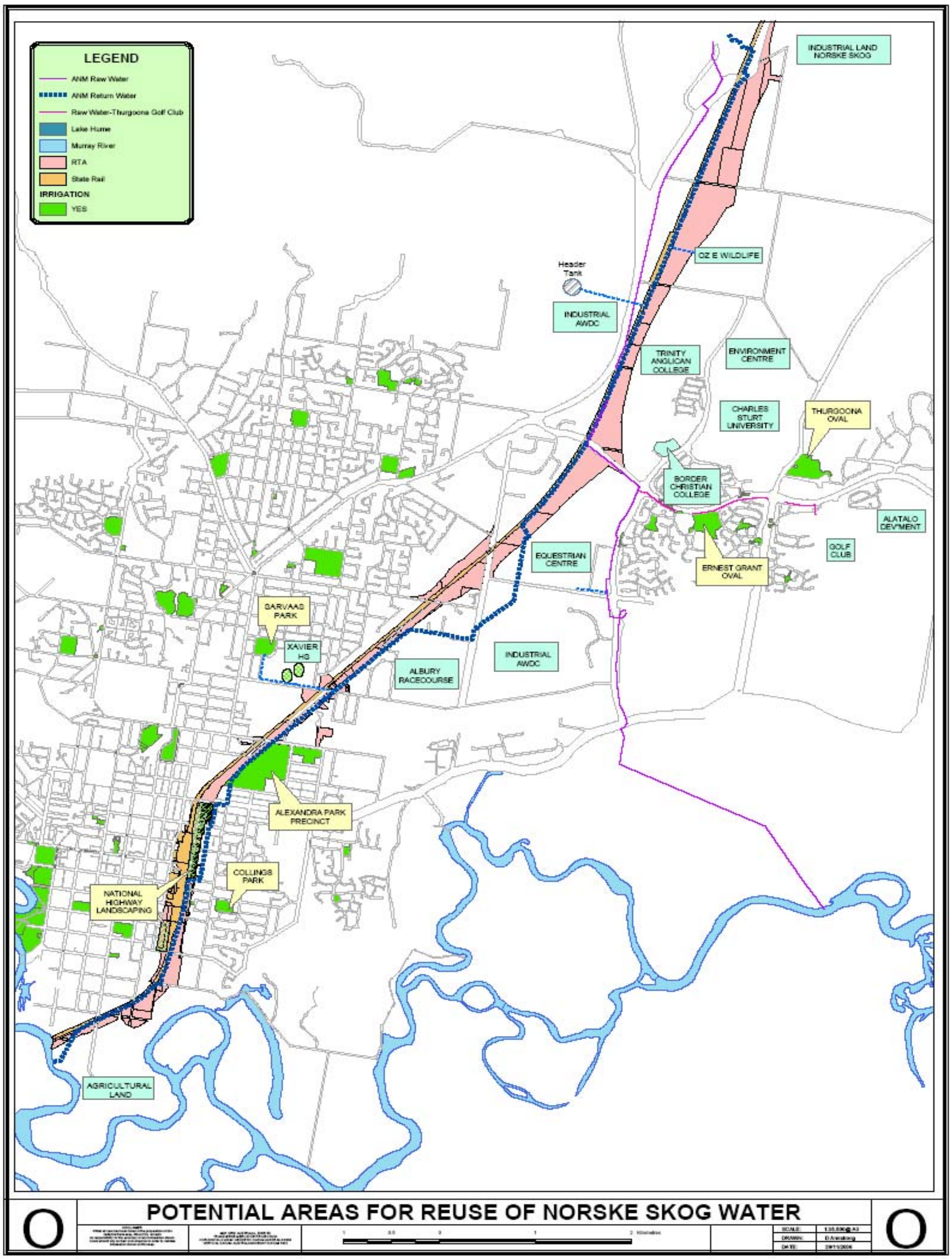

Figure 22 ALBURY MILL – Potential Areas for Third Party Irrigation Use

In line with its intention in the 1992 EIS for its “Proposed Recycled Fibre Plant”, the Albury Mill wishes as part of its sustainable development agenda, to advance the “ultimate reuse development” concept. The reuse of cooling water / treated process water will allow Albury City Council and other third parties to substitute this water for existing potable water supplies, thus relieving the demands on this resource and making the potable water currently provided by Albury City Council available for other uses.

Norske Skog Albury Mill will provide access rights to the water in the discharge pipeline to third parties such as Albury City Council. The arrangements governing the distribution, management and monitoring of water extracted from the pipeline will be established on a case by case basis depending upon the reuse option proposed and the environmental approvals required. Norske Skog will report on the reuse locations and quantities as part of its existing environmental compliance reporting processes.

3.10 CHANGES TO THE ALBURY MILL WASTEWATER TREATMENT PLANT

The capacity of the Albury Mill Wastewater Treatment Plant was expanded in conjunction with the A265 Upgrade Project (2006). This allowed it to cater for changes in hydraulic and process loads associated with the planned increase in newsprint production. It currently operates successfully and in accordance with the design criteria.

The WWTP Final Sand Filters were decommissioned in 1996 when total ‘off-river’ reuse of treated process waters was commenced. These filters have been recommissioned, the filter media replaced and will assist with the maintenance of discharge water quality. This will add a further treatment stage to the existing primary and secondary treatment processes. This will be sufficient to ensure treated process water quality meets the proposed licence limits. The filter backwash water is recirculated back to the WWTP for reprocessing.

3.11 CHANGES TO THE WASTEWATER REUSE SCHEME IRRIGATION REGIME

Plans have been developed for the ongoing management of the WWRS. It is intended to continue with the harvesting, clearing and conversion of the original plantation areas to irrigated crop/pasture areas. It is anticipated that with the introduction of a green offset in the form of a salinity offset, the required effective irrigation area will be reduced to an area that allows effective and flexible management for the remaining volumes of treated process water generated and conveyed to the WWRS.

As a result of the green offset proposal being approved, the threshold area of irrigation can potentially be reduced to enable a more effective management regime to be introduced. It is proposed that this area threshold will be met by:

a) Harvesting mature plantation areas with reduced irrigation capacity.
b) Identifying existing cropping areas that can be developed for irrigation (eg using versatile “travelling” irrigators)
c) Retaining selected areas of *Pinus radiata* and Eucalypt irrigated plantations.
d) Defining, developing and managing the final minimum effective irrigation area in conjunction with DECC. Initial estimates indicate that the WWRS would require ~350Ha of effective irrigation (pasture and/or plantations)
e) Harvested ex-plantation sites suitable for irrigation and not immediately required for development to meet the minimum area will be managed as a “land bank” that may be developed for irrigation in the future to allow for more effective rotation of irrigated crop and pasture paddocks.

3.12 BENEFITS OF THE PROPOSAL

The proposed green offset arrangement in the form of a salinity offset offers several improved environmental, water management and economic outcomes:

- Treated process water for irrigated reuse can be better managed and applied more sustainably by the Albury Mill
- The Murray River catchment receives a net reduction in salt load due to the offset ratio of 2:1. (Note: Under current environmental approvals, any treated process water discharges to the Murray River, for example during wet weather, are not offset).
- Additional fresh water volumes will be available in Billabong Creek and the Murray River.
- The timing of treated process water discharges from the Albury Mill can be planned to achieve maximum in-river dilution / minimum impact.
- Greater operational flexibility in water management can be achieved.

A Green Offset arrangement will also offer better social and economic outcomes which will help facilitate regional development:

- The Albury Mill is a significant employer in the region with a large multiplier effect. Its ongoing contribution to the region is in excess of $100 million per annum, in addition to major capital works such as the recently completed $135M paper machine upgrade. A green offset would assist the mill to maintain an environmentally sustainable operation with significant potential regional development implications for the Albury Mill and for other major regional employers.
- The success of the ‘proof of concept’ stage will provide a working model for increased investment in salinity abatement. This working example of a Green Offset could be used to encourage future use of corporate funds to help meet regional environmental challenges and facilitate expanded economic activity in the region.
- The proposal will provide an alternative local water supply to Walbundrie and Walla Walla communities during dry periods.
- The proposal will improve flows and water quality in Billabong Creek for extractive users.

3.13 PROJECT STAGING

It is proposed that the salinity offset scheme will be introduced in stages to allow for appropriate analysis and review to occur.

Step 1. Proof of Concept Stage

It is anticipated that upon the successful approval of the proposal to revise the Treated Process Water Management Strategies, the Albury Mill in conjunction with DWE would conclude all commercial details and in consultation with DECC commence to operate as per the approval requirements. It is proposed that a late spring or early summer 2008 commencement date is achievable.

As mentioned previously, the Albury Mill intends to carry out the salinity offset under a ‘proof of concept’ regime. A 5 year window has been nominated.

Step 2. Third Party Irrigation Stage

Following the successful commencement of the salinity offset arrangements, the ability and opportunity to allow third party irrigation will be available. The progress and timeline of this initiative will be governed by the third parties themselves, capital funds and the approval processes.

Step 3. Possibility of Future Green Offsets

Future possibilities for future green offsets will be subject to individual review, the success of this initial salinity offset and community input. At this stage, no immediate plans are proposed to progress another offset.

3.14 PROJECT PROPOSAL SUMMARY

The Albury Mill proposes to implement an approved Green Offset and in particular a Salinity Offset whereby the mill will discharge on an annual basis a quantity of treated process water containing 1500 tonnes of salt to the Murray River. It is also proposed to offset this discharge by entering into a commercial arrangement with DWE to fund the operations of a Salt Interception Scheme located on the Billabong Creek adjacent to Walla Walla NSW. It is anticipated that the discharge by the mill will be offset by an abatement of salt entering the catchment by a 2:1 ratio.

The environmental benefits that this proposal will bring include an overall reduction of salinity within the Murray Darling Catchment and in particular the levels measured at Morgan SA. Increased amount of water available to assist in environmental flows within the Murray River and reduced salinity in the Billabong Creek. Although these environmental benefits are small relative to the size of the Murray Darling Basin, the demonstrating and applied science nature of the proposal will assist the community, government and industry in finding long term solutions for water management.

The tangible benefits to the Albury Mill include the provision of a more flexible solution for managing the mill’s water and treated process water regime, providing a more flexible management opportunity for the operation of the current Wastewater Reuse.

It is intended to be engaged with DWE and DECC in a ‘proof of concept’ review at a 5 year timeframe. If at anytime within that timeframe, evidence suggests that the offset concept is required to be suspended or ceased, the Albury Mill will so immediately. Under the green offset arrangements, the mill will reduce the area of effective irrigation land from 450 to 350 hectares, due to the reduced quantity of water for irrigation. The total 450 hectares of irrigation land currently in use will be retained by the mill throughout the ‘proof of concept’ stage.

This proposed scheme is aligned with government policy and directions and will provide a proving ground to assist in the sustainable economic development for industry within inland NSW, the growth of employment and securing long term futures for our communities.

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CHAPTER FOUR

4 FUTURE WATER AND WASTEWATER STRATEGIES

4.1 BACKGROUND

The Albury Mill has historically managed treated process water in line with NSW government policy and community expectations. When the mill commenced manufacturing operations (1981) it was required to treat its process waters and return at least 90% to the Murray River (a river management policy focus on quantity). Subsequent changes to NSW government policy to 'in river' discharges meant that in 1992 with the introduction of a recovered paper recycling process (which required the use of additional chemicals to remove ink from the paper and maintain acceptable product quality), the mill was required to cease routine discharge of treated process water and implement 'off-river' reuse (a river management policy focus on quality). In 2008 there are a range of government initiatives relating to environmental flows, water quality and the use of market based instruments. These reflect changes in the use and value of water, improved knowledge of environmental processes and developments in environmental regulation.

Since 1995 the mill has diverted ~26,000 ML of treated process water from the Murray River to the WWRS for irrigated reuse. Wet weather related discharges of treated process water via the Winter Release Program to the Murray River have been ~2,800 ML (~11% of the treated process water generated by the mill over this period).

An 'ultimate reuse development' was proposed by the company in its 1992 EIS for a Proposed Recycled Fibre Plant development[25], refer ***Reference 10.*** The EIS goes on to state that:

> "In the ultimate development, it is intended that downstream (non-ANM) users such as the Thurgoona, Albury and Hume Golf Clubs, and the Albury Racecourse will be supplied with cooling water supplemented with treated wastewater. This will be subject to planning approval and licencing. Several organisations have already expressed interest in obtaining ANM wastewater.
>
> Each of the potential downstream irrigation users could use Mill treated wastewater for irrigation purposes to supplement, replace or augment existing water supplies.
>
> In some cases, the use of ANM treated wastewater will obviate existing demand on the ACC water supply, releasing a maximum of 350ML/y of currently diverted River Murray water, to accommodate downstream demands. This would have a positive effect on downstream river quality."

Further development of this part of the WWRS concept to make water available to approved third parties, could be implemented subject to planning approval. Despite being described in reasonable detail in the EIS, the 'ultimate development' was not specifically dealt with in the Conditions of Consent for the approved project at that time. The 2004

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[25] Proposed Recycled Fibre Plant at Albury NSW, Environmental Impact Statement, Section 6.4 "Ultimate Development", Gutteridge Haskins & Davey Pty. Ltd. May 1992

Paper Mill Upgrade Consent Conditions DA-389-8-2003-i required 'investigations into alternative management options for the effluent, including the feasibility of a salinity offset scheme….'[26], refer **Appendix 1.** The Albury Mill has developed both these concepts of Third Party Reuse and Salinity Offsets to the stage of seeking planning approval. Notwithstanding this application, the Albury Mill has and will continue to investigate, trial and implement best practice and innovative water management practices.

4.2 CURRENT WATER MANAGEMENT

The current Water Management Model is shown in ***Figure 23***. This model shows the simple process of extracting raw water from the Murray River, segregating this raw water into water for cooling water and process water, treating the process water returned from the mill and then , transferring this water to storage and irrigation of plantations and pastures. Cooling water which has not come in contact with the process water is returned to the river.

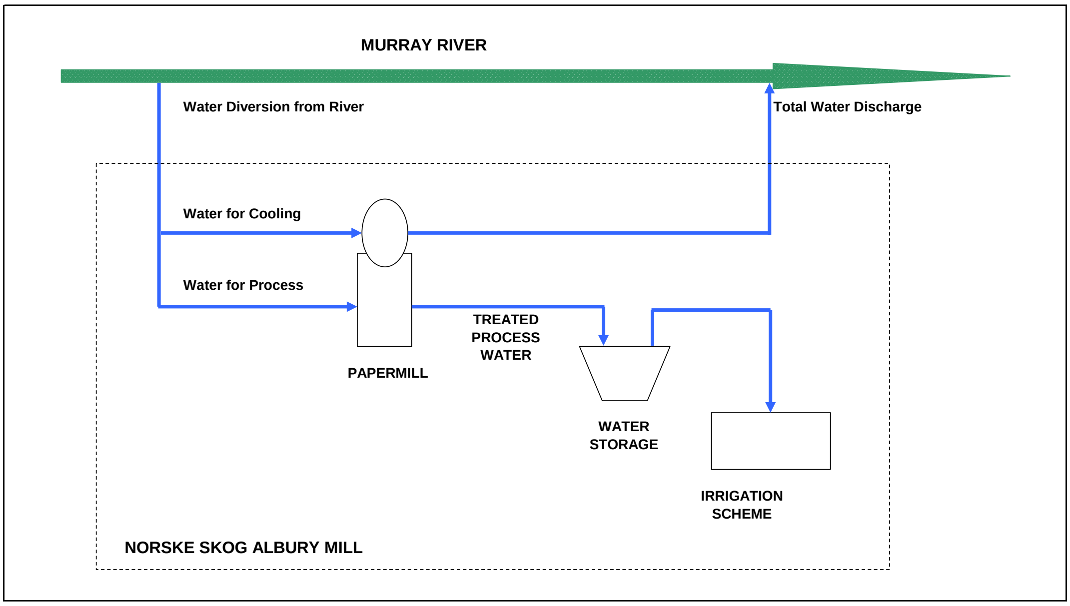

Figure 23 ALBURY MILL – Water Management Model (Current)

Technologies and options to manage water have continued to evolve over the life of the Albury Mill. No individual water management option is 'perfect' – each option carries an element of risk and cost. The success of some options, (for example further expansion of the existing waste water reuse areas) remains subject to variations in climate.

Options including the review of chemical and water use are undertaken on an ongoing basis as part of continuous improvement management practice at the Albury Mill. The mill

[26] DA 389-8-2003-i Section 3.9c. Upgrade of existing paper machine to 265,000 tonnes pa

will continue to investigate these alternatives and improvements in operating practices for the manufacture of publication grade papers in order to reduce chemical usage and water consumption.

The options which still require research and development such as the application of membrane and desalination technology will continue to be investigated. The mill has committed to continue this particular investigation throughout the 2008 calendar year.

Several constraints in operating an irrigated reuse scheme have been identified and have the potential to limit further growth and development at the Albury site including:

1. Operational experience (applied research and development) over the last 10 years has shown that sustainable irrigation capacity is less than the 9.7ML/ha/annum that was used for modelling purposes when the reuse scheme was initially proposed (1992). Experience has shown that an average of 6 ML/ha/annum can be applied in most irrigation seasons[27], refer **Appendix 6**.
2. Heavy rainfall in spring or summer complicates the operation of the reuse scheme in the current and foreseeable future irrigation seasons due to storage dam ‘carryover’. In reality, above average late spring or summer rains significantly reduce the irrigation potential for a season.
3. Seasonal climatic conditions have an impact on the ability to manage irrigated soil properties within desired salinity ranges. In 2003, the average salinity levels within the WWRS appeared to have peaked at ~3.3 dS/m. Since that time the levels of salinity have reached equilibrium at ~2.5dS/m, refer ***Figure 24***.
4. Minimal additional land in close proximity to the Albury Mill is available for reuse.
5. The mill is reaching the levels of low water usage that current technologies can provide

The ‘green offset’ being proposed has the potential to introduce operational flexibility to the management of treated process water. The Albury Mill will continue to explore and develop innovative and sustainable water management options and solutions.

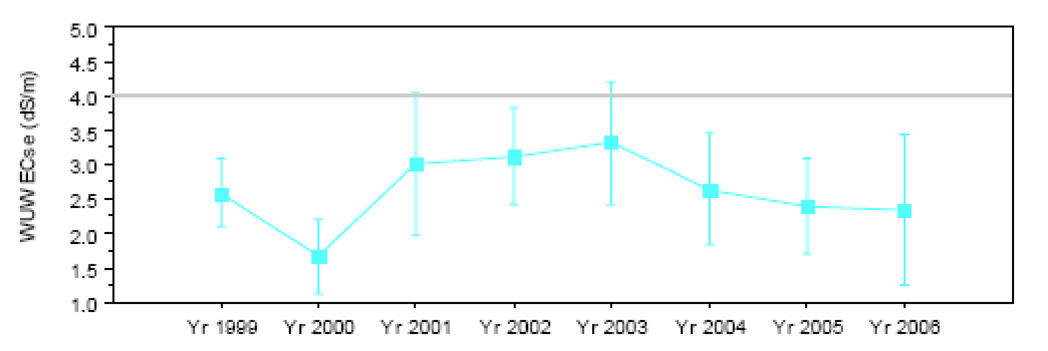

Figure 24 WWRS – Average Salinity in the Root Zone of Irrigated Radiata pine. Bars Indicate Standard Deviation

[27] Soil Properties and Nutrition of Radiata Pine Irrigated with Paper Mill Effluent at Albury in 2006 - Page 17. Peter Hopmans Report 2007/07, June 2007 Timberlands Research Pty. Ltd

4.3 ALTERNATE WATER MANAGEMENT STRATEGIES

In 2002-03, the Albury Mill reviewed its approach to water management in light of changing government policies and the need to have a sound water management plan to take the mill into the future. This was needed to build business confidence for potential future growth and investment. It has subsequently developed a forward strategy for the management of treated process waters. This review and strategy incorporated the following key aspects:

- Reduction of water and chemical use through 'standard' technologies
- Expansion of the Wastewater Reuse Scheme
- Assessment of Desalination Technology
- Assessment of Evaporation Technology
- Implementation of Green Offsets
- Third Party Irrigation of Cooling Water and Treated Process Water via the mill's return water pipeline
- Summary of Review

An important part of the overall mill water management strategy is the need to balance water quantity and water quality. This balance influences the type of water management options available, the complexities of implementation and the longer term success of the selected options.

4.3.1 Reduction of Water and Chemical Use through 'Standard' Technologies

In any pollution abatement program, the fundamental principles of reduce, recycle and reuse needs to be applied. Reduction in both the amount of water used at the mill and of the chemicals that generate salt have and continue to be, rigorously pursued by the mill. The Albury Mill currently operates better than European best practice guidelines for water use per tonne of product. The mill currently uses 8.5-9 kL/tonne against a best available technology (BAT) guideline of 12-20 kL/tonne, refer **Reference 1**.

As part of its continual improvement program, investigations into more efficient ways of brightening pulp and de-inking recycled paper have been pursued by the mill in recent years. Initially these were investigated at the laboratory stage, but they have now progressed to mill trial stages. If successful, equivalent paper product quality will be obtained at reduced chemical usage and potentially lower dissolved salts in the treated process waters.

4.3.2 Expansion of the Waste Water Reuse Scheme

The Albury Mill has operated a waste water re-use facility for over ten years which has now reached the limit of land available to viably expand its operation. Urban development and the future Albury City Council's draft Local Environment Plan indicates that no further local land will be available for irrigation expansion

4.3.3 Desalination Technology

Salt removal from water utilising desalination technology has been identified by the mill for some time as a possible alternative for managing the salinity of its treated process water. The mill has been conducting research into the use of membranes for salt removal over the past 4 years, (R&D cost of ~$1M to date). These trials have had the involvement of suppliers, as well as the development of a mill specific trial plant. The application of desalination technology in the paper industry differs from that of seawater desalination. The mill treated process water contains much lower levels of salt than seawater, thus requiring a different approach.

The mill has most recently been operating its small multistage membrane pilot plant in order to study in detail the practical application of this technology. The lead times required to obtain sufficient information to properly evaluate the technology are significant.

The work completed so far indicates that membrane technology has potential application in both water recovery and some degree of salt removal.

Membrane technology is the application of micro-, ultra-, nano- and reverse osmosis filtration to progressively remove constituents, ranging from particulate matter through to salts, from water. This process is depicted conceptually in **Figure 25**. Technical barriers to implementing this technology for complete salt removal lie mainly in the chemical composition of the salt present in treated process water. The salt present in Albury Mill treated process water has a reduced solubility and precipitates out in the final concentration stage, blocking equipment and making it necessary to clean the equipment at a frequency that is uneconomical for the process to operate.

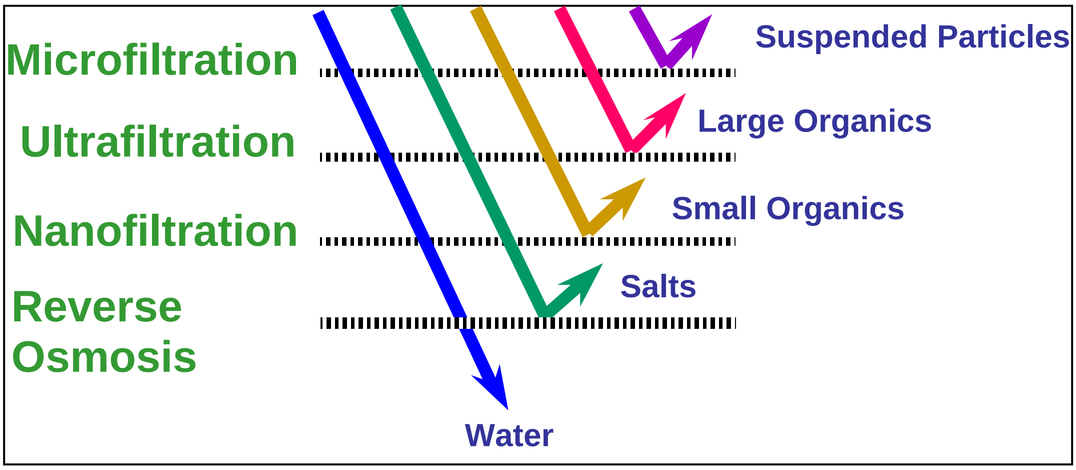

Figure 25. Conceptual model of the membrane filtration stages required to remove constituents such as solids, organic matter and salt from treated process water.

Current indications suggest that a membrane plant to remove about half the salt would cost in excess of $15M. Other issues yet to be understood include waste disposal of concentrated brine in inland Australia, energy usage and overall operating costs. This is pioneering research for the paper industry which still has significant challenges to solve.

The Water Management Model was developed to add the conceptual stage of membrane technologies and is shown in **Figure 26*.*** This model shows (in red) that a portion of the treated process water output from the WWTP will be put through a desalination plant and returned to the mill for reuse. The remaining output of the WWTP will still be transferred to the WWRS for irrigation processes. It is the opinion of the mill that the lead time still required to complete the R&D work is measured in years and not months.

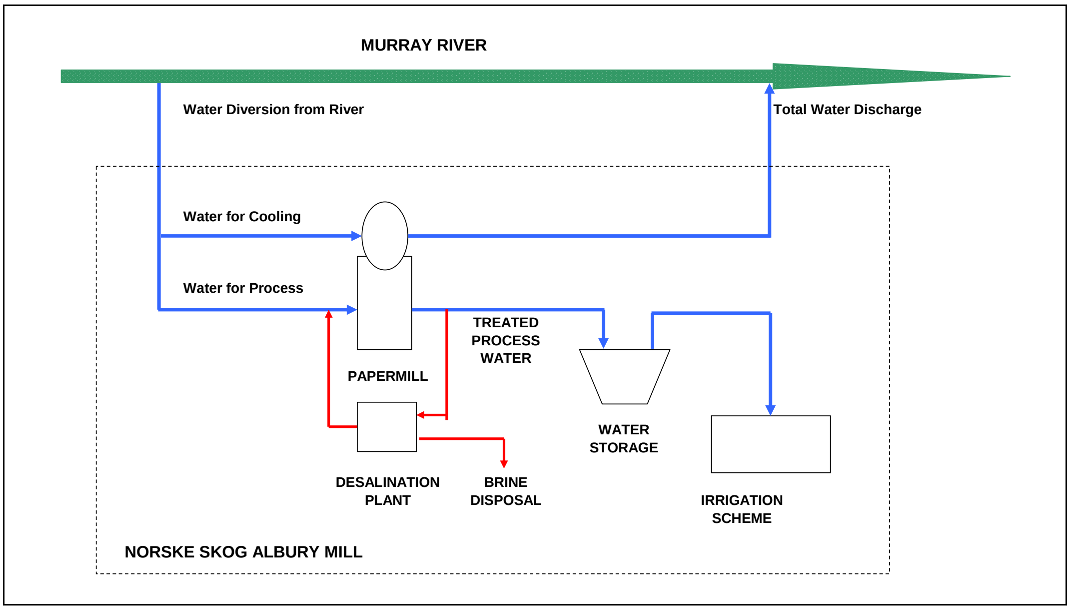

Figure 26 ALBURY MILL – Water Management Model (Including Desalination Stage)

4.3.4 Evaporation Technology

The use of thermal evaporation technology based on Multiple Vapour Recompression technology is used where cheap energy is available to desalinate water. Its application to the complete desalination concept will be vital in order to remove the final parts of water to allow any remaining salts to be adequately disposed. The Albury Mill has briefly investigated its application to the mill treated process water has been estimated to cost >$50M. The capital cost alone is more than an order of magnitude greater than the total operating costs of the proposed 'green offset' project over a 10 year period. It is therefore currently uneconomic.

4.3.5 Implementation of Green Offsets (Salinity Offset)

The utilisation of treated process water for a ‘green offset’ in the form of a ‘salinity offset’ forms the basis of this proposal.

The Water Management Model was developed with the inclusion of a green offset and is shown in **Figure 27*.*** Treated process water is partially split with ~3ML of this water being returned to the Murray River via the mill return pipeline (shown in red). The remaining water would still be transferred to the WWRS for irrigation purposes.

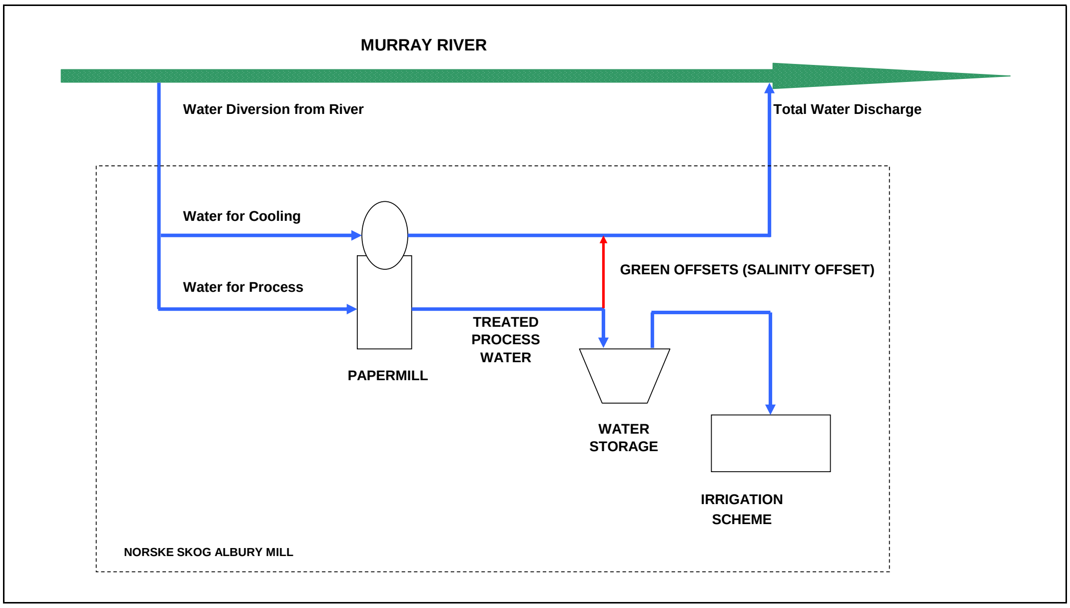

Figure 27 ALBURY MILL – Water Management Model (Including Green Offset Stage)

4.3.6 Third Party Irrigation of Cooling Water and Treated Process Water

The potential for private third parties accessing mill water being returned to the Murray River using a combination of treated process water and cooling water for their own irrigation schemes is of future significance. It is possible, through such a scheme, to provide water for playing fields, open parkland, golf course and other users. This not only provides additional flexibility and capacity for reuse, it also value adds throughout the water cycle, preserves scarce water resources allowing existing potable water supplies from the Murray Darling Basin to be conserved. In order to implement a Third Party users scheme, it is essential to have gained approval for a Green Offsets Scheme as the third party users would access water via the common return water pipeline.

Any third party irrigation use of the mill’s combined cooling and treated process waters would be subject to a separate development application from the Albury City Council.

A Water Management Model was developed with the inclusion of third party irrigation and salinity offsets (shown in red) and is shown in **Figure 28**.

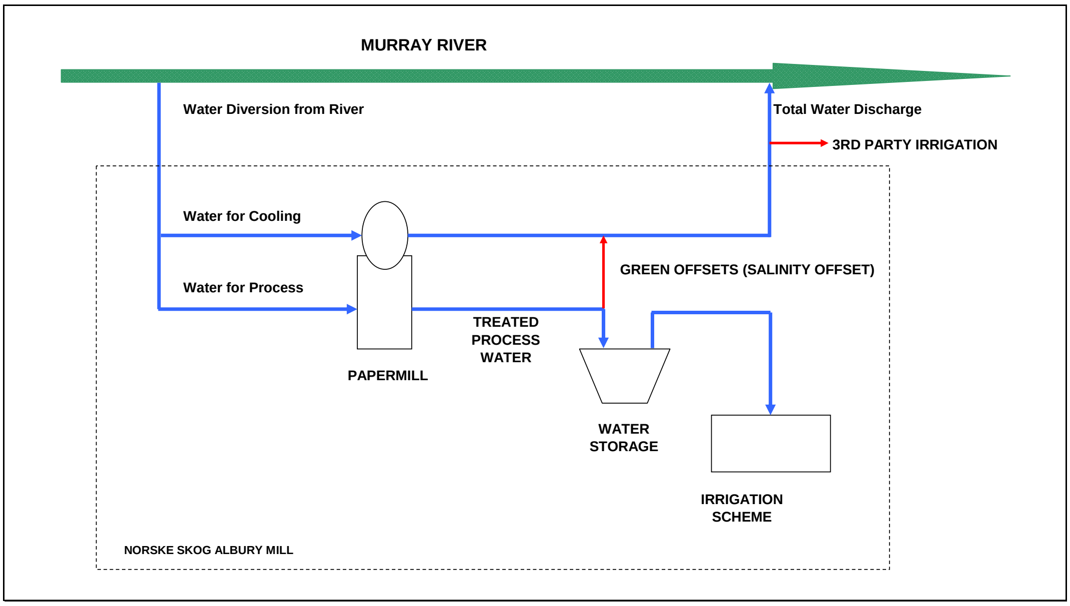

Figure 28 ALBURY MILL – Water Management Model (Including Third Party Irrigation)

4.3.7 Summary of Water Management

The Albury Mill has been engaged in many discussions, trials and research to develop future options for water management that will allow for sustained incremental and step change developments to occur into the future. The relative merits of these alternative water strategies are summarised in **Table 6.**

SALINITY MANAGEMENT	STATUS	FEASIBILITY
Reduced Chemical Consumption	Continuous mill trials and implementation of solutions	Some salt reductions achieved. Continuous improvement ongoing
Expanded Re-use	Currently at maximum capacity	No additional land available
Membrane Desalination Technology	Pilot Trials underway with research continuing	Technical issues to be resolved
Evaporation Technology	Cost estimate obtained	Uneconomical (>$50M)
Green Offsets	Proposed Salinity Offset meets regulatory requirements and subject to this application	Achieve a net salinity reduction in the Murray River catchment
Third Party Irrigation	Conceptually viable but subject to individual approvals	Viable

Table 6 ALBURY MILL – Summary of Alternate Water Strategies

Following the review of the mill's future water and waste water management options, the mill has chosen to pursue the following strategy:

1. Continue to pursue world's best practice technologies for water use and management

2. Continue to investigate and reduce chemical usage in the pulp and papermaking processes

3. Continue to utilise off-river disposal for a significant portion of the mill's treated process water via the established WWRS

4. Conclude the R&D investigations and high level costing estimates into the available technologies for the desalination of the mill's treated process water by the end of 2008

5. Seek approval for a partial discharge of the mill's treated process water to the Murray River under an approved 'green offsets' scheme.

6. Seek concept approval for Third Party irrigation of the mill's treated process water by local entities

4.4 PROJECT JUSTIFICATION & BENEFITS

The Albury Mill believes that many benefits for the mill, community and environment can be achieved with the mill's participation in a Salinity Offsets Scheme. These benefits include:

- A more flexible operational strategy for water management at the Albury Mill which will allow some treated process water to be returned to the river with the remainder being used for irrigation purposes at the current Wastewater Reuse Scheme
- A more flexible arrangement for the management of the Wastewater Reuse Scheme going into the future which will allow better management of soil quality, salinity balances and optimal irrigation practices
- A more robust water management arrangement which will minimise the filling of the winter storage dam when climatic conditions prevent irrigation due to late spring and summer rainfall events
- An increased water availability of up to 1.1GL pa to the Murray River. This water can be then reutilised for environmental flows, irrigation water by others or by industries, towns etc.
- The potential to value add to the water cycle by allowing the concept of Third Party Irrigation to occur using a combination of cooling and treated process water from the mill return water pipeline to irrigate local playing fields
- Decreased salinity level within the Murray Darling Catchment as measured at Morgan, SA
- Decreased salinity within Billabong Creek downstream from Walla Walla, NSW
- Improved and more consistent water quality to downstream water users from the Billabong Creek Salt Interception Scheme
- A failsafe methodology to implement a Green Offset in the form of a Salinity Offset. If for any reason the scheme is deemed to not deliver the expected results, the Albury Mill will cease discharge and revert to its current practices

CHAPTER FIVE

5 STATUTORY PLANNING

5.1 PURPOSE OF THE STATEMENT OF ENVIRONMENTAL EFFECTS (SEE)

The aim of the SEE is to assess the environmental impacts associated with the proposed activity. The SEE process will also identify measures that, if approval can be given, will be necessary to reduce the environmental, social, and economic impacts of the proposal to acceptable levels. Such measures, if necessary, can be included as a condition of consent issued by the Department of Planning (DoP).

The SEE is therefore the underpinning document in the environmental assessment process that concludes the likely significance of the proposed activity.

5.2 STATUTORY REQUIREMENTS

5.2.1 Environmental Planning and Assessment Act 1979 (EP&A Act)

Within NSW, the *Environmental Planning and Assessment Act 1979* is the controlling legislation for all developments or activities that are likely to have a significant impact on the environment.

The Albury Mill operates under a variety of consents and licences which include:

- Development consents granted by the NSW Minister for Planning and dated 12th October 1992, being:
  - DA 147/92 to Albury City Council to install a recycled fibre plant and associated work
  - DA 41/92 to Hume Shire Council to establish a wastewater reuse scheme

- A development consent was granted by the NSW Minister for Infrastructure, Planning and Natural Resources and dated 7th January 2004, being:
  - DA-389-8-2003-i to Albury City Council for an upgrade to the existing paper machine to increase production from 215,000 tpa to 265,000 tpa and associated works

This proposal aims to modify through section 96(2) of the Act the following development consents in order to allow the introduction of a Green Offset in the form of a Salinity Offset and also the concept introduction of Third Party Irrigation:

- DA 41/92 Development Consent
- DA-389-8-2003-I Development Consent

The modifications will result in changes to the existing treated process water management strategies and processes. The modifications sought will allow the following to occur:

- The implementation of green offsets so that a quantity of treated mill process water may be returned to the Murray River with the resultant salt load offset by appropriate schemes which will result in an overall environmental benefit to the Murray Darling Basin. Norske Skog proposes that for every tonne of salt discharged in the treated process water to the Murray River, two tonnes of salt will be removed from the Murray River catchment. All other water quality parameters will remain within limits specified by the NSW Department of Environment and Climate Change (DECC).

- The approved salt interception scheme established by the NSW Department of Water & Energy (DWE) at Billabong Creek (BCSIS), Walla Walla NSW between 2003 and 2006 will be funded by Norske Skog and operated by DWE. The BCSIS will remove 3,000 tonnes of salt per annum from the environment, thus resulting in a net environmental benefit of 1,500 tonnes of salt after allowing for the annual return of treated process water at the Albury Mill containing ~1,500 tonnes of salt.

- To provide the potential for a quantity of treated process water, of a quality determined by DECC, cooling water or a combination of both be available to interested third parties for reuse where non-potable water quality is an acceptable application. This water will be obtained via the Albury Mill return water pipeline to the Murray River. The distribution, management and monitoring of water provided to third parties will be the responsibility of the relevant third party and subject to separate approval processes.

5.2.2 Regional Environmental Plans (REP)

Murray REP 2 aims to ensure that appropriate consideration is given to development with the potential to adversely affect the riverine environment of the River Murray, to establish a consistent and co-ordinated approach to environmental planning and assessment along the River Murray, and conserve and promote the better management of the natural and cultural heritage values of the riverine environment of the River Murray.

Consequently, for works that require development consent, formal consultation under Part 3 of Murray REP 2 is often required when section 11 (1) (a) makes reference to works that require development consent must be referred to the listed agencies for review and identifies who is responsible for the referral process. Section 12 of the REP identifies who should be consulted whilst the proposal is being assessed.

For this proposed amendment to Norske Skog's waste discharge, no formal consultation is required as the proposed works are not listed in the consultation table in section 13 of Murray REP2.

However, there is a requirement to adopt the planning principles in Part 2 of Murray REP 2 whilst considering the impacts from the proposal on the Murray River. The principles relating to water quality specifically relate to this proposal. Whilst there may be minor localised impacts from the discharge of a low salinity effluent, the regional impacts from the salinity offset well outweigh the minor impacts within the mixing zone where effluent is discharged. These planning principles are outlined below and have been adequately incorporated into this proposal.

General principles

When this Part applies, the following must be taken into account:

(a) the aims, objectives and planning principles of this plan,
(b) any relevant River Management Plan,
(c) any likely effect of the proposed plan or development on adjacent and downstream local government areas,
(d) the cumulative impact of the proposed development on the River Murray.

Specific principles

When this Part applies, the following must be taken into account (only those relevant to this project are listed below:

Land degradation

- Development should seek to avoid land degradation processes such as erosion, native vegetation decline, pollution of ground or surface water, groundwater accession, salinisation and soil acidity, and adverse effects on the quality of terrestrial and aquatic habitats.

Landscape

- Measures should be taken to protect and enhance the riverine landscape by maintaining native vegetation along the riverbank and adjacent land, rehabilitating degraded sites and stabilising and revegetating riverbanks with appropriate species.

Water quality

- All decisions affecting the use or management of riverine land should seek to reduce pollution caused by salts and nutrients entering the River Murray and otherwise improve the quality of water in the River Murray.

Wetlands

- Wetlands are a natural resource which have ecological, recreational, economic, flood storage and nutrient and pollutant filtering values.
- Land use and management decisions affecting wetlands should:
  - (a) provide for a hydrological regime appropriate for the maintenance or restoration of the productive capacity of the wetland,
  - (b) consider the potential impact of surrounding land uses and incorporate measures such as a vegetated buffer which mitigate against any adverse effects,
  - (c) control human and animal access, and
  - (d) conserve native plants and animals.

5.2.3 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth)

Under the assessment and approval provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance are subject to a rigorous assessment and approval process. An action includes a project, development, undertaking, activity, or series of activities.

The EPBC Act currently identifies six matters of national environmental significance:

- World Heritage properties;
- Ramsar wetlands of international significance;
- listed threatened species and ecological communities;
- listed migratory species;
- Commonwealth marine areas; and
- nuclear actions (including uranium mining).

Actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land), and actions taken by the Commonwealth that are likely to have a significant impact on the environment anywhere in the world, may also require approval under the EPBC Act.

Whilst the Murray River is an Icon River and of national significance, this activity does not trigger the EPBC Act in respect to these issues. The proposed activity does not involve nuclear actions and will not impact on a Commonwealth Marine Area. Therefore the activity does not require referral to the Commonwealth Department of the Department of the Environment, Water, Heritage and the Arts for these reasons.

5.2.4 Water Management Act 2000 (WMA 2000)

Norske Skog has current Water Access Licence's (WAL005346) with 6250 unit shares of High Security water and (WAL502057) 50 Unit Shares of Domestic water.

The Water Supply Works approval (50WA502058) consists of a pump on Lot 6 DP 730438 on the Murray River.

The Water Access Licence works from a net loss water balance from the Murray River, in which water that is returned to the river through discharge of treated effluent, is deducted from the water extracted through the authorised works.

There will be no change to the Water Access Licence or Water Supply Works approval for the proposed amendment. Also, the proposal is not inconsistent with the vision, objectives, strategies or performance indicators detailed in sections 8-12 of the Water Sharing Plan for the New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2003.

5.2.5 Protection of the Environments Operations Act 1997

There is currently an Environment Protection Licence issued under section 55 Protection of the Environment Operations Act 1997 (licence No 1272). This licence will require to be amended to cater for the additional discharge to the Murray River.

5.3 CONSENT AUTHORITY

As this proposal requires a modification to development application DA 389-8-2003-i, the consent authority is the Minister for Planning.

5.4 SEE REVIEW AND EXHIBITION

The SEE will be required to go on public exhibition for a minimum period of 14 days but is likely to be exhibited for a period of 28 days or as determined by the Department of Planning.

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CHAPTER SIX

6 DESCRIPTION OF EXISTING ENVIRONMENT

6.1 OVERVIEW OF UPPER MURRAY RIVER

The NSW portion of the Upper Murray catchment covers an area of approximately 5200 square kilometres and is located in southern inland NSW with the predominant river being the Murray River.

The catchment is bounded by the Great Dividing Range to the east, the Murrumbidgee catchment to the north, the Victorian border (Murray River) in the south and ends at Hume Dam. The catchments terrain varies from the beginning of plains west of Hume Dam, through the gently undulating farming land of the western slopes to rugged, timbered hill and mountain country and the alpine grasslands of the Snowy Mountains. Mount Kosciusko (2,228 metres) has the highest elevation in the catchment.

The average rainfall decreases from east to west, with Tumbarumba receiving approximately 980 mm per year, while Albury and Holbrook receive 675 mm per year. Three storages, part of the Snowy Mountains Hydro-Electric Scheme are present in this basin; Toorna Reservoir, 28000 ML. Khancoban Pondage, 26000 ML. Geehi Reservoir, capacity 21000 ML.

One of the main issues currently facing the Murray River is the impact of rising water tables resulting in saline water discharging into the river during periods of low flow.

6.1.1 Extent of Salinity in the Murray Region

The extent of salinity can be described as the:

- salt load mobilised in the landscape (tonnes per year)
- area of land with rising groundwater (ha)
- area of land classified as saline (ha)
- salt loads exported through rivers (tonnes per year), and that could potentially be redistributed into the landscape through irrigation
- salinity levels in rivers and streams (EC units)[28], refer ***Reference 11***.

Watson (2002)[29], refer ***Reference 12***, indicated that Eastern Murray (Upper Murray) sub catchments (including Billabong Creek) in the South West Slopes have the highest salinity risk in the Murray catchment based on a combination of salinity hazards:

- ‘wetness’,
- ‘salt source potential’, and
- ‘leakage’.

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[28] 1999 Murray-Darling Basin Ministerial Council (MDBMC) (1999) The Salinity Audit of the Murray-Darling Basin – A 100-Year Perspective. Murray-Darling Basin Commission, Canberra.

[29] Watson (2002) NSW Murray Catchment Salinity Report – Salt Loads, Salinity Risk and a Focus for Actions. Department of Land and Water Conservation. Albury NSW.

In 2000, it was estimated in the National Land and Water Resources Audit that an estimated area of 39,526 ha in the Murray region had water-tables at less than 2 metres (NLWRA 2001)[30] refer ***Reference 13***. This is predicted to increase to 293,191 ha by 2050. It was also estimated that the Lake Hume catchment had 127 ha affected by high water-tables (less than 2 m depth) and that this would rise to 19,254 ha by 2050 (NLWRA 2001).

6.1.2 Salt Loads and River Salinity in the Murray River

Watson (2002) reported salt loads for the Murray catchment, and divided the catchment into the following eight 'evaluation areas' (based on unique physiography and data): The Eastern Murray, Wakool, Cadell, Berriquin/Denimein, Murrakool, Central and West Corurgan, Barmah/Millewa, and North West Grazing (refer **Reference 12**).

In 2000, the amount of salt exported from the Murray catchment to the Murray River was approximately 126,000 tonnes and is predicted to increase to 167,000 tonnes by 2020 under a 'do-nothing' scenario. The Eastern Murray (Upper Murray, South West Slopes) contributes around 80% of the total export from the NSW Murray catchment and is increasing annually, followed by approximately 3% from Murrakool, and 17% from irrigation areas (Watson 2002).

Above Albury the inflows are very fresh and are supplemented with good quality water through the Snowy Mountains Scheme. The potential for salinity increases is low and has not been studied (Murray-Darling Basin Ministerial Council 1999), refer **Reference 11**.

Downstream of the Hume Dam, the Edward–Wakool river system diverts flow away from the Murray, which is mostly used in the irrigation districts. At Torrumbarry, water is diverted to several districts where modest returns flow significant salt accessions to the Murray (MDBMC 1999). Billabong Creek draws Murrumbidgee flows towards the Murray districts, where salt accumulates and discharges back into the Murray (Murray-Darling Basin Ministerial Council 1999).

6.1.3 Impacts of High River Salinity

Widespread clearing of native woodlands and grasslands has occurred in the region. These areas are now home to a wide variety of shrubs and groundcovers that are in urgent need of conservation and protection.

Many of these areas also intersect areas that are currently subject to high water tables, or at risk from developing high water tables over the next 30 years[31] (**refer Reference 14**). Future predictions for conservation areas and patches of remnant vegetation suggest that the number of such areas affected by high water-tables will also increase over the next 50 years (NLWRA 2001, refer ***Reference 13***). It is likely that there will be future impacts on the region's environment and biodiversity.

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[30] National Land & Water Resources Audit (NLWRA) (2001) Australian Dryland Salinity Assessment 2000: extent, impacts, processes, monitoring and management options. National Land and Water Resources Audit, Canberra

[31] Wilson S (2002) Dryland Salinity: The current impacts and costs to non-agricultural stakeholders, the environment and cultural heritage, Murray Region of NSW. Wilson Land Management Services for the Murray Darling Basin Commission & National Dryland Salinity Program.

Although the quality of the main stem of the Murray River system is generally good to moderate, other surface flows in the region are experiencing very high salinity levels (e.g. Billabong Creek, Wakool River). These high salinity levels are having a detrimental effect on aquatic fauna and flora in the region. Particularly during summer and autumn, high salinity levels have adverse flow-on impacts on small invertebrates and aquatic plants and the fish, frogs and larger invertebrates that rely on them as a food source.

Some wetlands in the region have also been affected by rising water tables and saline groundwater as well as river regulation that has altered the natural wetting and drying cycles of these areas (DLWC 2000)[32] refer ***Reference 15***.

There is a significant social and economic cost from salinity in the Murray that affects all levels of government as well as private enterprise and the general public.

In order to decrease the future impacts from salinity in the Murray Catchment, the NSW Government and the MDBC have been planning and/or undertaking salt reduction programs such as salt interception schemes (ie Billabong Creek, Upper Darling), preparing and implementing Catchment Action Plans with targets of salt reduction through projects funded by both State and Federal levels and manipulating water levels to reduce saline inflows (where possible).

The salinity reduction program that is designed to offset the discharge from this project is the Billabong Creek Salt Interception Scheme. Norske Skog proposes to fund the operation and maintenance of the BCSIS located on the Billabong Creek adjacent to the township of Walla Walla NSW.

The BCSIS will prevent 10 tonnes of salt/day or approximately 3,000 tonnes of salt/year from entering the Billabong Creek and Murray River. Modelling work undertaken as part of the work indicates that the impact at Morgan (South Australia) is to lower Murray River salinity levels by 0.1 EC units.

6.2 PROCESS WATER MANAGEMENT

Water is an integral part of every stage of making paper. A simplified flow diagram of water from when it enters the process to when it leaves the mill is shown in **Figure 29**. The following discussion describes the processes outlined in this figure.

Raw water from the Murray River is treated in a raw water treatment facility prior to distribution to the various pulping and paper-making processes. After treatment the water takes two separate routes. Cooling water (designated by the green lines in **Figure 29**) is used for heat exchange with equipment throughout the mill and does not come into contact with process water and is returned directly to the river. Process water (indicated by the blue lines in **Figure 29**) is distributed to various locations in the mill, and used directly in the pulping and papermaking processes.

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[32] Department of Land & Water Conservation (DLWC) (2000) NSW Salinity Strategy. NSW Department of Land and Water Conservation.

The manufacture of newsprint at the Albury mill involves the blending of two pulp types, one made from plantation grown softwood (*Pinus radiata*) and the other from recycled paper. The softwood pulping process (known technically as thermo-mechanical pulping, and abbreviated as TMP) involves the mechanical refining of softwood chips at an elevated temperature. This process releases natural wood components such as extractives, wood sugars and other carbohydrates into the process water. The main impact from the recycled fibre process is the addition of inorganic chemicals to enhance ink detachment from fibres and the associated release of inks and other contaminants from the recycled fibre. The detached ink is removed via a flotation process along with a small amount of fibre and combined with other solid waste for disposal by land spreading. No chlorine-containing chemicals are used for bleaching of pulp. The process water from the recycled fibre process contains inorganic salt residues from the inorganic deinking chemicals plus organic contaminants similar to those released during the TMP process.

The process waters from the softwood pulping process, recycled fibre process and paper making process (designated by the red lines in **Figure 29**) are contaminated by compounds released from the fibre in the pulping and papermaking processes and therefore need to be treated. To achieve this they are combined for treatment in an advanced multi-stage effluent treatment facility. The first stage is primary treatment, the main objective of which is to settle out any particulate matter in a clarifier. The settled sludge is combined with other solid wastes from the mill for disposal by land spreading. Following the settling stage, process water then passes through a heat exchanger to cool it to a temperature suitable for treatment using an activated sludge process. Activated sludge is a biological oxidation process that uses naturally occurring aerobic bacteria, added nutrients (in the form of urea and phosphoric acid) and air to break down the extractives, wood sugars, carbohydrates, and other organic compounds present in the process water. The biological treatment process employed has a residence time of greater than two days. The products of this high-rate biological process are biomass, carbon dioxide and water. The main components in the treated process water are some residual colour (caused by similar coloured materials to that present in natural river water), and inorganic salts. Minor components include a small nutrient residual (nitrogen and phosphorous).The excess biomass is removed in another clarifier and combined with other solid waste for disposal by land spreading.

Following biological treatment the treated process water passes through a holding pond that has a 4 day residence time where further “polishing” of the effluent occurs through the effects of sunlight and wind action. In the current mill operation, the treated process water is then transferred from the four day holding lagoon to Lake Ettamogah, a 2200 ML capacity storage facility where water is held for application to both tree plantation and agricultural crops. In the event that the storage facility is at its maximum capacity, the treated process water may be returned to the Murray River. In this instance an additional stage of treatment is applied by passing it through a sand filter where any remaining particulate material is removed.

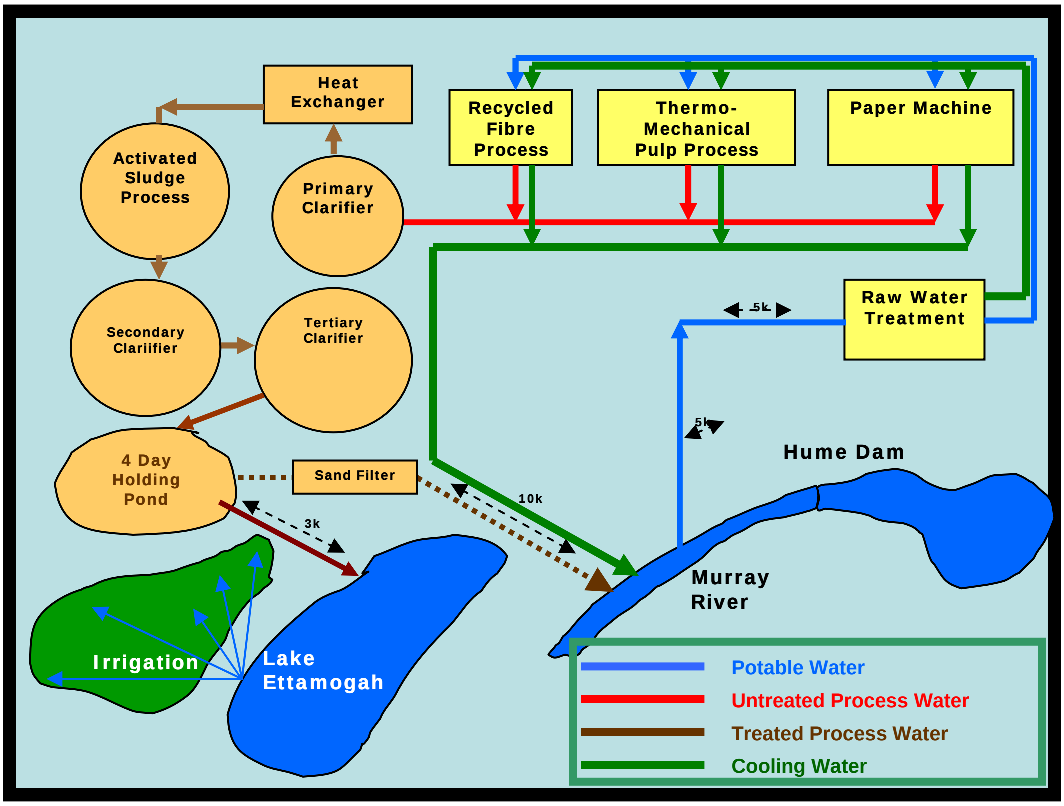

Figure 29. Conceptual layout of water use, treatment and re-use at Norske Skog Albury Mill.

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CHAPTER SEVEN

7 ENVIRONMENTAL IMPACT ASSESSMENT

7.1 Overview of the Predicted Impacts to the Murray River

This section of the application sets out the proposed quality of treated process water returned to the Murray River and compares treated process water impacts against guidelines set down in the National Water Quality Management Strategy.

The National Water Quality Management Strategy (NWQMS) contains a benchmark document "The Australian Guidelines for Water Quality Monitoring and Reporting (2000)" the policy objective of which is:

> "to achieve sustainable use of the nation's water resources by protecting and enhancing their water quality while maintaining economic and social development"[33], refer **Reference 16.**

In the guidelines, 'environmental values' is the term applied to particular values or uses of the environment. The Water Quality Guidelines recognise the following environmental values: Aquatic ecosystems; Primary industries; Recreation and aesthetics; Drinking water; Industrial water; and Cultural and spiritual values.

Associated with each environmental value are 'guidelines' or 'trigger values' for substances that might impair water quality. The guidelines are numerical concentration limits or narrative statements designed to support and maintain a designated water use. If these values are exceeded, they may be used to trigger an investigation or initiate a management response. With respect to aquatic ecosystems, guidelines are provided for three ecosystem conditions, with a different level of protection recommended for each:

- High conservation/ecological value systems;
- Slightly to moderately disturbed systems; and
- Highly disturbed systems.

The Murray River at the discharge point for treated process water is taken to be a 'slightly to moderately disturbed system'. It has low nutrient status, soft water and is regulated with high spring-summer flows.

The remaining sections of this chapter will address water quality (specifically how the treated process water compares against both numerical and narrative water quality criteria), Flora and Fauna impacts and propose a monitoring program that will monitor the impacts of the proposal should it proceed.

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[33] http://www.mincos.gov.au/publications/australian_guidelines_for_water_quality_monitoring_and_reporting.

7.2 Water Quality

7.2.1 Treated Process Water Quality

As outlined in chapter 6, the treated wastewater has undergone extensive processing to remove contaminants from it prior to leaving the mill site. The biological treatment given to the process water is extremely efficient and removes ≈ 99% of the biologically degradable organic matter. The main components in the treated process water are some residual non-degradable organic compounds (caused by similar coloured materials to that present in natural river water), and inorganic salts. Minor components include a small nutrient residual (nitrogen and phosphorous).

Table 7 summarises the composition of the treated process water and groups the constituents according to their physical or chemical properties. The mill has not routinely discharged effluent to the Murray River for some time, so direct monitoring data associated with any river discharge is not available. Treated process water that leaves the Four day Holding Pond (see **Figure 29**) has the closest water quality to that proposed in this application. The numbers in **Table 7** are based on treated process water quality at this location. Treated process water that will be discharged under a Salinity Offset scheme will also pass through a sand-filter, thus reducing further the concentration of particulate matter in the effluent.

The data in **Table 7** therefore represent a situation with respect to particulate related parameters (total suspended solids, total nitrogen, total phosphorous and turbidity) that over-estimates the likely concentration in the stream. Proposed licence limits have been developed in discussions with DECC for each constituent listed in **Table 7**, and are included for comparison. The limits listed in **Table 7** will be referred to as proposed licence limits for the purposes of discussing the treated process water quality below.

Constituent	Concentration (mg/L)	Proposed EPA Licence Limit (mg/L)
Oxygen Depleting Substances		
Biochemical Oxygen Demand	10±5	20
Particulate Matter		
Total Suspended Solids	16±14	20
Dissolved Salts		
Total Dissolved Solids	1695±264	2000
Sodium	335±81	
Calcium	113±23	
Magnesium	12±3	
Potassium	52±11	
Bicarbonate	699±200	
Sulphate	473±106	
Chloride	45±11	
Nutrients		
Total Nitrogen	7.6±3.0	15
Ammonia	0.51±0.66	3
Nitrate	1.05	
Total Phosphorous	0.32±0.28	0.5
Metals		
Iron	0.31±0.19	3
Zinc	0.20±0.09	0.4
Copper	0.006±0.009	0.05
Manganese	1.1±0.3	2.5
Cadmium	<0.001	0.006
Chelating Agents		
Diethylenetriaminepenta-acetic acid	3.0±2.7	50

Table 7. Average concentration (± one standard deviation) and proposed licence limits under the Protection of the Environment Operations Act (1997) of constituents in treated process water as it will be prior to discharge to the Murray River. The concentration results are the average from 48 or more effluent samples collected approximately weekly from January 2006 to March 2008 from the outlet from the 4-day holding pond, apart from the Nitrate value, which was taken for the period January 2006- June 2007.

7.2.2 Oxygen Depleting Substances

Biochemical oxygen demand (BOD) is a measure of the amount of oxygen required to degrade residual organic matter in the treated process water. Excessive BOD in effluent discharged to rivers and waterways will result in dissolved oxygen depletion. Thus it is important that BOD be removed before releasing effluent to waterways. The BOD of the process water before biological treatment (part of the process outlined in **Figure 29**) is in excess of 1200 mg/L. The reduction to an average of 10 mg/L (see **Table 7**) in treated process water equates to a >99% reduction, and is half the licence limit of 20 mg/L. The long term trend for BOD in treated process water is shown in **Figure 30**, and apart from some excursions between 2003 and 2005, remains below the 10 mg/L level.

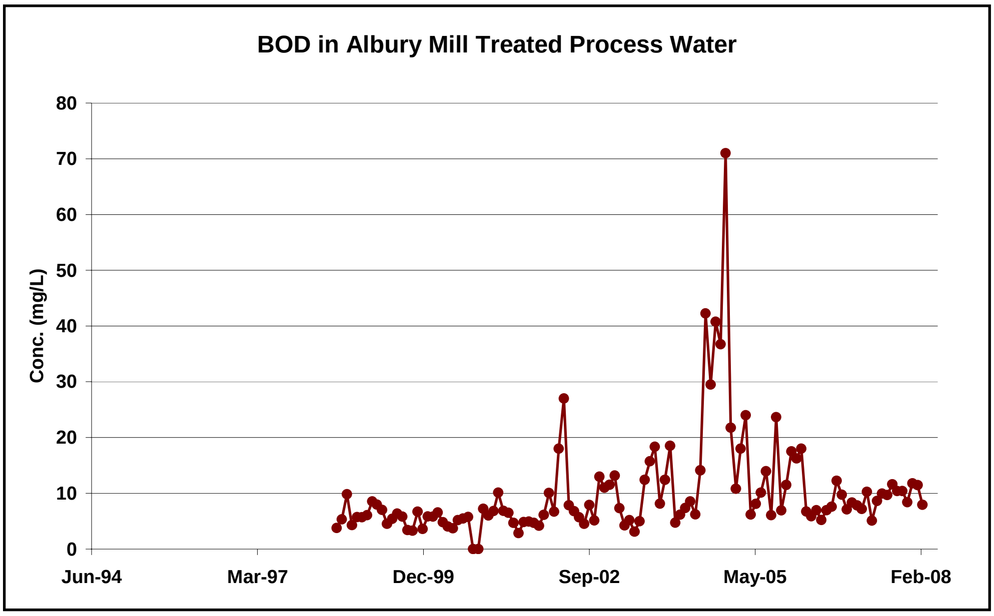

Figure 30. BOD in treated process water from 1998 - 2008.

The BOD data presented in **Figure 30** represents oxygen depletion in treated process water over a standard 5 day period (BOD_5). A related parameter, ultimate biochemical oxygen demand (UBOD) was measured on a treated process water sample collected in March 2008. The UBOD for this sample, measured over 90 days, was 23 mg/L. It may therefore be concluded that organic matter present in treated process water that returns a 5 day BOD result within the range recorded in **Figure 30** would have a UBOD that is only slightly greater than the BOD_5.

In addition to there being a small quantity of organic substances that give rise to a biochemical oxygen demand, treated process water also contains some non-biodegradable organic matter that gives it a slight "straw yellow" colour. This non-biodegradable organic matter does not consume oxygen in the receiving environment. The substances that give the treated process water this slight colour are believed to comprise humic and fulvic acids.

7.2.3 Particulate Matter

Total suspended solids (TSS) is a measurement of the particulate matter present in the treated process water. This fine colloidal material is primarily residual biomass/detritus from the biological oxidation process. The average TSS concentration in treated process water that is proposed to be discharged to the Murray River, will be lower than the average value listed in **Table 7** (16 mg/L). This is because the water will pass through a sand filter under the proposed green offset arrangement, which will remove some of the particulate matter currently present.

7.2.4 Dissolved Salts

The major constituent in treated process water from the Norske Skog Albury mill is dissolved solids (see **Table 7**). The current average concentration of 1695 mg/L in treated process water is below the licence limit of 2000 mg/L. These dissolved solids are comprised almost entirely of the inorganic ions sodium, calcium, magnesium, potassium, bicarbonate, sulphate and chloride at the concentrations listed in **Table 7**. Thus it is accurate to say that the main dissolved component of treated process water is dissolved inorganic salt. However its composition is significantly different to that of seawater salt (sodium chloride). The major salt in the mill's treated process water is sodium bicarbonate, with sodium sulphate the second most abundant inorganic salt. In contrast to dissolved organics, dissolved salt cannot be removed by the current effluent treatment process.

Figure 31 shows how the concentration of dissolved solids varied in treated process water over the period 1994 – 2008. The seasonal and annual variation observed in **Figure 31** is due to changes in process chemical requirements at different times of the year. The upward trend observed reflects improvements in water use efficiency and increases in production volumes over time, as well as the introduction and increased use of recycled fibre.

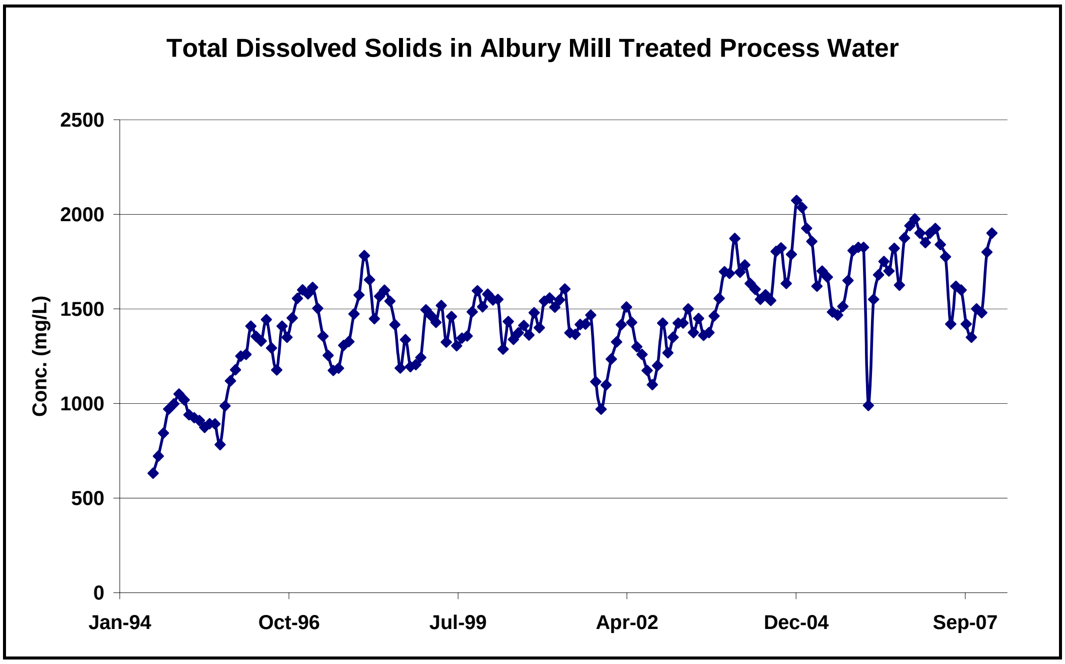

Figure 31. Total dissolved solids concentration in Albury mill treated process water from 1994 – 2008

7.2.5 Nutrients

The next group of compounds in **Table 7** are the nutrients, of which total nitrogen has the highest concentration. Nitrogen is added in the form of urea to the wastewater prior to entering the activated sludge treatment process due to the wastewater being deficient in nitrogen. The normal mode of operation is to add sufficient nitrogen to just satisfy the nutrient requirements of the biomass. This should result in minimal carryover of nutrient in the treated process water. The average concentration of total nitrogen in the treated process water of 7.6 mg/L is almost half that of the licence limit, 15 mg/L. The long term trend for total nitrogen in treated process water in **Figure 32** below shows no particular upward or downward trend. The likely concentration for total nitrogen in treated process water in the proposed partial return to the Murray River is likely to be lower than that listed in **Table 7** due to the additional filtering effect that sand filters will have on removing particulate matter, of which total nitrogen is a component.

Total nitrogen is composed of organic and inorganic components. The organic component is the major component in Norske Skog Albury mill treated process water and is primarily dead biomass/detritus from the biological process. It degrades slowly in the environment. The inorganic components of nitrogen in treated process water comprise ammonia and nitrate and may be readily taken up by aquatic plants in the environment. Together, ammonia and nitrate account for around 20% of the nitrogen. The long term trend for ammonia in treated process water (**Figure 33**) shows no particular upward or downward trend. The long term trend for nitrate (**Figure 34**) shows that, apart from occasional upward excursions, nitrate has remained under 2 mg/L from around 2003 onwards. This is indicative of nitrification not occurring in the activated sludge plant, and is the desired mode of operation for treating a wastewater that is deficient in nitrogen.

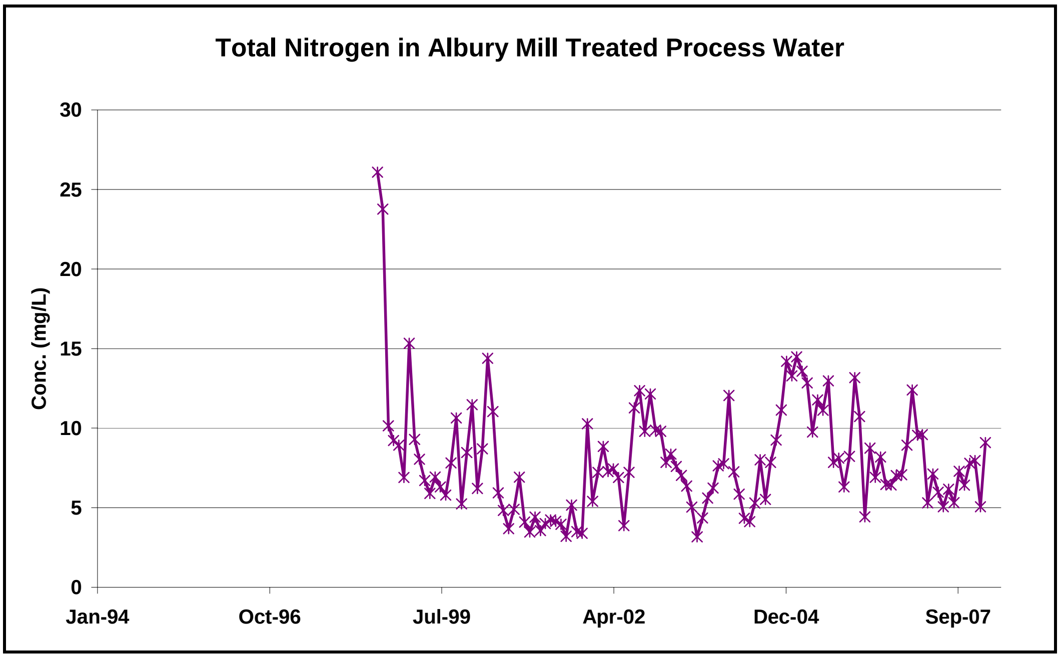

Figure 32. Total nitrogen in treated process water from 1998 - 2008.

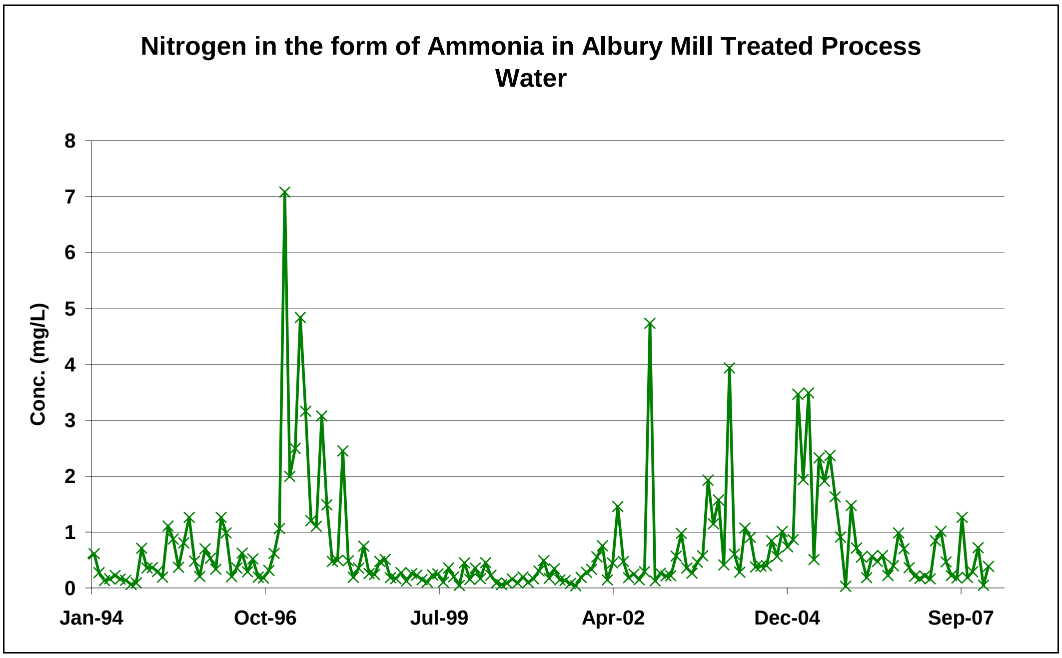

Figure 33. Concentration of nitrogen as ammonia in treated process water from 1994-2008.

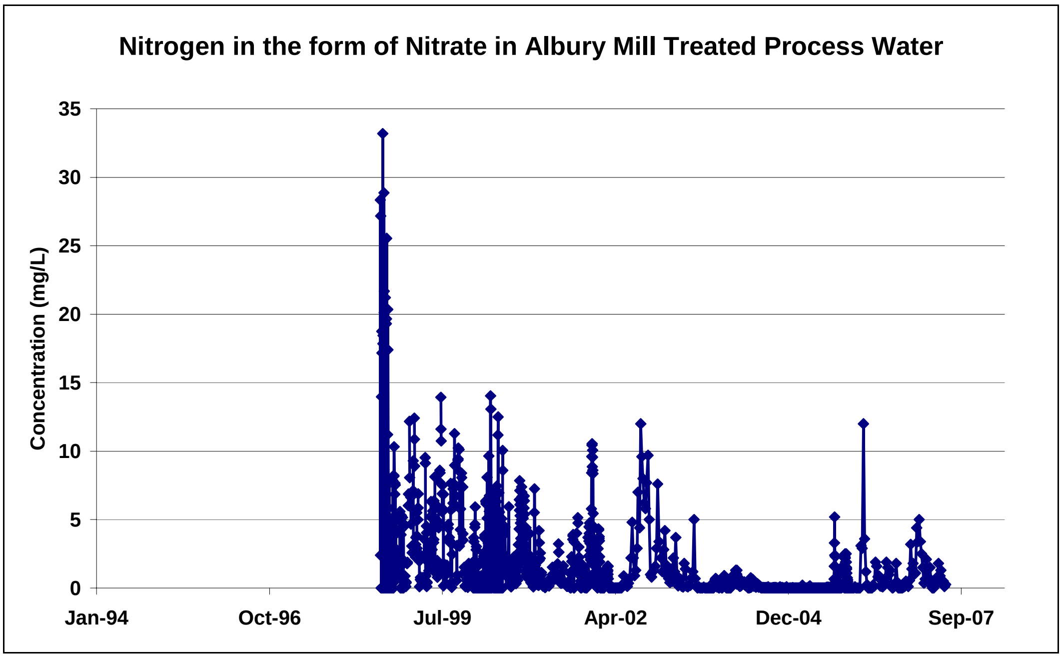

Figure 34. Concentration of nitrogen as nitrate in treated process water from 1998-2007.

Phosphorous is another nutrient that is present in treated process water, and is measured as total phosphorous. Its average current treated process water concentration of 0.32 mg/L is well below the licence limit of 0.5 mg/L. As is the case for nitrogen, so phosphorous has both an organic and an inorganic form, with the former also degrading slowly in the environment. The inorganic form, referred to either as ortho-phosphate or soluble phosphate, is assimilated more rapidly by aquatic plants. The dominant form in treated process water is the slowly degrading organic form.

The long term trend for total phosphorous in treated process water in **Figure 35** shows no particular upward or downward trend. The likely concentration for total phosphorous in treated process water in the proposed partial return to the Murray River is likely to be lower than that listed in **Table 7** due to the additional filtering effect that sand filters will have on removing particulate matter, of which total phosphorous is a component.

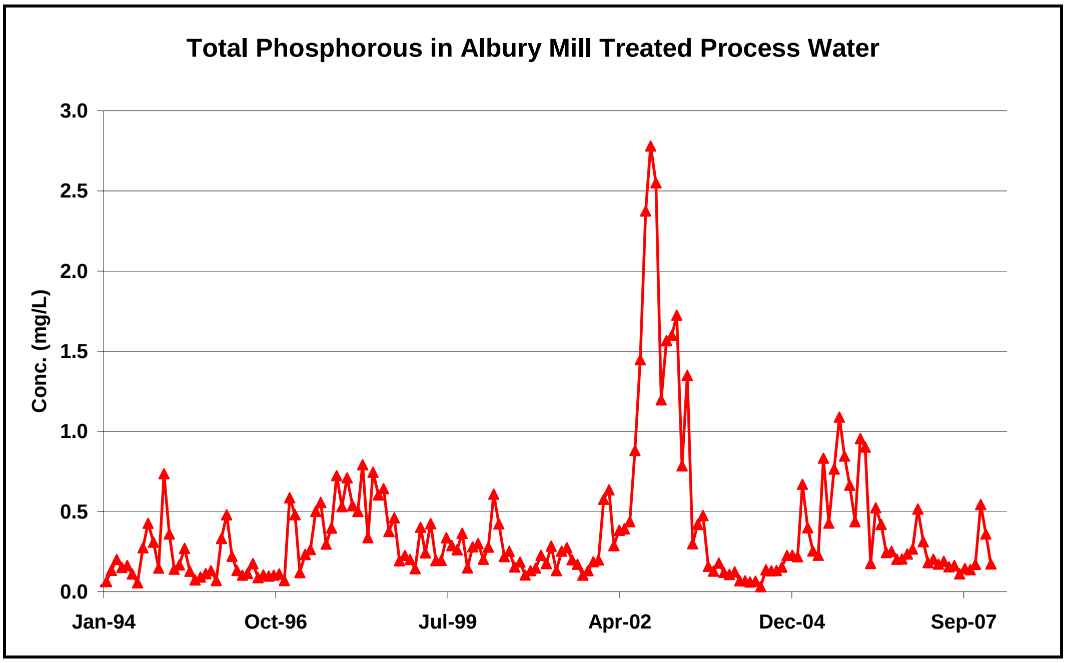

Figure 35. Total phosphorous concentration in treated process water from 1994 - 2008.

7.2.6 Metals

Heavy metals of environmental relevance that may be present and measured in the treated process water are iron, zinc, copper, manganese and cadmium. Iron, zinc and manganese are present in the incoming wood and a proportion of these are released in the pulping process. Cadmium and copper could potentially be present in deinking waste, and their measurement has been a requirement of environmental licence conditions since the recycling facility was first commissioned at Albury. All metals are well below their respective licence limits.

The long term trends for the concentration of metals in treated process water are shown in **Figure 36** to **Figure 40.** Iron (**Figure 36)** shows no particular long term trend. Zinc (**Figure 37**) by contrast shows a slightly downward trend with time from a range of 0.2 – 0.3 mg/L to below 0.2 mg/L in more recent times. Apart from isolated excursions in 2000- 2001, copper remains consistently below the licence limit of 0.05 mg/L and has averaged 0.006 mg/L for the past 2 years (**Figure 38)**. Manganese (**Figure 39**), shows a downward trend from > 2 mg/L in 2000-2001 to < 1 mg/L in more recent times. Cadmium (**Figure 40**) also shows a downward trend to non-detectable levels in recent times.

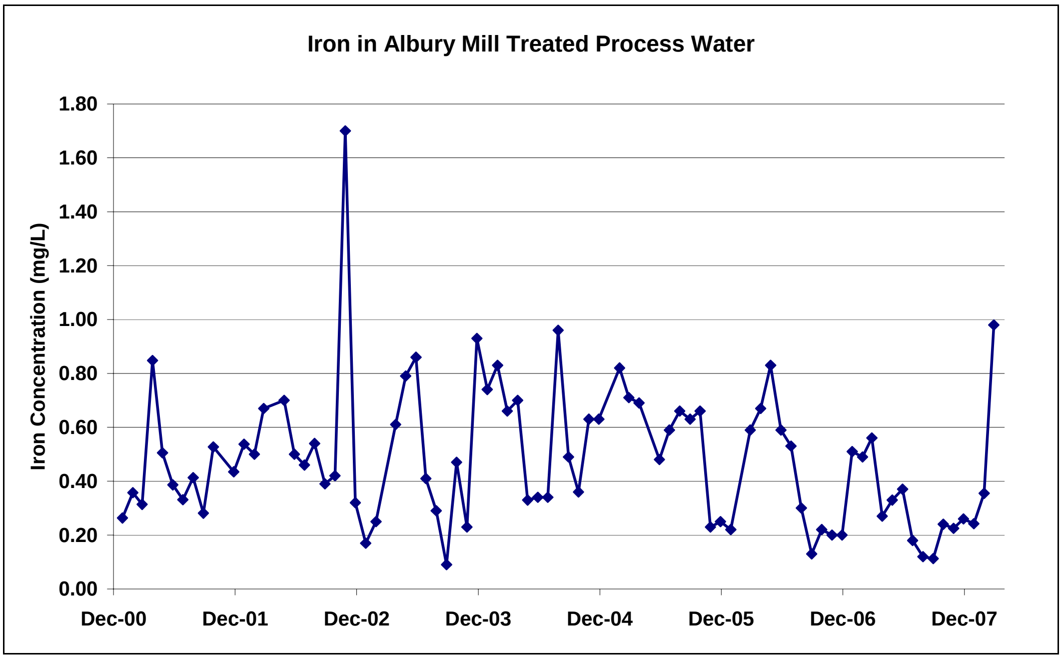

Figure 36. Iron concentration in treated process water from 2000- 2008.

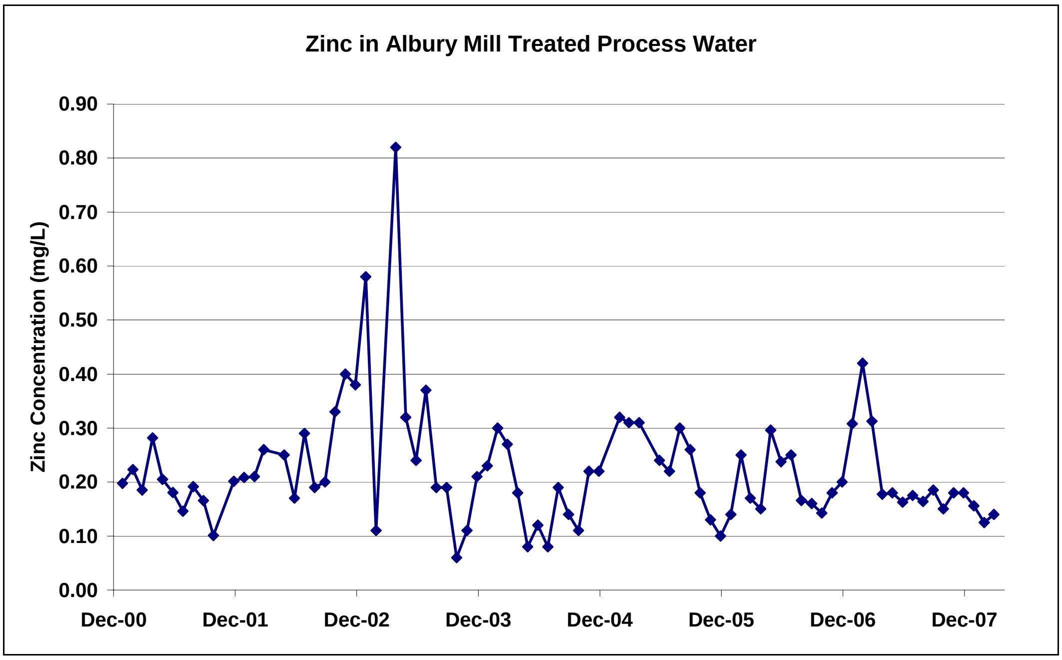

Figure 37. Zinc concentration in treated process water from 2000- 2008.

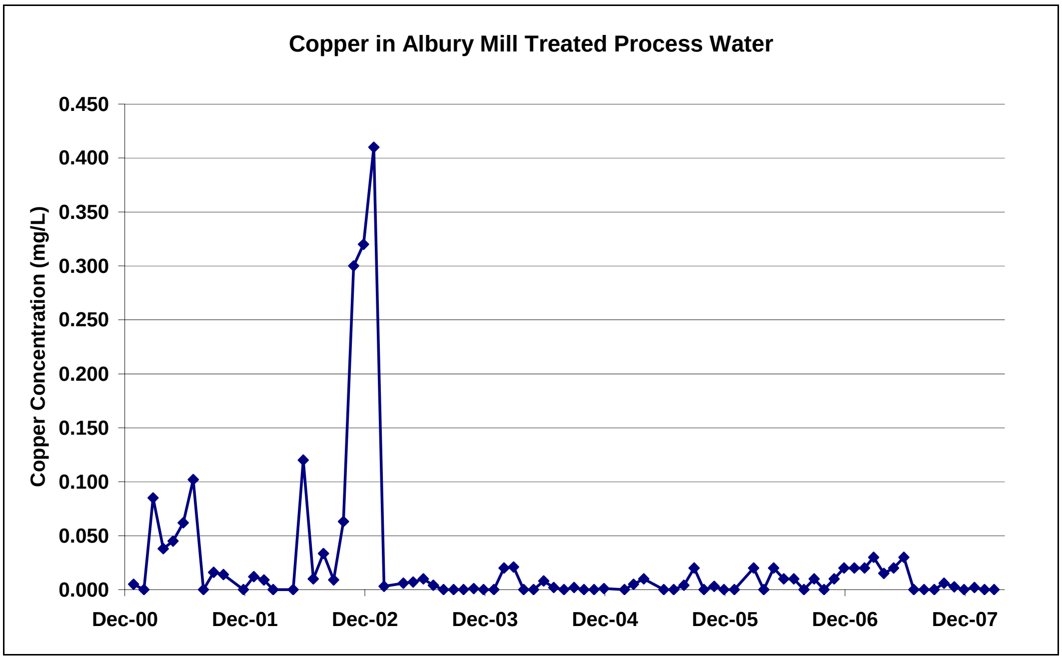

Figure 38. Copper concentration in treated process water from 2000- 2008.

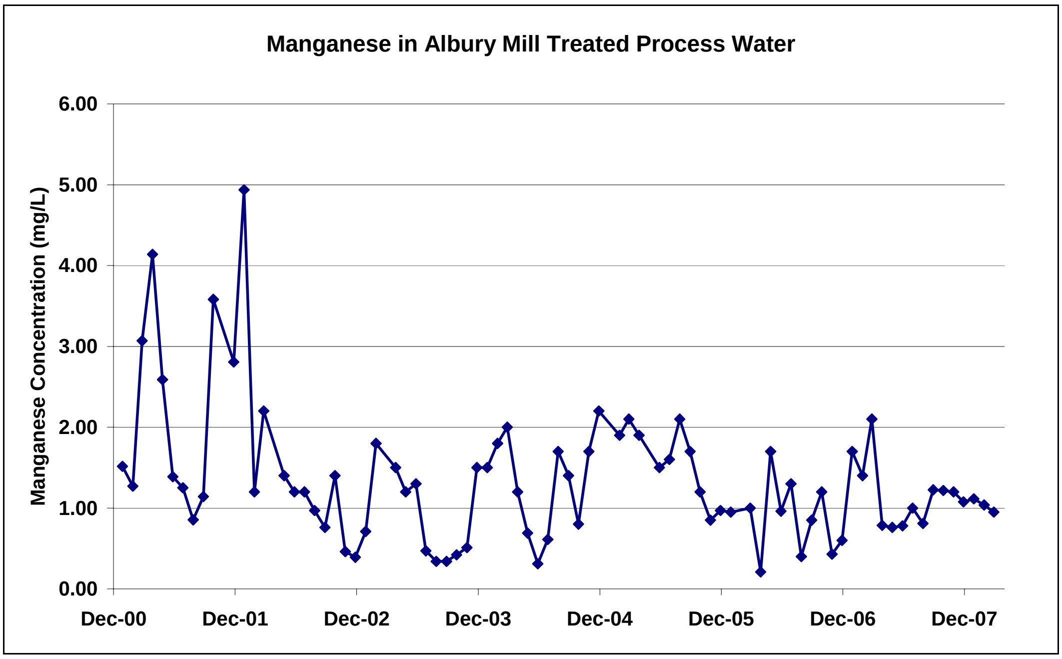

Figure 39. Manganese concentration in treated process water from 2000- 2008.

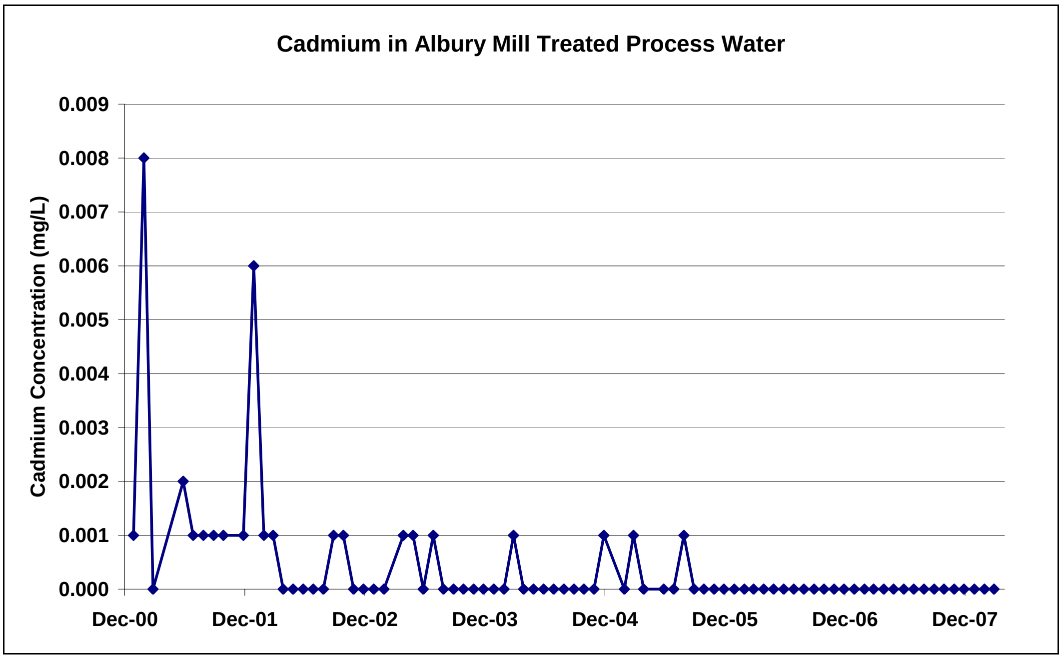

Figure 40. Cadmium concentration in treated process water from 2000- 2008.

7.2.7 Chelating Agents

The final compound listed in **Table 7,** diethylenetriaminepenta-acetic acid, is commonly used as a chelating agent. It is added in the pulp brightening process to improve the efficiency of the brightening chemicals. It is degraded to a significant extent both in the pulping process and in the wastewater treatment process[34], refer **Reference 17**. Its main relevance environmentally is the possibility of chronic toxic effects on aquatic species[35], refer **Reference 18**. It is present at a very low concentration of 3 mg/L, compared to the licence limit of 50 mg/L. The trend in DTPA concentration over the last 8 years (**Figure 41**) indicates fairly stable levels, apart from elevated levels during 2004, but all well below the licence limit of 50mg/L.

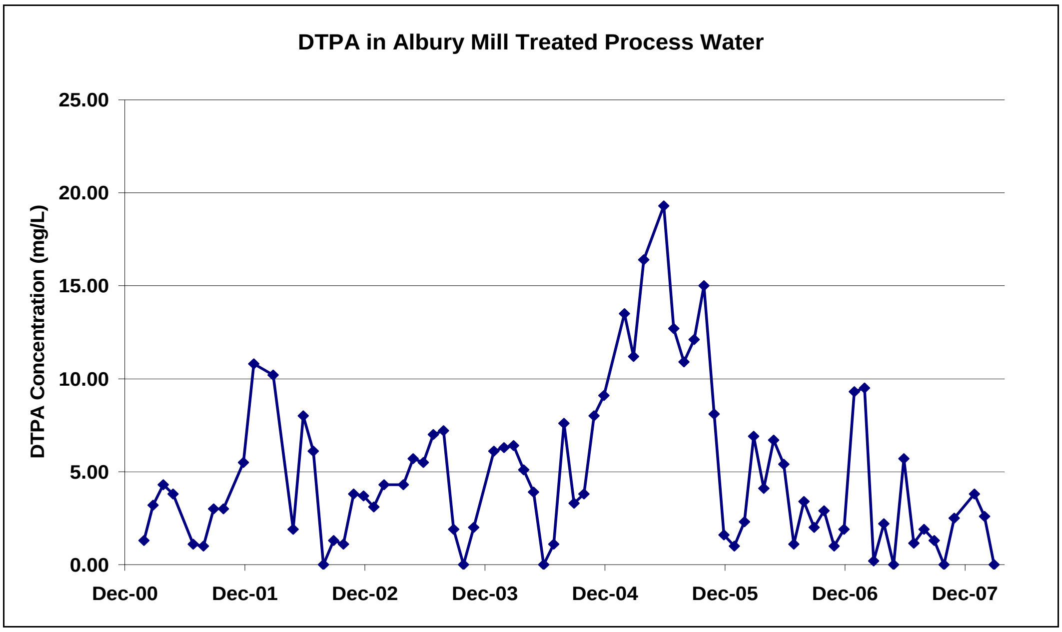

Figure 41. DTPA concentration in treated process water from 2000- 2008.

7.2.8 Summary of Water Quality Data

In summary, total dissolved solids has increased with time over the period 1994 – 2008, nutrients, iron and DTPA have remained largely stable over the period 2000 – 2008, and the metals zinc, copper, manganese and cadmium have trended to lower levels. All parameters listed in **Table 7** are well below the DECC licence limits.

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[34] Richardson, D. E., G. H. Ash, et al. (1994). "The Determination of Diethylene-triaminepenta-acetic Acid in Pulp Mill Effluent by Ion Interaction Reverse Phase Liquid Chromatography." Journal of Chromatography **688**: 47-53.

[35] van Dam, R. A., M. J. Barry, et al. (1996). "Comparative Acute and Chronic Toxicity of Diethylenetriamine Pentaacetic Acid (DTPA) and Ferric-Complexed DTPA to Daphnia carinata." Archives of Environmental Contamination and Toxicology **31**: 433-443.

7.3 Assessment Against Murray River Catchment Water Quality Objectives - Numerical Indicators

Water quality objectives for the regulated portion of the Murray River (from Hume Dam to the NSW-SA border) have been developed by the Murray Darling Basin Commission[36] refer **Reference 19**. Objectives consist of three parts: environmental values, their indicators and their guideline levels.

Meeting water quality levels suitable for local aquatic ecosystems is generally the basis for protecting the other environmental values, which are the uses people have for water. The water quality objective for Aquatic ecosystems is "Maintaining or improving the ecological condition of water-bodies and their riparian zones over the long term." Local water quality varies naturally because of various factors, including the type of land the waters are draining (e.g. soils, slope), or rainfall and runoff patterns (e.g. ephemeral or permanent streams).

The ANZECC 2000 Guidelines emphasise water quality criteria that can be determined on a case by case basis, according to local environmental conditions.

In order to assess the impact upon numerical indicators of water quality it is necessary to quantify the volume to be discharged and the concentration of the indicator in both the stream to be discharged and the receiving water. The final volume of treated process water that will be discharged to the river will be determined by the river flow conditions and the salt concentration of the treated process water and will be the lesser of:

(1) that required to ensure dilution will be >600:1; or
(2) that required to ensure salt load is <5 tonnes day per day.

The actual volume will vary depending on the river flow. At all times the dilution will be > 600:1. It is expected that it will average about 3 ML/day. Analysis of the past 5 years of historical flow records for the Murray River at Doctor's Point (the closest flow monitoring station to the discharge point) indicates there is sufficient water flow to achieve a 600:1 dilution outside the mixing zone on 358 days per year if 2 ML per day is discharged, whilst a flow of 3ML per day can achieve a 600:1 dilution on 317 days per year. The time when the dilution is least likely to be achieved is during the winter months. The treated process water would not be returned to the river during these times. As indicated in an earlier section, the diffuser design ensures that treated process water returned to the river at a flow of 3ML/d is predicted to have a surface field dilution of 60:1. That is, effluent in the river water immediately above the point will be diluted at least 60 times. Thus the minimum dilution of effluent within the mixing zone is estimated to be 60:1.

Table 8 lists the concentration of each treated process water component once diluted by river water for both of these conditions, 60:1 within the mixing zone and 600:1, beyond the mixing zone.

[36] http://www.environment.nsw.gov.au/ieo/Murray/report-02.htm#P201_26584

7.3.1 Oxygen Depleting Substances

The ANZECC Guidelines place no numerical indicator upon the biochemical oxygen demand constituent. The concentration of biochemical oxygen demand after dilution is predicted to be below the detection limit (estimated to be 5 mg/L) either within or outside the mixing zone. Furthermore, the impact of the very low level of BOD on the concentration of dissolved oxygen present in the river water will be insignificant, and no measurable depletion of dissolved oxygen will be observed either in or beyond the mixing zone.

7.3.2 Particulate Matter

No numerical indicator is placed upon total suspended solids, although a related indicator, turbidity, has a numerical trigger value of 2- 25 NTU. The value of 0.027 mg/L for total suspended solids after dilution would result in a turbidity value well below the lower value of this trigger level range.

7.3.3 Dissolved Salts

The ANZECC Guidelines list a high protection trigger value range of 30-350µS/cm for salinity of upland rivers, which, after application of a conversion value from conductivity to total dissolved solids of 0.75, this conductivity range equates to a total dissolved solids range of 22.5-262.5 mg/L. The treated process water after dilution could therefore contribute almost 3 mg/L of total dissolved solids to that present in the water. The average conductivity measured over a five year period from 2003 – 2008, at Doctor's Point, upstream of the Norske Skog return water discharge pipe, is 43.3 µS/cm[37], (refer **Reference 20),** which equates to around 32 mg/L total dissolved solids. Thus, on average, the treated process water could increase the very low total dissolved solids concentration in the Murray River at Albury from 32 to a maximum of 50 mg/L within the mixing zone and from 32 to a maximum of 35 mg/l downstream of the mixing zone. The effect is therefore to increase the total dissolved solids to a higher value within the trigger value range specified for upland rivers. However, the salinity offset will address this increase.

7.3.4 Nutrients

The ANZECC guidelines list a high protection trigger value for total nitrogen of 0.25 mg/L for upland rivers. The background level of total nitrogen in the Murray River at Albury is around 0.32±0.78 mg/L[38], and so exceeds the recommended trigger value of 0.25 mg/L. By contrast, the treated process water proposed to be discharged by Norske Skog could add an additional 0.01 mg/L of total nitrogen to that already present in Murray River water outside the mixing zone, to give an in-river concentration of 0.33 mg/L, an increase barely measurable above the background level. An additional 0.12 mg/L of total N could be added within the mixing zone to give a concentration within the mixing zone of 0.44 mg/L. The effect outside the mixing zone is therefore to increase the total nitrogen to an insignificantly higher value above the trigger value specified for upland rivers. However, as

[37] http://waterinfo.nsw.gov.au/cgi-bin/browse.epl?site=409017

[38] Based on analytical data collected for 16 in-coming raw water samples to Norske Skog Albury mill from January 2007 to May 2008.

pointed out in Section 7.2.5, the form of the nitrogen is predominantly as detritus and dead biomass which is a slowly degradable form of nitrogen. It is therefore unlikely to lead to increased algal blooms or nuisance aquatic weeds either within or beyond the mixing zone.

No numerical indicator is specified in the ANZECC guidelines for ammonia or nitrate. Analytical data for Murray River water at Albury suggest that nitrate is the dominant form of nitrogen present in the river at this location.

The ANZECC guidelines list a high protection trigger value for total phosphorous of 0.02 mg/L for upland rivers. The background level of total phosphorous in the Murray River at Albury is around 0.05±0.07 mg/L[39], and so exceeds the recommended trigger value of 0.02 mg/L. Addition of the treated process water could add an additional 0.0005 mg/L, or 1%, of total phosphorous to that already present in river water outside the mixing zone, to give an in-river concentration of 0.0505 mg/L, an increase barely measurable above the background level. An additional 0.005mg/L of phosphorous could be added within the mixing zone to give a concentration within the mixing zone of 0.055 mg/L. The effect outside the mixing zone is therefore to increase the total phosphorous to an insignificantly higher value above the trigger value specified for upland rivers. No adverse effect is expected within the mixing zone from total phosphorous as it is predominantly in the form of detritus and dead biomass, which will not degrade into an available form during the time it remains in the mixing zone.

7.3.5 Metals

No numerical indicator is specified in the ANZECC guidelines for iron.

The ANZECC guidelines list a high protection trigger value for zinc of 0.008 mg/L for protection of 95% of species. The treated process water could add 0.003 mg/L of zinc to Murray River water within the mixing zone, and 0.0003 mg/L beyond the mixing zone. As no suitable background data on the level of zinc in Murray River water was available, the impact if any of this parameter was assessed by ecotoxicological tests (see Section 7.5).

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[39] Based on analytical data collected for16 in-coming raw water samples to Norske Skog Albury mill from January 2007 to May 2008.

Constituent	Concentration (mg/L)	Concentration @ 60:1 Dilution [1] (mg/L)	Conc. In River after 60:1 Dilution (mg/L)	Concentration @ 600:1 Dilution [2] (mg/L)	Conc. In River after 600:1 Dilution (mg/L)	High Protection Trigger Value
Oxygen Depleting Substances						
Biochemical Oxygen Demand	10 ± 5	0.2	Background Unknown	0.02	Background Unknown	None Listed
Particulate Matter						
Total Suspended Solids	16 ± 14	0.27	Background Unknown	0.027	Background Unknown	None Listed
Dissolved Salts						
Total Dissolved Solids	1695 ± 264	28	60	2.8	35	22.5 – 262.5[3]
Nutrients						
Total Nitrogen	7.6 ± 3.0	0.12	0.44	0.012	0.33	0.25
Ammonia	0.51 ± 0.66	0.01	Background Unknown	0.001	Background Unknown	None Listed
Nitrate	1.05 ± 1.69	0.018	Background Unknown	0.002	Background Unknown	None Listed
Total Phosphorous	0.32 ± 0.28	0.005	0.055	0.0005	0.0505	0.02
Metals						
Iron	0.31 ± 0.19	0.005	Background Unknown	0.0005	Background Unknown	None Listed
Zinc	0.2 ± 0.09	0.003	Background Unknown	0.0003	Background Unknown	0.008 [4]
Copper	0.006 ± 0.009	0.0001	Background Unknown	0.00001	Background Unknown	0.0014 [4]
Manganese	1.1 ± 0.3	0.018	Background Unknown	0.0018	Background Unknown	1.9 [4]
Cadmium	<0.001	<0.00002	Background Unknown	<0.000002	Background Unknown	0.0002 [4]
Chelating Agents						
Diethylene-triaminepenta-acetic acid	3.0 ± 2.7	0.05	Background Unknown	0.0050	Background Unknown	None Listed

Table 8. Comparison of treated process water constituent concentrations against ANZECC guidelines following 600:1 dilution with river water.

[1]Estimate of surface field dilution immediately above diffuser (ie within the mixing zone) of 3ML/d in a river flow of 800ML/d.

[2]The minimum dilution outside the mixing zone upon complete mixing of treated process water with Murray River water.

[3] Based on EC values from ANZECC Guidelines. Assume EC * 0.75 conversion for Total Dissolved Solids.

[4] Trigger values for protection of 95% of species in freshwater.

The ANZECC guidelines list a high protection trigger value for copper of 0.0014 mg/L for protection of 95% of species. The treated process water could add 0.0001 mg/L of copper to Murray River water within the mixing zone, and 0.00001 mg/L (ie <1% of the trigger value) beyond the mixing zone. As no suitable background data on the level of copper in Murray River water was available, the impact if any of this parameter was assessed by ecotoxicological tests (see Section 7.5).

The ANZECC guidelines list a high protection trigger value for manganese of 1.9 mg/L for protection of 95% of species. The treated process water could add 0.018 mg/L of manganese to Murray River water within the mixing zone, and 0.0018 mg/L (ie <0.1% of the trigger value) beyond the mixing zone. As no suitable background data on the level of manganese in Murray River water was available, the impact if any of this parameter was assessed by ecotoxicological tests (see Section 7.5).

The ANZECC guidelines list a high protection trigger value for cadmium of 0.0002 mg/L for protection of 95% of species. The treated process water will add <0.00002 mg/L of cadmium to Murray River water within the mixing zone, and <0.000002 mg/L (ie <1% of the trigger value) beyond the mixing zone. As no suitable background data on the level of cadmium in Murray River water was available, the impact if any of this parameter was assessed by ecotoxicological tests (see Section 7.5).

7.3.6 Chelating Agents

No numerical indicator is specified in the ANZECC guidelines for the chelating agent diethylene-triaminepenta-acetic acid (DTPA). DTPA can exist in both a free form and as an Fe(III)-DTPA complex in biologically treated effluent (refer **Reference 17**), with an average of 50% in the latter form. Toxicity studies by van Dam et al (refer **Reference 18**) indicate that the no observed effect concentration (NOEC) of DTPA and Fe(III)-DTPA to *Daphnia carinata* are 1 and 67 mg/L respectively. The treated process water could add DTPA (in both free and iron bound forms) to the Murray River at a concentration within the mixing zone of 0.05 mg/L, and 0.005 mg/L beyond the mixing zone. These levels are well below the NOEC levels, so no adverse impact is expected on aquatic species. The ecotoxicological tests referred to later in this chapter would also have detected any impact from this treated process water component.

7.3.7 Summary of Water Quality Indicator Assessment

In summary, of those parameters listed in **Table 8** that have ANZECC trigger values listed, total dissolved solids is the only parameter that is expected to have a measurable increase in Murray River water outside the mixing zone. The nutrients total nitrogen and total phosphorous are not expected to have an adverse effect within the mixing zone as the nitrogen and phosphorous are not in a readily available form. Beyond the mixing zone, the concentration of total nitrogen and total phosphorous will not be detectable above background levels. The background concentrations of the heavy metals zinc, copper and cadmium at the point of discharge is not known so the likelihood that effects could be observed were assessed using ecotoxicological tests as set out in Section 7.5. No toxicity was observed to any of the five test organisms in undiluted effluent. Therefore it may be inferred that once diluted 600 times in the Murray River there will be no impact from these heavy metals.

7.4 Flora and Fauna Impact Assessment

An extensive bank of knowledge of the impact of Albury Mill treated process water on the Murray River at Albury was developed through an extensive range of monitoring programs conducted between 1992 and 1998. The results of these studies are discussed in detail below in order to document the impacts from an historical perspective. This discussion is followed by an assessment of the current treated process water impact through ecotoxicological tests.

7.4.1 Assessment of Historical Impacts

A comprehensive program to monitor the impact of treated process water from the Norske Skog Albury mill was conducted by the Murray Darling Freshwater Research Centre from 1992 -1999 (when the mill was known firstly as Australian Newsprint Mills Ltd and then Fletcher Challenge Paper). The monitoring program covered the following areas: water, sediments, eco-toxicology, bio-accumulation and biota. Full details including methodology, results and conclusions of the monitoring program may be found in **Appendix 7**. Additional background information may be found in **Appendix 8**. A summary of the results set out in **Appendix 7** is given in **Table 9**. In order to assess whether any change in effluent properties or impact are likely to have occurred between when the comprehensive MDFRC monitoring was done in 1992-1999, a comprehensive suite of ecotoxicology tests were performed on current mill effluent. These results are also discussed in this section.

Water

Water samples were collected at three sites on a monthly basis, at a point ≈1km upstream of the outfall up until February 1994 and thereafter ≈3km upstream (due to severe erosion at the former site), at a point ≈200m downstream of the outfall and ≈2km downstream of the outfall near Union Bridge. A range of heavy metals (including cadmium, copper, iron, manganese and zinc), nutrients (total nitrogen, ammonia, nitrate and total phosphorous) and physical parameters (including turbidity, colour, conductivity and total dissolved solids) were measured for these samples.

The consistent and recurring conclusion from the water monitoring (see **Table 9** for summary of each year's results) shows that there is very little variation in the concentration of any constituent between the upstream, mixing zone and downstream site on any one sampling occasion. However significant variations are observed from one sampling event to another, with clear seasonal patterns for some parameters such as iron, manganese, nitrate and turbidity.

Thus it may be concluded that in the period that the full quota of treated process water was discharged to the Murray River between 1992 and 1996, there was no measurable impact to any of the water quality parameters measured either within or beyond the mixing zone for the treated process water. The report from MDFRC concluded that "The data show little if any variation between sites despite their proximity to the discharged wastewater, but some seasonal variation."

Sediments

Sediment samples were collected from deposition zones ≈500m above and ≈500m below the effluent outfall. Twenty samples were taken in each deposition zone at 10m intervals at a distance from the bank (≈2m) equal to 60cm water depth. Samples were collected according to standard procedures, sieved and the -2mm fraction dried and analysed for a range of heavy metals (including cadmium, copper, iron, manganese and zinc), total nitrogen and exchangeable phosphorous.

The sediments at all three sites consist primarily of gravel and sand with little silt or clay present. In general, metals tend to be associated with either silt or clay, so the low content of both these classes meant that levels of metals tended to be very low. Due to localised events such as "snags" and floods, upstream sites sometimes showed lower concentrations of analytes than downstream sites (eg 1993, 1994) whilst the reverse was observed on other occasions (eg 1996, 1997).

The report from MDFRC concluded that "Annual sediment samples collected from three deposition zones consistently showed that the sediment downstream of the wastewater outfall was within the normal range for sediment along this stretch of the river. Variations in concentrations of analytes correlated well with variation in the organic content of the sediment independent of the sites location."

Ecotoxicology

Acute (96hr) eco-toxicological assays were conduced on *Chironomus tepperi* and *Daphnia carinata* using treated process water from a range of locations within the mill (including the discharge from the four day holding pond) and control water from the Murray River upstream from local point source discharges. Chronic (21day) assays were conducted on *Daphnia carinata* using treated process water and control water from the same locations as for the acute tests.

A variety of responses were observed with both acute and chronic toxicity tests. Un-diluted effluent often resulted in adverse effects for both chronic and acute tests on the microcrustacea *Daphnia carinata*. The MDFRC report concluded with respect to the microcrustacea tests that "Wastewater concentrations of 100% often resulted in significant adverse effects. Lower concentrations (10% or less) more often resulted in enhanced growth and reproduction. Microalgae and bacteria present in the wastewater were likely to be supplementing the artificial diets of the animals." With respect to the macroinvertebrate toxicity tests the MDFRC concluded that "Acute toxicity tests using *Chironmous tepperi* larvae were conducted monthly from 1992 to 1997. The tests rarely produced any significant mortality."

Bioaccumulation

Bioaccumulation trials on yabbies (*Cherax destructor*) and Silver Perch (*Bidyanus bidyanus*) were conducted using a mixture of 50% Murray River water and 50% treated process water from the four day pond outlet. At the end of 1996, Carp Gudgeon (*Hypseleotris spp*) were used for bioaccumulation trials over a 5 week period. Appropriate numbers of animals were added to each tank and a sub-sample removed at regular intervals for whole body chemical assay of a variety of heavy metals (including cadmium, copper, iron, manganese and zinc).

In general the bioaccumulation studies, conducted over several 9 month periods, demonstrated no differences as a result of exposure of test animals to treated process water except for some increases in manganese in the freshwater crayfish *Cherax* destructor due to accumulation of manganese in bacterial bio-films formed on parts of the crayfish. The MDFRC report concluded that "Good growth rates were observed in both the control and the wastewater treatments, but the animals from the latter did have some slightly elevated concentration of some metals. Manganese was consistently higher in animals living in wastewater and further investigations showed that the metal was not accumulating with in the animal's tissues but on the shell as a result of surficial deposits laid down by the action of Mn oxidizing bacteria (1996-1998)."

Bioaccumulation studies were conducted in small fish (silver perch in 1994-1996 and western carp gudgeon adults in 1997). The MDFRC report concluded that "Exposure to the wastewater resulted in either no difference compared with the controls, or an improvement with respect to growth rate and condition. Apart from some slightly higher values for aluminium and manganese in perch (1996), fish exposed to wastewater had consistently lower concentrations of all metals compared with those in the control water. This was attributed directly to greater proportional consumption of artificial food in the form of pellets by the fish in control water containing no naturally occurring food. (Wastewater from the holding pond was used unfiltered and contained significant number of micro-crustaceans and macroinvertebrates.)"

Biota

Artificial substrate samplers were used to collect macro-invertebrates at three paired sites, at a point ≈1km upstream of the outfall, a point ≈200m downstream of the outfall and ≈2km downstream of the outfall near Union Bridge. Samples were sieved to 500µm and the remaining portion preserved in 70% alcohol for sorting and identification. A variety of relevant statistical processes were used to determine differences in community structure and the relationships between sites.

Attempts were made to collect fish at each of the sites used for collecting macro-invertebrate samples, but, after a variety of approaches were unsuccessfully attempted, this aspect of the program was abandoned early in 1996. The MDFRC report concluded that was "thought to be typical of the paucity of fish in a regulated river of this size."

The consistent pattern observed over the course of the macroinvertebrate sampling and analysis was that there was no consistent biological difference between the upstream and downstream sites. The MDFRC report concluded that " Good numbers of animals from a variety of taxonomic groups reflected seasonality and the influence of unregulated tributaries on this reach of the River. Multivariate techniques used to compare the samples showed no difference between the sites in relation to the wastewater discharge, but some differences over time with respect to season."

7.4.2 Summary of Historical Studies

The overall conclusion from 8 years of research conducted by the Murray Darling Freshwater Research Centre on the impacts of treated process water on the sediments and biota in the Murray River was that "The wastewater generated by the newsprint mill was non toxic and capable of supporting significant biota." The ability of the wastewater to support a diversity of species was further demonstrated by studies done on the biota in Lake Ettamogah, a 2200 ML water storage dam used to store treated process water from the mill prior to irrigation on both trees and crops. The MDFRC report concluded in this instance that "A species list for Lake Ettamogah compiled in 1998 ….. identified 5 species of fish, 16 species of aquatic insects and 7 species of crustaceans living in the wastewater, as well as amphibians, reptiles, birds and mammals associated with the environs of the lake."

Year	Water	Sediments	Ecotoxicology	Bioaccumulation	Biota
1992	Little variation between sites for metals and phosphorous, but variation over time.	Sediments primarily sand and gravel, high variability but no significant difference between sites. No significant difference between mean of upstream and downstream sites for any elements.	No acute toxicity, apart from one traceable event. Chronic toxicity results varied due to test method development.	No differences as a result of exposure to treated process water.	No consistent biological difference between sites. Fish catching trials unsuccessful.
1993	Little variation between sites, but significant variation over time (seasonal effects).	Mean concentration of analytes downstream higher than upstream, due primarily to influence of a "snag".	Some acute & chronic effects in 100% treated process water on some occasions.	No differences as a result of exposure to treated process water.	No biological differences between sites; limited grouping according to sampling date. Fish catching trials unsuccessful.
1994	Little if any variation between sites, but significant seasonal effects.	Sediments primarily sand and gravel. Downstream samples had greater distribution in analyte concentrations than upstream. Mean concentration for downstream sites higher than upstream sites.	Acute toxic effects to *D. carinata* observed on some occasions in 100% treated process water. No toxic effects to *C. tepperi*.	Manganese increased slightly over time in *C. destructor* in 50% treated process water.	No biological differences between sites; limited grouping according to sampling date. Fish catching trials unsuccessful.
1995	Little if any variation between sites, but significant seasonal effects.	As for 1994, but variability between upstream & downstream due to differences in the degree of deposition.	Acute toxic response to *D. carinata* observed on two tests. Both stimulatory and inhibitory responses for *D. carinata* chronic assays. No toxic effects to *C. tepperi*.	No difference in growth between control and treated process water samples. Variable differences in metals between control & treatment. For *C. destructor*.	No biological differences between sites; limited grouping according to sampling date. No relationship between site macroinvertebrates & proximity to outfall. Fish catching trials unsuccessful.

Year	Water	Sediments	Ecotoxicology	Bioaccumulation	Biota
1996	Most data show little if any variation between sites, but significant seasonal effects, except for possible particulate event in June/July (not effluent related).	Additional upstream site included. Upstream sediments have greater concentration range and higher levels than downstream site. Sediment composition influenced by geomorphology rather than effluent.	No significant acute toxicity to *C. tepperi*. Some acute toxic response to *D. carinata.* Some inhibitory responses for *D .carinata* chronic assays.	Manganese increased in *C. destructor* in 50% treated process water. No significant difference between control & treatment for *B. bidyanus*.	No difference in macroinvertebrate community structure between sites. No effect from treated process water. Fish catching trials abandoned.
1997 NB As of Jan. only cooling water was discharged to the river.	Little if any variation between sites, but significant seasonal effects.	Additional upstream site included. Upstream sediments have greater concentration range and higher levels than downstream site. Analytes lower at all 3 sites *cf* 1996 due to 1996 floods.	No significant acute toxicity to *C. tepperi*. No acute toxic response to *D. carinata.* Both stimulatory and inhibitory responses for *D .carinata* chronic assays.	Longer term *C. destructor* trial showed increase growth and manganese bioaccumulation (bacterial biofilm on the animals). Short term trial on Carp Gudgeon (*Hypseleotris spp*) showed lower metals in fish exposed to treated process water than river water control.	No difference in macroinvertebrate community structure between sites.

Table 9. Summary of conclusions from Murray Darling Freshwater Research Centre bio-monitoring of Norske Skog Albury mill effluent 1992-1997.

7.5 Assessment of Current Treated Process Water Impacts

The work conducted by MDFRC from 1992 – 1998 concluded definitively that the treated process water produced by the mill over that time was not harmful to the environment, and could in fact support significant biota. As discharge to the Murray River ceased in 1996, there is no additional river monitoring data that can be used to estimate what the impact of the current treated process water would have been.

Any changes to the treated process water properties that could have occurred in the intervening period that may result in adverse impacts were therefore estimated by conducting ecotoxicological studies on the treated process water currently produced by the mill. Since the ecotoxicological studies were done by the MDFRC in 1992-1998, standard protocols for ecotoxicological testing have been further developed and adopted. Therefore ecotoxicological testing was conducted in a manner consistent with section 3.5.2 of the Australian Guidelines for Water Quality Monitoring and Reporting (refer **Reference 16**). The guidelines suggest that for single species aquatic bioassays, tests be conducted on algae, bacteria, invertebrates and fish.

Test	Species	Concentrations tested	Result
Chronic Toxicity: 72hr growth inhibition	Algae: *Selenastrum capricornutum*	0-100%	72 hr IC50 >100%, NOEC > 100% LOEC > 100%
Acute Toxicity: EC_{50} over 30 mins	Bacteria: *Vibrio fischeri* (Microtox®)	27-90%	30 min EC50>82% NOEC = 82% LOEC > 82%
Acute Toxicity: 48 Hr survival	Invertebrate: *Ceriodaphnia cf dubia*	0-100%	48 hr EC50>100% NOEC >100% LOEC > 100%
Chronic Toxicity: 7 day partial life cycle	Invertebrate: *Ceriodaphnia cf dubia*	0-100%	7 day EC50 >100% NOEC > 100% LOEC > 100%
Chronic Toxicity: 96hr fish imbalance test	Fish: Larvae of the Eastern Rainbowfish *Melanotaenia splendida*	0-100%	96 hr EC50 >100% NOEC > 100% LOEC > 100%

Table 10. Summary of ecotoxicological testing done on Norske Skog Albury mill treated process water sampled 12th May 2008.

IC50 is that concentration of treated process water that inhibits growth of 50% of the test species over the test period.
NOEC is the no observable effect concentration
LOEC is the lowest effect concentration
EC50 is that concentration of treated process water in which 50% of the test species do not survive over the test period.

Adherence to these guidelines and the requirement that the tests be conducted in an appropriately accredited laboratory meant that toxicity could not be tested on the same test species that MDFRC had used in 1992 – 1998. A sample of treated process water was collected from the discharge of the four day holding pond on 12th May 2008, cooled to 4^oC and dispatched by overnight courier to a NATA accredited laboratory for a range of acute and chronic bioassays. The tests conducted and the results obtained are summarised in **Table 10**. A full report of the tests conducted, including statistical analysis of the results may be found in **Appendix 9**.

No toxicity was observed for any bioassay at the highest concentration tested (100% in most instances). The test species closest to that used by the MDFRC in toxicity testing conducted between 1992 and 1998 (*Daphnia carinata)* was the freshwater cladoceran *Ceriodaphnia cf dubia*. This species is similar to the *Daphnia carinata* used by MDFRC in their toxicity testing between 1992 and 1998. The differences in response between these two species are expected to be minor. Thus it was clear that the treated process water collected on this occasion was of equivalent or better quality than that used for the large number of tests conducted between 1992 and 1998.

7.6 Summary of Predicted Impacts from Treated Process Water

The impacts of treated process water constituents on river water quality has been determined on the basis of discharging effluent at a dilution ratio of 600:1. The most suitable time to discharge treated process water is when river flow is high during the spring and early summer periods. At these times the dilution ratio will be much higher than 600:1 and therefore the concentration of constituents will be lower than those used in **Section 7.3**

The main component in treated process water is TDS in the form of inorganic salts. It also has a slight “straw yellow” colour due to the presence of small amounts of non-biodegradable organic matter such as humic and fulvic acids. Virtually all biodegradable material has been removed in the biological treatment plant. The very small amount of organic matter still remaining will not lead to any significant depletion of dissolved oxygen in river water, as almost all biodegradable material has been removed. The dissolved salts will increase the level of TDS in the river in the mixing zone from around 32 mg/L to around 50 mg/L and once completely mixed the final TDS level will be around 35 mg/L. Nutrients are predominantly in the form of slowly degradable nitrogen and phosphorous, and the increase in concentration of these components outside the mixing zone will be undetectable. No suitable data was available for the metals zinc, copper, iron, manganese or cadmium in Murray River water at Albury, so any possible impact of these was assessed by ecotoxicological tests. The level of the chelating agent DTPA once treated process water has been discharged to the river will be well below the NOEC for this compound.

The impact of treated process water discharged by the Albury Mill was comprehensively studied between 1992 and 1996 whilst all mill effluent was still being discharged to the river. A range of ecotoxicological tests, water and sediment analyses and biota surveys demonstrated that the treated process water produced by the mill over that period of time was having no discernible impact within the mixing zone of the effluent. The implication is that provided the quality of the current treated process water has not deteriorated, it is a reasonable hypothesis that the current effluent would similarly have no impact, especially if the lesser volume of only 3 ML/day of effluent is proposed for discharge.

This hypothesis was tested by conducting a range of ecotoxicological tests on the current treated process water. The conclusions from a range of acute and chronic toxicity tests

across bacteria, algae invertebrates and fish were that no effects were observed at effluent concentrations of 100%. Thus, no adverse effect would be expected in the river.
In summary, the only measurable change to water quality as a result of this proposal will be in the TDS concentration of river water. By operating the Billabong Creek Salt Interception Scheme this increase in salt entering the river will be offset at a ratio of 2:1. For every one tonne of salt added to the Murray River at Albury, two tonnes will be removed using the BCSIS at Walla Walla.

7.7 Environmental Monitoring Program

To ensure that any unforeseen impacts are detected, a monitoring program that assesses treated process water impacts directly will be implemented by ecotoxicological testing. Should the results of these direct measurements demonstrate potential impacts, a second level of investigations will be undertaken in which river biota and sediments will be monitored. The details of these proposed programs are set out below.

7.7.1 Ecotoxicological Monitoring

Ecotoxicological testing will be initially carried out once every six months on treated process water using the same species and protocols used to assess the ecotoxicological properties of the current treated process water (refer **Appendix 9**). Tests covering bacteria, algae, invertebrates and fish will be carried out using a NATA accredited laboratory.

The bacteria test will be performed using the marine bacterium *Vibrio fischeri* (Microtox®). The end point of this test is the concentration of treated process water that produces a 50% reduction in light output from the bacteria.

Algal bioassays will be conducted using the freshwater unicellular green alga *Selenastrum capricornutum.* The endpoint of this chronic test is the concentration of treated process water inhibits 50% of the algae over a 72 hour period.

An acute and a chronic invertebrate bioassay will be conducted on *Ceriodaphnia cf dubia*. In the case of the acute test, the endpoint is the concentration in which 50% of the test species do not survive over a 48 hour period. The chronic bioassay endpoint is the concentration of effluent that prevents reproduction of 50% of the species over the 7 day period of the test.

The results of the six monthly bioassays will be submitted to the Department of Environment & Climate Change, and should unacceptable impacts be found, the biota and sediment monitoring programs set out below under Ecological Monitoring will be undertaken. If no adverse effects are detected by the ecotoxicological testing within the first two years of the “Proof of Concept” period, then testing will decrease to once a year for the remainder of the period.

7.7.2 Ecological Monitoring

The monitoring program will be based on a BACI (Before, After, Control, Impact) design in which the area of study is assessed before the impact commences and with a “control” and “impact” site. The location of the “impact” site will need to be assessed in light of bridge construction over the Murray River in the vicinity of the mixing zone of Norske Skog mill treated process water. The area may have been altered by this construction activity and will need to be re-assessed for its suitability for this monitoring program in order to compare results with work done in 1992-1996.

The first of these surveys will be conducted in the winter of 2008 to produce the “Before” data associated with the BACI design. Should unacceptable impacts be observed in the ecotoxicological testing, the “After” aspect of the monitoring program will be undertaken in consultation with DECC.

Biota Monitoring

Full details of the monitoring program for biota are set out in **Appendix 10**. The proposed work takes into account the designs used in earlier work (refer to **Appendix 7**), in which six sites were used. In the revised program it is proposed to collect a total of twelve samples for macroinvertebrates, six being from two paired sites ~ 500 m upstream of the outfall and six being from two paired sites within the mixing zone at a suitable location, taking into account changes arising from construction of a new bridge associated with the Hume freeway. Aquatic macroinvertebrates will be collected using artificial substrates and identified at the same taxonomic resolution used in the previous surveys, and counted so that taxonomic diversity and relative abundance can be calculated for each site. Appropriate statistical methods will be used to process and analyse the data.

Sediment Monitoring

Full details of the monitoring program for sediments are set out in **Appendix 10**. The proposed work takes into account the designs used in earlier work (refer to **Appendix 7**). Sediments will be collected at two sites, one 500m upstream of the outfall, and the other 500m downstream of the outfall. Samples will be collected at 10m intervals along the 60cm depth contour. Twenty samples will be taken from each deposition zone. These samples will be combined in the laboratory in groups of four based on their transect position, and a sub-sample of the mixed composite analysed for cadmium, copper, iron, zinc, total nitrogen and total phosphorous.

7.8 Contingency Measures

Adverse impacts from the ecological monitoring would trigger consultation with DECC, and if required by them, discharge of treated process water to the Murray River would cease.

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CHAPTER EIGHT

8 MONITORING AND REPORTING OF GREEN OFFSET FOR SALINITY.

The objective of the Green Offset scheme is for 2 tonnes of salt to be removed from the Murray Darling Catchment via the Billabong Creek Salt Interception Scheme for every one tonne of salt added in Albury Mill treated process water. The BCSIS is capable of removing 3000 tonnes of salt per annum from the catchment. Up to 1500 tonnes of salt will be discharged in Albury mill treated process water to the Murray River. To verify the performance of the scheme, a monitoring program will be operated for both the BCSIS and the Albury Mill treated process water returned to the Murray River. This chapter discusses how this will be achieved.

8.1 Billabong Creek Salt Interception Scheme Operational Data

A full description of the monitoring that will be performed to assess the performance of BCSIS is outlined in Appendix 4. A summary of the proposed monitoring scheme is set out below.

The BCSIS includes a number of components. These include:

- Gauging stations to monitor salinity and stream flow
- Billabong Creek flow information (ML/day)
- Quality and quantity of water pumped into Billabong Creek
- Groundwater depths as measured by the monitoring bores
- Pump hours run

A lot of this information can be logged and tele-metered. The operator of the BCSIS will forward to Norske Skog Albury Mill on a monthly basis, sufficient operational data to demonstrate that adequate progress is being made to achieve the annual target of removing 3000 tonnes of salt from Billabong Creek. The data that the operator will record is set out in **Table 11**. This data will also be used to compile an annual report to demonstrate performance against key performance indicators. The annual report will cover the period from 1st May to 30th April, and be reported to DECC in August each year.

Item	Production Bore Sites Information to be monitored and reported	Site Visit Frequency
1	Pump hours run	Monthly
2	Pump down time	Monthly
3	Power consumption	Monthly
4	Supply Voltage and Amps	Monthly
5	Pump Frequency	Monthly
6	Motor Amps	Monthly
7	Standing Water level	Monthly
8	Discharge from pump	Monthly
9	Mains pressure at bore site	Monthly
10	Salt load pumped	Monthly
11	Pumped Water Conductivity	Monthly
Item	**Monitoring Bore Information to be monitored and reported**	**Site Visit Frequency**
1	Standing Water Level	Monthly
2	Groundwater Conductivity	Monthly
Item	**Stream Gauges (410182 & 410183) Information to be monitored and reported**	**Site Visit Frequency**
1	Water Level	Monthly
2	Water Conductivity	Monthly
3	Walbundrie (410091)	No operational change

Table 11. Parameters to be monitored for verification of BCSIS performance. (See Appendix 4 for more detail).

8.2 Albury Mill Treated Process Water Monitoring

Once river discharge commences a variety of parameters will be measured in order to ascertain the treated process water quality with respect to the constituents outlined in **Table 7** in Chapter 7. In addition to the concentration of constituents outlined in that table, effluent flow will also be measured and logged so that a cumulative tally of the amount of total dissolved solids entering the Murray River can be made. The frequency of measurement of all parameters will be determined by negotiation with DECC. This will be assessed on an annual basis against the amount of salt removed from the catchment by the BCSIS.

CHAPTER NINE

9 CONCLUSION

Norske Skog Albury seeks to implement a number of changes to its existing treated process water management strategies and processes. NSW Department of Planning (DoP) approval is sought to allow the mill to modify the following Development Consents:

- 1992 Development Consent DA 41/92
- 2004 Development Consent DA 389-8-2003-i

The Norske Skog Albury mill is a modern newsprint mill that produces 265,000 tonnes of newsprint per annum. It is located in the Upper Murray River catchment 12km north east of Albury and operates under a variety of consents relating to operation of a recycled fibre plant, wastewater reuse scheme and expanded newsprint manufacturing and licences relating to environment protection and water access.

Some 5000 ML of water is withdrawn annually from the Murray River, of which ≈ 1100 mega-litres (ML) is returned after use in various cooling applications. Of the remaining ≈ 3800 ML, some ≈ 1100 ML is consumed in the process, and ≈ 2700 ML is transferred to a wastewater reuse scheme.

The Albury mill reviewed its water management strategy in 2002-03 in order that a sustainable water management plan could be developed to underpin the mill's future operation and development. The strategy review incorporated the following elements:

- Reduction of water and chemical use through 'standard' technologies
- Expansion of the Wastewater Reuse Scheme (WWRS)
- Assessment of Desalination Technology
- Assessment of Evaporation Technology
- Implementation of Green Offsets
- Third Party Irrigation of Cooling Water and Treated Process Water via the mill's return water pipeline

As a result of this review the following were concluded:

- The mill operates better than European best practice with respect to water use, and has modified its pulp brightening and deinking process so that less chemicals are used.
- There is no suitable land available for expansion of the WWRS and greater operational flexibility would come from having another option available.
- Desalination technology provides a possible solution to remove dissolved solids from the treated process water. However, issues such as waste brine disposal in an inland setting, high energy usage and running costs mean that implementation of this type of technology may not be feasible in the foreseeable future.
- Evaporation technology requires high capital expenditure, incurs high energy costs and is uneconomic.
- A Green Offset has the advantage that it will achieve a salinity reduction in the Murray River catchment whilst improving operational flexibility
- Third party irrigation is viable, with additional third party re-use options, such as for watering sporting fields and parks, made possible if effluent discharge is approved under a Green Offset arrangement.

It was therefore concluded by Norske Skog Albury that a Green Offset for salinity in which treated process water is returned to the Murray River should be explored, along with the opportunity for third party re-use.

The impacts of returning treated process water to the Murray River have been studied in detail over many years and a significant body of knowledge has been accumulated. The impact in the Murray River at Albury of treated process water discharged by the Albury Mill was comprehensively studied between 1992 and 1996 by the Murray Darling Freshwater Research Centre whilst all mill effluent was still being discharged to the river. A range of ecotoxicological tests, water and sediment analyses and biota surveys demonstrated that the treated process water produced by the mill over that period of time had no discernible impact within or beyond the mixing zone of the effluent.

Treated process water parameters have been compared against Australian New Zealand Environment Conservation Council (ANZECC) guidelines and relevant trigger values for protection of aquatic ecosystems. This demonstrated that the only measurable change to water quality would be in the concentration of dissolved salts. This increase would be compensated for through operation of the salt interception scheme under the proposed Green Offset plan.

Recent ecotoxicological tests were conducted on a range of species, as set out by the NSW Department of Environment & Climate Change (DECC). No acute or chronic toxic responses were observed in any test at any concentration of treated process water. This indicates that there should be no adverse ecotoxicological effect from discharging the treated process water that the mill currently produces to the Murray River.

The proposed water management plan under a Green Offset plan will increase the amount of water returned to the Murray River from the current ≈ 1100 ML to ≈ 2200 ML per year. Benefits of the proposal include more flexible water and wastewater reuse management arrangements for the mill, increased environmental flow to the Murray River, increased economic benefit to the Murray Darling Basin by adding value to the water cycle, decreased salinity in both Billabong Creek and the Murray Darling Catchment as measured at Morgan South Australia and a failsafe methodology to implement a Green Offset for salinity.

Norske Skog is therefore applying to have the 1992 Development Consent DA 41/92 and the 2004 Development Consent DA 389-8-2003-i modified to allow the following to occur:

1. The implementation of a Green Offset for salinity that will result in an overall reduction in salinity for the Murray Darling Basin. A salinity offset would be produced by operation of the Billabong Creek Salt Interception Scheme (BCSIS) which is located near Walla Walla. The BCSIS will be financially supported by Norske Skog and operated by the NSW Department of Water & Energy (DWE). For every two tonnes of salt removed by operation of the BCSIS, Norske Skog would be allowed to discharge one tonne of salt to the Murray River in the form of treated process water. This means the salinity offset will be implemented with a 2:1 ratio.

   In total the BCSIS will remove 3,000 tonnes of salt per annum and will result in a net environmental benefit of 1,500 tonnes of salt after allowing for the annual return of treated process water at the Albury Mill containing ~1,500 tonnes of salt.

All water quality parameters will remain within limits specified by DECC. Effluent discharges will continue to be subjected to the existing minimum dilution of 600:1 with Murray River water. The volume of effluent that may be discharged under this criterion will vary, but will typically average 3 ML/day.

2. Permit a quantity of treated process water (of a quality determined by DECC), cooling water, or a combination of both, to be available to interested third parties for reuse where non-potable water quality is an acceptable application. This water will be obtained via the Albury Mill return water pipeline to the Murray River. The distribution, management and monitoring of water provided to third parties will be the responsibility of the relevant third party and subject to separate approval processes.

The likelihood of adverse environmental effects from returning treated process water to the Murray River are very low and to confirm this, an ecotoxicological testing regime will be devised in consultation with DECC and carried out once every six months for the first two years of the “Proof of Concept” period, and once every year thereafter in the event that no adverse effects are found. Should adverse effects be found from the ecotoxicological testing, an ecological monitoring program based on the BACI (Before, After, Control, Impact) design will be implemented. Adverse impacts from the ecological monitoring would trigger consultation with DECC, and if required by them, discharge of treated process water to the Murray River would cease.

Verification of the performance of the BCSIS in removing salt will be determined by a number of measures, including gauging stations to monitor salinity and stream flow, quality and quantity of water pumped into Billabong Creek, groundwater depths as measured by the monitoring bores and pump hours of operation. A range of key performance indicators based on these parameters will be developed and reported at either monthly or annual intervals. This information will be compiled into an annual report that will be submitted to DECC in August each year. The Albury Mill will measure and record a range of parameters in relation to its treated process water discharge to the Murray River in order to verify that the offset of two tonnes of total dissolved solids removed for one of total dissolved solids discharged has been achieved.

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CHAPTER TEN

10 REFERENCES

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